PALÆONTOGRAPHICAL SOCIETY.

VOL. LII.

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ISSUED FOR 1898.

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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, 3 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. 1 (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.

Volume	Issued	Contents
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.

* 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. The previous Volumes are not in separate parts.

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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.
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		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.
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„ XXVII.*	„ 1873	The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates.
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		Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen. 2 plates.
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		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.
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		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.
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		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.
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		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.

* 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. The previous Volumes are not in separate parts.

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.

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CATALOGUE OF WORKS—Continued.

Vol. LI.*	Issued for the Year 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.
„ LII.*	„ 1898	The Palæozoic Phyllopoda, Part III, by Prof. T. R. Jones and Dr. Woodward, 8 plates. The Carboniferous Lamellibranchiata, Part III, by Dr. W. Hind, 10 plates. The Inferior Oolite Ammonites, Part X, by Mr. S. S. Buckman, 4 plates. The Carboniferous Cephalopoda of Ireland, Part II, by Dr. A. H. Foord, 10 plates. The Devonian Fauna of the South of England, Vol. III, Part II, by the Rev. G. F. Whidborne, 17 plates.

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§ 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 Prof. T. Rupert Jones and Mr. 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.

Volume	XLIII	for	1889	was	issued	to the	Members,	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.
,,	LII	,,	1898	,,		,,	,,	December, 1898.

§ IV. SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* DECEMBER, 1898): *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	41
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[illegible]
		CARRIED FORWARD...	4630	552	9624	1880

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* DECEMBER, 1898)—*continued*

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...	4630	552	9624	1880
The Palæozoic Phyllopoda, by Prof. Rupert Jones and Dr. H. Woodward, *in course of completion*	1887, 1892, 1898	1888, 1892, 1898	176	25	343	84
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	12	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	9h
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	31	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, *in course of completion*	1896, 1897, 1898	1896, 1897, 1898	276	25	581	90
The Inferior Oolite Ammonites, by Mr. S. S. Buckman, *in course of completion*	1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1898	1887, 1888, 1889, 1890, 1891, 1892, 1892, 1893, 1894, 1898	478	108	1201	190
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...	11596	1385	29591	5993

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* DECEMBER, 1898)—*continued.*

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...	11596	1385	29591	5993
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, 1898	1897, 1898	48	17	144	38
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, 1898	1896, 1897, 1898	236	38	641	189
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, 1891	1868, 1870, 1891	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, 1864	1851, 1859, 1861, 1864, 1866	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	21	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	310	12
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1870	1871	115	4	247	30
		TOTAL	11726	1977	30001	7114

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—1898) *of the* Palæontographical Society.

	PLANTS.	PROTOZOA. Sponges.	PROTOZOA. Foraminifera.	RADIATA. Stromatoporoids and Corals.	RADIATA. Echinodermata.	ARTICULATA. Cirripedes.	ARTICULATA. Cypridæ, Cytherinæ, &c.	ARTICULATA. Phyllopoda.	ARTICULATA. Merostomata.	ARTICULATA. Trilobites.	ARTICULATA. 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, 1898	1872, 1878	1883, 1884	
Devonian	...	1887	...	1853, 1885, 1888, 1890, 1892	1895, 1898	......	1888	1860	1865, 1868, 1872, 1878	1862, 1888	
Silurian	...	1886, 1887	...	1854, 1885, 1890	......	......	...	1887, 1892, 1898	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—1898) *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, 1898	...	(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, 1898	1897, 1898	1877		
Devonian	1895, 1898	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 1898.

LONDON:

MDCCCXCVIII.

A MONOGRAPH

OF THE

BRITISH PALÆOZOIC PHYLLOPODA

(PHYLLOCARIDA, PACKARD).

BY

PROF. T. RUPERT JONES, F.R.S., F.G.S., &c.,

AND

DR. HENRY WOODWARD, F.R.S., F.G.S, &c.

PART III.

DITHYROCARIS.

PAGES 125—176; PLATES XVIII—XXV.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1898.

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

PART III.

DITHYROCARIS.

I. INTRODUCTORY REMARKS.

It will be seen in our list of synonyms at pp. 129, 130 that the genus *Dithyrocaris*, first known and named as *Argas* in 1835, and frequently mentioned by geologists subsequently, has had its features and structure described chiefly by J. Scouler, J. E. Portlock, F. M'Coy, H. Woodward, R. Etheridge, jun., James Hall, and J. M. Clarke; whilst F. A. Römer, Ludwig, Meek and Worthen, and Scudder have noticed some fragmentary portions, chiefly of the caudal extremity.

So many of the known remains of this genus have been found in the Carboniferous strata of the West of Scotland that it is advisable to have before us, for easy reference, a classified list of the localities there, and the geological horizons, from which the specimens have been obtained. The following list of the local formations and the species found in them has been made with the help of Dr. John Young, F.G.S., of the Hunterian Museum, Glasgow.

A List of the Species of Dithyrocaris *and allied genera, with their Localities in the Carboniferous Formations of Scotland and elsewhere.*

In the Upper Limestone series:

Chœnocaris tenuistriata (M'Coy). Settle, Yorkshire; also Belgium.

— *Youngii*, sp. nov. Lingula-shale, Robroystone, near Glasgow.

Dithyrocaris testudinea, Scouler. Cement-Limestone, Orchard, Glasgow.

In the Middle Coal and Limestone series:

Dithyrocaris tricornis, Scouler. } Ironstone pits, Inkermann, near

— *testudinea*, Scouler. } Paisley.

In the Lower Limestone series :

Dithyrocaris glabra, Woodward and Etheridge. Calderwood Cement-Limestone, East Kilbride.

— — W. and E. Shales above the First Calmy Limestone, Raes Gill, Carluke.

— *ovalis* — } Shale above the Calderwood Cement-
— *granulata* — } stone, East Kilbride.

— *testudinea*, Scouler. Shales above the Main Limestone and Lingula-limestone; and shale above Calderwood Cement-Limestone, East Kilbride district.

— — — Shale over the Main Limestone, Raes Gill, Carluke.

— — — Shale over the Hosie Limestone series, Campsie.

— — — Shales over the Main Limestone, Lickprivick, East Kilbride.

— — — Yoredale Beds, Congleton Edge, Cheshire.

— *tricornis*, Scouler. Shale above the Calderwood Cement-stone, East Kilbride.

— — — Yoredale Beds, Redesdale.

— *Colei*, Portlock. Lower Carboniferous shales, Clogher, Tyrone; Ballynascreen, Londonderry.

— — — Craigenglen, in strata under the Main Limestone series, Campsie.

— — — Calciferous Sandstone group, Tweeden Burn, near New Castleton, Roxburghshire.

— *orbicularis*, Portlock. Lower Carboniferous shales, Ballynascreen, Londonderry.

— *funiculata*, sp. nov. Calciferous Sandstone group, Tweeden Burn. Also Tyrone.

— *Scouleri*, M'Coy. Lower Limestone shale, Aghmaglogh, Clogher, Tyrone.

— — — Cement-stone group, Tweeden Burn.

— *insignis*, sp. nov., and var. *multijugata*, nov. Millstone-grit series, Eccup, near Leeds.

Dithyrocaris Belli (Woodward). Devonian, Gaspé, Canada.

Calyptocaris striata (Woodward). Lower Carboniferous, Carmichael Burn, Lanark.

Chœnocaris? Richteriana, sp. nov. Devonian, Saalfeld.
Hibbertia orbicularis, sp. nov. Burdiehouse, Scotland.

Tail-pieces:
Dithyrocaris lateralis, M'Coy. Mountain-limestone, Derbyshire.
— — — Cement-stone group, Tweeden Burn.
— *Dunnii*, sp. nov. Yoredale Beds, Redesdale.
— — Calciferous Sandstone group, Harelow Hill Quarry, Penton, Cannobie.
— *Neilsoni*, sp. nov. Shales, East Kilbride. (See Note.)
— sp. Calciferous Sandstone group, Leatwater, below Hirzel, Coldstream.

Gastric teeth (separate or in place): Dolly Quarry and Cowden's Quarry, Dunfermline; Orchard Quarry, near Glasgow; Hosie Limestone series, Campsie; Ardross, Fife; East Kilbride; Scaterau, Dunbar; Eccup, Yorkshire; Congleton Edge, Cheshire; Yoredale series, Redesdale; Newcastle-on-Tyne; and Tyrone, Ireland.

The Calderwood Cement-stone (of the Lower Limestone group) is worked at Calderside and East Kilbride, at the Kirktonholm and Glebe quarries and elsewhere. It has there an average thickness of about two feet. It is regarded as the equivalent of the First Kingshaw Limestone of the Lower Carboniferous Limestone group of the Carluke district. The Cement-stone near East Kilbride is succeeded in descending order by three limestones, locally known as Third, Second, and First Calderwood Limestones, with their intervening and accompanying shales, certain of which have proved to be very fossiliferous, especially that between the two lowest limestones (Nos. 2 and 1) of the section.

The Cement-stone is known by other local names in the Carluke district, as at Hallcraig Bridge on the left bank of Jock's Burn, where the Lingula-Limestone and Shales of the Lower-Limestone series occur. There are also localities along with the Raes Gill Ironstones, Carluke.

For convenience of reference we give the following table of the Formations.

Note.—The specimens marked "Shales, East Kilbride," in Mr. Neilson's and other collections, are from shales in connection with the Calderwood Cement-stone. Nearly all are from the shale lying over that limestone. Specimens of *Dithyrocaris* are very rare in the limestone and the shale below, which differs considerably from the overlying shale. The exposures are only a few hundred yards apart. It has been observed that, although the carapaces are well represented in this shale, there are but few teeth found at East Kilbride; and that where separate teeth occur carapaces seem to be absent. Probably diverse currents may account for this fact.

Table of the Geological Horizons and some of their Localities in Western Scotland.

PERMIAN.

CARBONIFEROUS SYSTEM.		7. Upper Coals and Ironstone	Ell Coal, Rutherglen.
		6. Millstone-grit or Moor-rock.	
	CARBONIFEROUS LIMESTONE SERIES.	5. Upper Limestone Group	Auchenbeg. Lesmahagow. Orchard and Robroystone, near Glasgow.
		4. Middle Limestone Group or Lower Coal and Ironstone Group	Possil Ironstone. Edge Coal series. Inkermann Ironstone pits, near Paisley.
		3. Lower Limestone Group	Calderwood, East Kilbride. Raes Gill, Carluke. Hosie, Campsie, Hurlet, Main, and Craigenglen Limestones.
	CALCIFEROUS SANDSTONE SERIES.	2. Upper or Cement-stone Group	Ardross, Fife. Kirktonholm Works, Glebe Quarry, &c., East Kilbride District. (Burdiehouse, near Edinburgh.)
		1. Lower or Red Sandstone Group	Carmichael Burn, near Lanark.

OLD RED SANDSTONE.

Besides the large series of specimens of *Dithyrocaris* in the British Museum (Natural-History Branch) we have had opportunity given to us by the Keepers of other Museums, and by private individuals, of studying their many valuable collections in Scotland and elsewhere. For this we sincerely thank Sir A. Geikie, Director of the Museum of Practical Geology and the Geological Survey; Prof. T. McKenny Hughes, Keeper of the Woodwardian Museum, University of Cambridge; the Trustees of the Griffith Collection, Dublin; Dr. R. H. Traquair, Director of the Edinburgh Museum of Science and Art; Messrs. B. N. Peach and J. G. Goodchild, of the Geological Survey of Scotland; the Trustees of the Andersonian Museum, Technical College, Glasgow; Dr. John Young, of the Hunterian Museum, Glasgow; Mr. James Neilson, of Glasgow; Mr. R. Dunlop, of Airdrie; Mr. J. Dunn, of Redesdale; Mr. E. J. Garwood, F.G.S., Trinity College, Cambridge; Mr. P. F. Kendall, F.G.S., Leeds; Dr. W. Hind, F.G.S., Stoke-on-Trent, and others who have favoured us with replies to inquiries, and with other useful information.

Dr. Scouler's original specimens have been lent by the Trustees of the Andersonian Museum; some of J. E. Portlock's type-specimens have been studied among those lent from the Museum of Practical Geology; the specimens described in 1871–4 by Woodward and Etheridge, jun., are included in the Collection of the Geological Survey of Scotland; and other rare and valuable fossils have been confided to our care by Prof. McKenny Hughes, Dr. Traquair, and the other kind helpers named above.

Genus DITHYROCARIS, *Scouler*, 1843.

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— — 1874. Ibid., dec. 2, vol. i, p. 107.

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Rhachura, Scudder, 1878. 'Proceed. Boston Soc. Nat. Hist.,' vol. xix, p. 296.
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— R. Etheridge, jun., 1879. 'Quart. Journ. Geol. Soc.,' vol. xxxv, p. 464.
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Dithyrocaris, Lesley, 1889. 'Dictionary Foss. Pennsylv.,' p. 212.
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Mesothyra (*?*), J. M. Clarke, 1893. 'American Naturalist' (September), p. 796.
Dithyrocaris, J. Neilson, 1894. 'Trans. Geol. Soc. Glasgow,' vol. x, p. 71.
— W. Hind, 1897. 'Monogr. Carbonif. Lamell.,' Pal. Soc., p. 94.

Dithyrocaris appears to be a Phyllocarid having for the most part a nearly flat or somewhat convex test, subcircular, suboval, or suboblong in shape, composed of two subconvex lateral halves or valves, which meet in the middle along the dorsal line at a very obtuse angle in the clypeiform specimens, but at a higher angle in some that may be bivalved. The hinge-line is simple, and the valves easily separated.

Besides a dorsal (middle) ridge, appertaining to both valves, each valve has a median ridge (the *mesolateral*). Generally a pair of short sigmoidal rugose ridges occur on the *cephalic* or *gastric* region, and another small pair further back and nearer to the dorsal edge (the *nuchal ridges*). Another ridge is sometimes present, near to and parallel with the dorsal on each valve (the *juxta-dorsal ridges*).

In shape the tests vary from orbicular to suboblong, and the valves from suboblong to semicircular. Each valve has usually a slight projection on the curvature of its anterior edge. A neat fringe, or occasionally a cord-like border, of oblique striæ, pointing backwards, ornaments at least a part of the convex outer (*ventral*) border; and this edge, curving backwards, is prolonged over and beyond the posterior border in a strong sharp spine or spike. The extreme verge of this border was turned downwards or inwards.

In some tests there is good evidence that the dorsal or central junction-line is overlapped by a rugose ridge of minute angular imbricating flakes of shell-matter, forming plicæ or wrinkles (just as in the other ridges), and ending in a strong triangular point. In one or more folded specimens and in some separate valves this middle ridge, bearing an obliquely spinous fringe, lies on its side, and thus shows its crest. This dorsal ridge is seen in some specimens to lie evenly with the moieties, but in others clearly to override the two dorsal edges placed in apposition beneath it, and not to lie between them as in the figures and description of *Mesothyra* by Hall and Clarke, 'Nat. Hist. New York Palæont.,' vol. vii, 1888.

The surface of the two valves or moieties may be smooth, punctate, or granulated; and some are traversed by oblique wavy lines (analogous to lines of growth). Interstitial sculpture is also present. Some allied forms bear thin longitudinal ridges. In many instances abdominal segments and a trifid caudal appendage are present. Gastric teeth frequently occur, sometimes in their place in the cephalic region, but more often free and scattered in the shales.

It has been observed in the 'Geological Magazine,' vol. viii (1871), p. 106, that "it is exceedingly difficult to decide whether this form [*Chœnocaris tenuistriata*] had its valves widely expanded, as in the recent *Apus*, and probably in the fossil *Dithyrocaris Scouleri;* or whether, as in *Nebalia* and *Ceratiocaris*, they were folded down upon the sides of the animal's body. The distinction seems to be an important one; but the frequent occurrence of the united expanded valves of *Ceratiocaris* in the Upper-Silurian shales of Lesmahagow often renders it difficult to decide as to the actual and normal degree of expansion or of folding down of the lateral borders of these crustacean shields during the lifetime of the animal."

The partially open or not quite closed carapace of *Chœnocaris Youngii*, Pl. XXII, fig. 1, looks as if a bivalved test were kept from closing by the intervention of the shaly matrix; but it may have been habitually more or less open or gaping. The ventral margin of *Dithyrocaris* seems to have stood out free from the valves in some specimens, being, as noticed by others, obliquely striate on the upper surface and longitudinally striate below; and this free edge is folded in under the margin in some instances, Pl. XXVII, fig. 5. In *Chœnocaris* it seems to be limited in width, and to remain at right angles with the valve to form a rabbeting joint with the other valve, Pl. XXI, fig. 11, and Pl. XXII, fig. 1 *d*, if closed.

The chief features to be noticed on the carapace-valves are—

1. Anterior process or spine.
2. Posterior process or spine.
3. The middle or *dorsal* ridge and its flanges.
4. The *juxta-dorsal* ridges.
5. The middle-lateral (*mesolateral*) ridges.
6. The *cephalic*, *gastric*, or *ocular* ridges.
7. The *nuchal* ridges.
8. The anterior and posterior notches or medial indentations.
9. The antero-dorsal and postero-dorsal notches.

As far as at present known the allied genera comprise the following forms, and perhaps others to which the various caudal appendages and gastric teeth may have belonged :

With meso-lateral ridges.	With a dorsal ridge. (*Dithyrocaris.*)	Overriding—	1.	GLABRA	smooth, with slight mesolaterals.		
		?	2.	OVALIS	Granulated; with stronger meso-laterals.		
		Overriding—	3.	GRANULATA			
		Overriding—	4.	TESTUDINEA	with transverse lines		
		?	5.	SCOULERI	smooth		Mostly with strong meso-laterals.
		?	6.	FUNICULATA	slightly reticulate		
		?	7.	INSIGNIS	sinuato-reticulate		
		Overriding—	8.	COLEI	with weak juxta-dorsals	sharp granules, reticulation, and pits.	
		?	9.	ORBICULARIS			
		Overriding	10.	TRICORNIS			
	Without a dorsal ridge ?		11.	BELLI	multilineate and reticulate		
	Without a dorsal ridge. Gaping bivalve. (*Chœnocaris.*)		12.	TENUISTRIATA	multilineate and reticulate	With juxta-dorsals	
			13.	YOUNGII	smooth		
			14.	? RICHTERIANA	costulate		
	Without a dorsal ridge. Closed bivalve. (*Calyptocaris.*)		15.	STRIATA	multicostulate		

In the 'Geological Magazine,' December 2nd, vol. i (1874), p. 109, it was suggested that some of the then known species of *Dithyrocaris* showed, by the relatively deep central indentations in their anterior and posterior borders, that the carapaces in this "Group B" may have been more acutely bent down at the sides during life, and more easily separated into two parts after life, than in the "Group A," or true *Dithyrocaris*. Thus:

Group A.	Group B.
Dithyrocaris tricornis.	*Dithyrocaris granulata.*
— *Colei.*	— *glabra.*
— *ovalis.*	— *? tenuistriata.*
— *testudinea.*	— *? Belli.*
— *Scouleri.*	

We do not think that this suggested grouping is sufficiently well founded to serve as a basis for classification.

As seen in the Table at page 132, the features which characteristically define some of the species, namely, Nos. 1—10, as truly belonging to *Dithyrocaris*, are wanting in others, which therefore must be separated from that genus.

The mesolateral ridges are present in all, in different degrees of development; but the dorsal ridge, an important feature, is absent in some (Nos. 11—15). Some differ further by the two halves of the carapace not forming a shield-like, but a bivalve test, folding down on each side, in Nos. 12, 13, and 14, though not perfectly fitting below, but remaining somewhat open; whilst No. 15, a costulated form, is symmetrically bivalved and closed up, like some Ostracoda.

Prof. R. P. Whitfield, at page 36 of the 'American Journal of Science,' vol. xix, 1880, states[1] that "the genus *Dithyrocaris*, M'Coy, is described as having three longitudinal ridges on the carapace. This feature is seen only when the two valves are pressed open, as in M'Coy's example, so as to present the appearance of one large plate, in which case the hinge-line forms the middle ridge."

This is also well shown in many of the illustrations of the present Monograph, —such, for instance, as Pl. XX, figs. 1 *a* and 3 *a*. There is, however, sometimes present another longitudinal ridge in each valve, lying near to and parallel with the dorsal ridge. This, feeble in Pl. XXIV, figs. 1 and 2, strong in Pl. XXI, figs. 8, 9, and 11, and in Pl. XXXI, figs. 8 and 9, we term the *juxtadorsal* ridge.

At first sight the presence of this ridge might seem to constitute an important difference; but it is essentially present, though weak, in *Dithyrocaris tricornis* and *D. Colei*, and strong in a variety of *D. insignis*. It is also a characteristic of *Chœnocaris tenuistriata*. It seems to be duplicated in *Ch. Richteriana*, and is recognisable among the costulæ in *Calyptocaris striata*.

In looking at the relative length of the *Style* and *Stylets* in the trifid caudal

[1] Also at p. 365 of the 'Annals New York Acad. Science,' vol. v, 1890.

appendages as supplying a distinctive character in the different species, we find that—

The Style and Stylets are of equal or nearly equal length in—

	Length of Carapace. mm.		Length of Stylets. mm.
Dithyrocaris Colei, xxiii, 1—4; xxiv, 4	85 and 95	...	30 and 45
— *testudinea*, xxiv, 7	37	...	11
— *Neilsoni*, xxix, 3 *a*, *b*, *c*	?	...	26
— (*Rhachura*) *venosa*, xxix, 4	?	...	48
— *carbonaria*, xxix, 5, 6	?	...	22
— *Kochi*, xxix, 7, 8	?	...	25
— *breviaculeata*, xxix, 9	?	...	15

The Stylets are shorter than the Style in—

Dithyrocaris testudinea ? xxiii, 7	27	...	9
— *Scouleri*, xxv, 6	37	...	25
— *Kayseri*	?	..	50

The Stylets are rather longer than the Style in—

Dithyrocaris Dunnii, xxiii, 9, 10; xxix, 1, 2 ...	?	...	11 ?
— *glabra*, xix, 3; xxiii, 11	32	...	23
	43	...	15
— *testudinea*, xxi, 4	47	...	14

and longer in—

Dithyrocaris lateralis, xxiii, 5, 6	?	...	36
	?	...	42
— *testudinea*, xxi, 5; xxiii, 8; xxxi, 4	?	...	14
— *tricornis*, xxiv, 6	80	...	33
— *insignis*, xxx, 1—3; xxxi, 6	43 and 56		30 ?
Mesothyra oceani	140	...	70

and much longer in—

Mesothyra Neptuni	?	...	110

The measurements are so often difficult to make and unsatisfactory, on account of the frequent imperfections in the specimens, that the results obtained do not supply us with definite characteristics for the species at present catalogued. Besides the obscurity and breakage of parts there are several reasons for the apparent variations in the relative length of the caudal spines, both one with another and with the size of the carapace. Stages of growth, sexual difference, and the systematic variation of feature and character have to be taken into consideration, and the material at our command has not yet enabled us to arrive always at definite conclusions.

The carapaces and their halves are all here figured with the front end upwards and the posterior downwards. The straight edge (*dorsal* or upper) of the right-hand valves is on the left hand in the plates, and the curved edge (*ventral* or lower) of the right-hand valves is on the right hand in the plates.

We propose to commence the descriptions with the more simple and smooth forms, and to take successively those with ridges and other surface ornamentation.

In arranging the plates and their figures we at first looked up the specimens that had been already published, and began with the apparently simplest forms. The arrangement of the drawings, however, was greatly influenced, of course, by the incoming of specimens at different times and from different sources.

Table of the Distribution of Dithyrocaris *and Allied Genera.*

			Scotland.	Ireland.	England.	Belgium.	Germany.	Canada.	U.S. America.
		CARBONIFEROUS.							
Carapaces.	1.	*Dithyrocaris glabra*, 1873, Woodward and Etheridge	×						
	2.	— *ovalis*, 1873, W. and E.	×						
	3.	— *granulata*, 1873, W. and E.	×						
	4.	— *testudinea*, 1835, Scouler	×	...	×				
	5.	— *Colei*, 1843, Portlock	×	×					
	6.	— *orbicularis*, 1843, Portlock	...	×					
	7.	— *tricornis*, 1835, Scouler	×	...	×				
	8.	— *funiculata*, 1898, sp. nov.	×	×					
	9.	— *Scouleri*, 1842 or 1844, M'Coy	×	×					
	10.	— *insignis*, sp. nov.	×	...	×				
	11.	*Calyptocaris striata*, 1871, Woodward, sp.	×						
	12.	*Chœnocaris tenuistriata*, 1844, M'Coy, sp.	...	×	×	×			
	13.	— *Youngii*, 1898, sp. nov.	×						
Tailpieces.	14.	*Dithyrocaris lateralis*, 1851, M'Coy	×	...	×				
	15.	— *Dunnii*, 1898, sp. nov.	×	...	×				
	16.	— *Neilsoni*, 1898, sp. nov.	×						
	17.	— *carbonaria*, 1870, Meek and Worthen	...	...	...	...	...	...	×
	18.	*Rhachura? venosa*, 1878, Scudder	...	...	...	...	...	...	×
Carapace—	19.	*Hibbertia orbicularis*, 1898, gen. et sp. nov.	×						
		DEVONIAN.							
Carapace—	20.	*Dithyrocaris Belli*, 1871, Woodward	...	...	...	...	...	×	
Tailpieces.	21.	— *Kochi*, 1864, Ludwig	...	...	...	...	×		
	22.	— *breviaculeata*, 1864, Ludwig	...	...	...	...	×		
	23.	— *Kayseri*, 1884, Clarke	...	...	...	...	×		
	24.	— *? Jaschei*, 1856, Römer	...	...	...	...	×		
	25.	*Mesothyra Oceani*, 1888, Hall and Clarke	...	...	...	...	...	...	×
	26.	— *Neptuni*, 1863, Hall	...	...	...	...	...	...	×
	27.	*Chœnocaris? Richteriana*, 1898, sp. nov.	...	...	...	...	×		

Note.—In our "Seventh Report on the Palæoz. Phyllop.," 1889 (' Brit. Assoc. Rep.,' 1890, p. 65), we referred to two specimens of *Dithyrocaris*, in M. Paul Lebesconte's Collection at Rinnes, from Lower Silurian Rocks, but have not yet been able to study them fully.

II. DESCRIPTION OF THE SPECIES.

1. DITHYROCARIS GLABRA, *Woodward and Etheridge*, 1873. Plate XVIII, figs. 1, 2; Plate XIX, figs. 1—4; Plate XXIII, fig. 11; Plate XXV, figs. 1, 2.

DITHYROCARIS GLABRA, *H. Woodward and R. Etheridge, jun.*,[1] 1873. Mem. Geol. Survey Scotland, Explan. Sheet 23, Appendix, p. 99.

— — *H. Woodward and R. Etheridge, jun.*, 1874. Geol. Mag., dec. 2, vol. i, p. 108, pl. v, figs. 4 and 5; Report Brit. Assoc. for 1873 (1874), Sect., p. 92.

— — *J. Armstrong*, 1876. Catal. W.-Scot. Fossils, p. 45.

— — *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 73.

— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249

— — *J. Coutts*, 1884-5. Trans. Geol. Soc. Glasgow, vol. vii, pp. 200 and 327.

— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886, p. 64.

— — *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.

Size.—The following are the measurements of the two half-carapaces (Pl. XVIII, figs. 1 and 2) as given in the 'Geol. Magazine,' 1874, p. 109, for pl. v, figs. 4 and 5:

	Large half-carapace (fig. 4).	Smaller half-carapace (fig. 5).
Greatest breadth	25 mm.	22 mm.
Greatest length	62 ,,	55 ,,
Length along the dorsal line	40 ,,	30 ,,
Breadth of anterior notch	10 ,,	12 ,,
Depth of anterior notch	7 ,,	10 ,,
Breadth of posterior notch	23 ,,	20 ,,
Depth of posterior notch	15 ,,	15 ,,

Specific Characters.—Valves (or moieties of carapace) elliptical; smooth except for a granulated antero-dorsal area, the granules sometimes extending over the dorsal area. Dorsal junction of the valves overridden by a rugose ridge, like a closely set row of ridge-tiles (Pl. XXV, figs. 1 and 2). Sometimes there is a faint indication of a mesolateral ridge (Pl. XIX, figs. 1 and 3).

Abdominal segments exposed, few; trifid appendage of strong style and stylets of nearly equal length (Pl. XIX, fig. 3; and Pl. XXIII, fig. 11).

[1] The joint authorship is mentioned at p. 98.

The dorsal junction of the valves was furnished with a flanged crest or ridge (Pl. XXV, figs. 1, 2), such as occurs in *D. granulata* and other forms; and though the valves appear to have been sufficiently convex (Pl. XIX, fig. 2) to have formed a bivalve carapace, there is no direct evidence of this having been the case. In its congener *D. granulata*, with which form it has much in common, the moieties are rather convex, and yet the carapace seems to have been clypeiform or Apus-like (Pl. XX, fig. 3).

Pl. XVIII, figs. 1 *a*, *b*. Mus. Geol. Surv. Scotl., F $\frac{22}{11}$, 4368, tablet 23, No. 11.

Size.—Length of valve, imperfect, 53 mm.; breadth of valve 25 mm.

Characters.—A flattened subelliptical left valve, imperfect by the loss of its posterior border and spine. Ventral margin elliptically curved; dorsal edge straight and simple. It has no mesolateral ridge, but a slight longitudinal undulation is formed by the compressed convexity. The apparent shading in Fig. 1 *a* is due to the thin shell being darkened by the black shale of the matrix, and it is emphasised at its border by a crack showing the black matrix, especially at an oval spot in the postero-dorsal region.

There are slight inequalities of the surface anteriorly, some of which are due to the presence of the gastric apparatus; there is an obscure nuchal ridge. The ventral border bears a fringe of closely-set, small, raised striæ, or compressed spinules, pointing outwards and backwards; they die out anteriorly, to be replaced by small marginal prickles analogous to the ends of the striæ.

The anterior process near the middle line or axis of the valve consists of a group of small spines (about six) rising from amongst an obscure lattice-work of angular scales, which die out ventrally in oblique striæ, and are replaced dorsally by scattered tubercles on the antero-dorsal sinuous curve of the valve as far as the small nuchal ridge of stronger tubercles. They are continued still further along the dorsal region as minute tubercles (especially in fig. 2), spreading out near the margin as far as the postero-dorsal notch. The margin then curves down boldly to the strong posterior spine, the lower edge of which is continuous with the curve of the ventral border.

The specimen shown by fig. 1 *a* has been described and figured in the 'Geol. Mag.,' dec. 2, vol. i (1874), p. 108, pl. v, fig. 4.

In fig. 1 *b* the surface, when the outer pitted film of shell is removed, shows a very minute reticulation with porous meshes.

From black shale, non-calcareous, Cement-stone group, Lower Limestone series; Glebe, East Kilbride. Collected by Mr. A. Paton.

Pl. XVIII, fig. 2. Mus. Geol. Surv. Scotl., F $\frac{22}{11}$, 4078, tablet 23, No. 12.

Size.—Length of valve 55 mm., including both the anterior and the posterior spines. Breadth of valve 22 mm.

Characters.—A semi-elliptical right valve. The surface is smooth and slightly granulated locally as in fig. 1, but the longitudinal undulation, due to compression, has given the false appearance of a mesolateral ridge; and a little fracture makes an artificial notch close to the antero-dorsal spine. The rim of the ventral margin is distinctly depressed, but accidental pressure may have caused this.

This specimen was figured and described in the 'Geol. Mag.,' dec. 2, vol. i (1874), p. 108, pl. v, fig. 5. The outline of the antero-dorsal edge somewhat differs in Mr. George West's careful photograph and lithographed figure, Pl. XVIII, fig. 2, from that given in the fig. 5 referred to above.

This was also from black non-calcareous shale in the Cement-stone Quarry at Glebe, East Kilbride. Mr. A. Paton's Collection.

Pl. XIX, fig. 1. Brit. Mus. No. 59541, No. 1.

Size.—Length of valve 57 mm., including the spines; breadth of valve 24 mm.

Characters.—A fine left valve, with general features like those seen in Pl. XVIII, figs. 1 and 2, but there is a faint indication of a mesolateral ridge[1] coinciding with the depressed convexity. The ventral region is rather crumpled or puckered up by pressure, and there are discolorations by the black matrix where the test is thin. Both the anterior and the posterior spines are present (the former not quite so perfect as shown in the figure).

From black shale, slightly calcareous. E. Kilbride. Paton Coll.

Pl. XIX, fig. 2. Mus. Sci. and Art Edin., "1883, 23, 5," No. 1.

Size.—Length of valve 60 mm., including the spines; breadth of valve 25 mm.

Characters.—Two displaced valves of a carapace. The left is shifted sideways over and partly beyond the right valve, and both retain a considerable convexity, perhaps indicative of the specimen having been bivalved rather than of having been flatly shield-shaped.

As in other specimens, the dorsal region of each valve bears numerous minute, scattered, sharp tubercles, most apparent on the right valve (lying under the other in the figure). Both the front and the hind spines are more or less evident on each valve.

From black shale, slightly calcareous. East Kilbride.

Pl. XIX, fig. 3. Mus. Sci. and Art Edin., 1883, $\frac{23}{5}$, No. 4.

Characters.—A right valve, not quite perfect, smooth, and exhibiting a faint trace of a middle line. At its hinder end are the remains of two crushed abdo-

[1] This feature seems to give a weak foreshadowing of one of the characteristics of the next species (*D. granulata*).

minal segments (ultimate and penultimate) and a caudal appendage of three stout sharp spines, smooth but finely fluted. These have a reversed position, so as to intrude into the postero-dorsal region of the valve.

The middle spine (style) is obscured at its extremity, but seems to have been about as long as the others. The lateral or outside spines (stylets) are each about 25 mm. long.

As with fig. 2. Lower Carboniferous; East Kilbride.

Pl. XIX, fig. 4. Brit. Mus. No. 59541, No. 28.

Characters.—This figure shows a smooth impression (on black shale) of the posterior ends of two valves, somewhat displaced. The fringed or serrated hinder part of the ventral border in each valve is distinctly visible. The test of two abdominal segments remains, but broken by pressure; also the proximal portions of three relatively broad caudal spines, crushed and displaced.

Size.—The penultimate segment is about 5 mm. long; the ultimate segment about 10 mm. long, and about 7 mm. broad in its crushed condition.

Black shale, slightly calcareous. Lower Carboniferous; Ardross.

This is one of the specimens of *D. glabra* exceedingly abundant at Ardross or Ardross Castle. Our friend Mr. J. W. Kirkby informs us that "Ardross" and "Ardross Castle," in Fife, refer to the same locality. The beds containing the *Dithyrocaris* and other fossils are bounded on each side by volcanic ash, so that their exact position in the Carboniferous series is rather doubtful; but they are now mapped by the Geological Surveyors as Calciferous Sandstone, and he thinks they are in that division, probably somewhere near the top.

Pl. XXV, fig. 1. Brit. Mus. 59541, No. 6.

Characters.—These two valves, squeezed sideways together, one over the other, and retaining some considerable convexity, are about 38 mm. in width (the carapace when perfect was probably 50 mm. wide and about 55 mm. long).

The dorsal edge of the right valve overlaps the dorsal region of the other valve. There is present an imperfect dorsal crest (broken at each end, but still 20 mm. long), which has been shifted so as to have its right edge between some (intruded) shale and the overlying dorsal edge of the right valve, while its left edge rests on the dorsal region of the left valve. The disturbance that the valves have suffered unfortunately hinders the former relationship of the parts to be quite so plainly understood as in the next example (fig. 2).

From black shale, slightly calcareous, East Kilbride.

Pl. XXV, fig. 2. Brit. Mus., No. 8.

Characters.—This left valve, 48 mm. long and 25 wide, has some of its dorsal crest still attached to its dorsal region. The fragment consists of the front moiety of the ridge or crest, and begins at 2 mm. behind the nuchal ridge; it is $1\frac{1}{2}$ mm. broad, and has a relatively high, sharp, tent-like section. Its left-hand flange overlaps the dorsal edge of the valve for about $\frac{1}{2}$ mm.

This condition of the dorsal crest evidently shows that it was superposed on the two dorsal edges when they were in contact, overriding them like a ridge-tile on a house-roof.

From black shale, slightly calcareous, East Kilbride.

In a specimen of two valves overlapping (right on left, one of them 63 × 25 mm.), also from E. Kilbride, in Mr. J. Neilson's Collection, a fragment of the dorsal ridge, pushed off the junction of the valves, lies on the left valve, near its dorsal margin. In this specimen of *D. glabra*, the striæ of the postero-ventral margin are relatively few in the portion preserved, being separate and strong.

Pl. XXIII, fig. 11. Mus. Sci. and Art Edin., $\frac{91}{1}$, No. 5.

Size.—Valves 43 mm. long, 17 mm. wide; abdominal segments 13 mm., not easily separable in measurement, but probably antepenultimate 3 mm., penultimate 3 mm., ultimate 7 mm.; style and stylets about 12 mm. long.

Characters.—Two valves displaced, seemingly right valves, but probably one shows the inside of one valve and the other the outside of the other. The valve nearest the top of the figure (and lying obliquely underneath the other) exhibits a narrow, ribbon-like, flattened edge at the dorsal margin, looking like a flange of the dorsal angular ridge, but probably due merely to local pressure. The dorsal border of the overlying valve and the mesolateral ridge on each valve are not quite so clearly defined as in the drawing. Both valves had a smooth surface, which has been much wrinkled by pressure. The ventral margins in this specimen bear rather narrow fringes, and this modified feature is observable in other examples from Ardross.

Hard dark-grey shale, slightly calcareous. Lower Carboniferous; Ardross.

2. Dithyrocaris ovalis, *Woodward and Etheridge*, 1873. Mus. Geol. Surv. Scotl., F $\frac{22}{4}$, No. 4. Plate XVIII, figs. 3 *a*, *b*.

Dithyrocaris ovalis, *H. Woodward and R. Etheridge, junr.*, 1873. Mem. Geol. Surv. Scotl., Explan. Sheet 23, Appendix, p. 100.

— — *Iidem*, 1874. Geol. Mag., dec. 2, vol. i, p. 107, pl. v, fig. 1; Report Brit. Assoc. for 1873 (1874), Sections, p. 92.

DITHYROCARIS OVALIS, *J. Armstrong*, 1876. Catal. W.-Scot. Fossils, p. 45.
— — *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 73.
— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.
— — *J. Coutts*, 1884–5. Trans. Geol. Soc. Glasgow, vol. viii, pp. 200 and 327.
— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886 (1887), p. 64.
— — *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.

Size.—Length of single valves, probably 55 mm.; breadth of single valves, probably 18 mm.; breadth of the two valves side by side, probably 38 mm.

Specific Characters.—These are shown by the unique specimen here figured. It consists of two valves crushed, flat, and open; imperfect at the edges. The ventral border of each valve has left on the shale a strong impression of its thickened margin, but no ornament is visible, except that a very small portion of the postero-ventral margin of the left valve is preserved, with two or three obscure prickles pointing backwards, just at the beginning of the large posterior spine.

The surface is smooth on the ventral region of each valve; but the dorsal regions are covered with numerous little triangular tubercles, with the apex pointing backwards. A thin mesolateral ridge, very much depressed, evidently formed of minute oblique rugæ (as seen under the microscope, on the right valve), exists on each valve, dividing the ventral from the dorsal region, and reaching up to the cephalic region, where it is broken up by unequal pressure on probably the gastric apparatus. On the left valve are faint indications of some subsidiary parallel ridges.

The junction of the dorsal edges of the two valves is very obscure; they have been squeezed together, and the right valve partly overlaps the other. Its apparent edge and some longitudinal cracks simulate the relics of a middle dorsal ridge, but are deceptive.

The frontal notch seems to be neatly concave, but is somewhat obscured by fracture. There are no indications of anterior spines.

The posterior border, formed by the meeting of the curved ends of the two valves, is much broken; it seems to have had a deep mesial indentation. A portion of the postero-ventral spine of the left valve may be recognised.

From the Kirktonholm Cement-works, in black, non-calcareous shale above the Calderwood Cement-stone of the Lower Limestone Group, East Kilbride. Mr. A. Paton's Collection.

3. Dithyrocaris granulata, *Woodward and Etheridge*, 1873. Plate XVIII, figs. 4, 5 *a*, *b*, 6; Plate XIX, figs. 5, 6 *a*, *b*; Plate XX, figs. 1 *a*, *b*, 2 *a*—*d*, 3 *a*—*g*.

Dithyrocaris granulata, *H. Woodward and R. Etheridge, jun.*, 1873. Mem. Geol. Surv. Scotl., Explan. Sheet 23, Appendix, p. 99.
— — *W. and E.*, 1874. Geol. Mag., dec. 2, vol. i, p. 108, pl. v, fig. 3; and Report Brit. Assoc. for 1873 (1874), Sections, p. 92.
— — *J. Armstrong*, 1876. Catal. W.-Scot. Fossils, p. 45.
— — *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 73.
— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.
— — *J. Coutts*, 1844–5. Trans. Geol. Soc. Glasgow, vol. vii, pp. 200 and 327.
— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886 (1887), p. 64.
— — *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.

Specific Characters.—Dithyrocaris granulata is very similar to *D. glabra;* but it has on each valve a definite mesial (mesolateral) ridge; and an abundant granulation on the anterior and dorsal regions. These features distinguish this species from *D. glabra.* Moreover the medio-dorsal ridge, with its side-flanges, is perhaps more strong developed. It remains attached to a valve, and perfect, in Pl. XVIII, fig. 4, and Pl. XX, fig. 2 *a*; and a portion of it overrides the two dorsal edges of an open carapace in Pl. XVIII, fig. 6, and Pl. XX, fig. 1 *a*.

Pl. XVIII, fig. 4, and Pl. XX, fig. 2 *a*—*d* (magnified). Mus. Geol. Surv. Scotl., F $\frac{22}{6}$, No. 6.

Size.—Length of valve, 40 mm., including the spines; breadth of valve, 18 mm.

Characters.—A single left valve semi-elliptical, that is, having the shape of the moiety of an ellipse that has been divided longitudinally into two halves. The dorsal edge is straight; the ventral has a symmetrical elliptical curve. The ends differ; the anterior, defined by the rising and narrowing curve of the ventral border, bears a short antero-dorsal process, above which (to the right or left in the figures) the dorsal border begins with an ogee curvature. The posterior end is more broadly curved, but turned in suddenly to meet the junction-line of the valves, so that the dorsal border ends in a medial recess. The hinder border, moreover, is marked by a strong, postero-ventral, triangular, flat, sharp spine, with the upper edge of which the postero-dorsal curvature makes a strong angular notch.

The outer coating of the test on the ventral border has a delicately serrated margin on its posterior half or two-thirds. This is formed of oblique striæ (like minute closely-set spines), pointing backwards; but this fringe becomes narrow and dies out on the anterior part of the margin.

The dorsal edge has on its posterior two-thirds a narrow ridge of small angular rugæ, pointing backwards; and, in Pl. XX, fig. 2 *a* (magnified), this is seen to have a thin and narrow flat flange on each side; altogether constituting a narrow slip of test, seemingly at first sight intermediate to the two valves,[1] but really overlapping them at their junction; seen also in Pl. XX, figs. 1, 2, and 3.

On the surface the dorsal region of the valve is minutely punctated and bestrewn with minute tubercles, which are coarser in the antero-dorsal region; and, continued round the front of the valve, they there pass downwards and backwards for a little way in the antero-ventral region, as closely-set, parallel, oblique striæ. The ventral moiety of the valve is otherwise smooth.

A mesolateral rugose ridge, thinning away at its ends, passes along two-thirds of the surface of the valve, between the dorsal and ventral regions. It is composed of overlapping chevron-shaped flakes or scales, making transverse scale-like markings (see Pl. XX, fig. 2 *b*).

This specimen was described and figured in the 'Geol. Mag.,' 1874, p. 108, pl. v, fig. 2.

In the anterior part of the valve are two small rugose ridges; one (the "nuchal" ridge about 3 mm. long) near the front end of the dorsal edge, and parallel to it, just where the dorsal ridge ends, is thin and somewhat sinuous; the other (the "cephalic" or "gastric" ridge about 3·5 mm. long) between the nuchal and the front end of the mesolateral ridge, is more or less sigmoidal, terminating behind in a circular turn, which is either solid, or forms a small pit like an ocular spot. (The latter ridge is more persistent than the nuchal ridge, which is often obsolete or evanescent on one or the other valve in *Dithyrocaris*). All the ridges consist of apparently overlapping scales or flattened chevrons, with their angles pointing backwards. These are evidently essential elements in the leaf-ornament or lattice-work on the abdominal segments of *Ceratiocaris papilio* and *C. stygia* ('Monogr. Pal. Phyllop.,' Pal. Soc., 1888, pp. 35 and 39; but in *Ceratiocaris* the angles are set in a contrary direction to what holds good in *Dithyrocaris* (Pl. XX, figs. 2 *b* and 3 *g*).

From black non-calcareous shale in the Glebe Cement-stone Quarry, Kirktonholm Cement-works, East Kilbride. Mr. A. Paton's Collection

[1] As in Hall and Clarke's *Mesothyra*, &c.

Pl. XVIII, figs. 5 *a*, *b*. Mus. Geol. Surv. Scotl., F $\frac{22}{11}$ and 23, No. 13.

Size.—Length of valve 32 mm., including terminal spines; breadth of valve 15 mm.

Characters.—A single left valve, rather smaller than that in fig. 4, and with a rather sharper mesolateral ridge, and the rim of the ventral margin depressed. Otherwise the features are the same as in fig. 4.

This specimen was described and figured in the 'Geol. Mag.,' 1874, p. 108, pl. v, fig. 3.

From black non-calcareous shale in the Cement-stone Quarry; Lower Limestone group, Glebe, East Kilbride, Lanarkshire. Mr. Paton's Collection.

Pl. XVIII, fig. 6; and Pl. XX, figs. 1 *a*, *b* (magnified). Brit. Mus. No. 59541, No. 9.

Size.—Length of valve 35 mm., including the spines; breadth of valve 14 mm.; breadth of the two valves 28 mm.

Characters.—A pair of valves, united along their dorsal edges. The features of each valve are as described for figs. 4 and 5. A short piece of the dorsal ridge is preserved (magnified in Pl. XX, fig. 1 *a*); and there is sufficiently clear indication of it and of its narrow lateral flanges throughout its extent on the hinder two-thirds of the dorsal region. Posteriorly the dorsal junction ends in a nearly square central notch, without any special prolongation.

In "Coal shales," black, slightly calcareous, East Kilbride. Paton Coll.

Pl. XIX, figs. 6 *a*, *b*; and Pl. XX, figs. 3 *a*—*g* (magnified). Brit. Mus. No. 59541, No. 10.

Size.—Length of carapace, probably, 40 mm., when perfect; breadth of the two valves 25 mm.

Characters.—Two valves of a carapace in apposition by dorsal attachment. Though fractured by crush on the margins and posteriorly, it retains a considerable convexity (see Pl. XX, fig. 3 *b*). The carapace has the same features and characteristics as Pl. XX, fig. 1, but it looks rather blunt in front, owing to fracture and extension by pressure there.

The two mesolateral ridges are very distinct, and the dorsal ridge is high and well preserved (see Pl. XX, figs. 3 *a*, *b*, *d*, *f*, *g*). It ends by fracture where the test is broken away behind; fig. 3 *d* shows its cross-section (magnified) and its almost tubular cavity.

The nuchal and gastric ridges are also well shown; the latter seem to end behind in ocular pits; and the former have other and irregular elevations in their vicinity, near the front end of the dorsal ridge.

From "Coal shales," black, slightly calcareous, East Kilbride. Paton Coll.

Pl. XIX, fig. 5. Mus. Sci. and Art Edin., Coutts, 1887, $\frac{25}{15}$, No. 9.

Size.—Length of valve, imperfect, 48 mm.; breadth of valve about 25 mm.

Characters.—This is a right valve, imperfect at its posterior end; though much depressed at its edges, it retains some convexity. The surface is tuberculate on the antero-dorsal and the dorsal region; but otherwise smooth and shining.

The sigmoidal cephalic ridge is nearer to the dorsal edge than usual, probably owing to some displacements in the antero-dorsal region by pressure. The dorsal edge is nearly straight, but irregularly broken. The ventral edge has the narrow fringe or neatly corded rim as usual for a great part of its extent.

The mesolateral ridge is thin, but very distinct; there are some low, irregular elevations at its front end.

In black shale, slightly calcareous, from East Kilbride.

4. Dithyrocaris testudinea, *Scouler*, 1835. Plate XIX, figs. 7—9; Plate XXI, figs. 1—6; Plate XXII, fig. 3; Plate XXIII, figs. 7 (?), 8; Plate XXIV, fig. 7; Plate XXVII, figs. 3 *a*, *b*; Plate XXVIII, figs. 1 *a*, *b*, 2, 3 *a*, *b*, 4, 5 *a*—*c*; Plate XXIX, figs. 10—14; Plate XXXI, figs. 1—3, 4.

Argas testudineus, *Scouler*, 1835. Records of General Science (Thomson's), vol. i, pp. 137, 141, fig. 3.

Dithyrocaris testudineus, *Morris*, 1854. Catal. Brit. Foss., edit. 2, p. 107.

— — *Salter and Woodward*, 1865. Chart Foss. Crustacea, p. 17, fig. 11.

— — ? (teeth), *J. Young*, 1868. Trans. Geol. Soc. Glasgow, vol. i, p. 58.

— — *J. Armstrong*, 1871. Trans. Soc. Geol. Glasgow, vol. iii, Appendix, p. 30; and 1876, Catal. W. Scot. Fossils, p. 45.

— — *H. Woodward and R. Etheridge, jun.*, 1873. Mem. Geol. Surv. Scotl., Expl. Sheet 23, Appendix, p. 98; and Geol. Mag., vol. x, p. 482, pl. xvi, fig. 1.

— — *J. R. S. Hunter*, 1875. Palæont. Carb. Strata W. Scotland, part ii, p. 65.

— testudinea, *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 73.

— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.

Non Dithyrocaris testudineus, *R. Etheridge, jun.*, 1879. Quart. Journ. Geol. Soc., vol. xxxv, p. 465, pl. xxiii, fig. 1.

Argus testudineus, *Packard*, 1883. North-American Phyllop., p. 452.

Dithyrocaris testudineus, *J. Coutts*, 1884–5. Trans. Geol. Soc. Glasgow, vol. vii, pp. 197 and 327.

— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886 (1887), p. 63.

DITHYROCARIS TESTUDINEA, *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.
— TESTUDINEUS, *W. Hind*, 1897. Monogr. Carbonif. Lamell., Pal. Soc., pp. 93, 94.

Specific Characters.—Carapace broad-oval, somewhat convex, and probably clypeiform (*Apus*-like); anterior notch small and angular; posterior broad with a sinuous edge (Pl. XIX, fig. 7). Posterior spines well developed; ventral marginal fringe stronger behind than in front. Dorsal junction of the two moieties (valves) simple. Mesolateral ridges strong and rugose. Cephalic and nuchal ridges and protuberances more or less evident. Surface ornamented with wavy and interrupted lines sloping obliquely backwards from the dorsal to the ventral region. Abdominal segments marked with similar and chevron-like lines; of the three caudal spines, the style is shorter than the stylets.

Pl. XXIV, fig. 7. Mus. Techn. Coll. Glasgow.

This specimen was the first-described example of those referred to *Dithyrocaris testudinea;* and is therefore here taken first in the account of the species.

Size.—Length of valve 37 mm.; length of the exposed abdominal segments, free of the valves, and the trifid tail, 20 mm.; these have been twisted so as to show their ventral aspect; longest caudal spine exposed (one of the stylets), 11 mm.

The style 10 mm. long. Breadth of the two valves 30 mm.; incomplete for want of the ventral fringe on each valve; breadth of one valve about 15 mm. without the fringe.

Characters.—A broad-oval carapace, slightly convex; somewhat damaged by pressure, but presenting its chief features (except the marginal fringe) distinctly. It has a triangular notch in front opening into a narrow cleft (caused by pressure) between the antero-dorsal regions of the valves; also a broad posterior indentation with broken edges. The valves, or lateral moieties of the carapace, are semi-elliptical, and are in apposition by their dorsal edges, but overlapping irregularly in the lower half of the dorsal region, and slightly apart in front. In each valve of this specimen the ventral border is here destitute of a marginal fringe, such as is usual in other specimens. It is uniformly simple and flattened at the edge. In both valves it ends in a small, obscure spine; and the posterior border is imperfect on account of fracture. A strong ridge, having the usual rugose structure of overlapping chevron-shaped scales, rises along the middle of each valve, intermediate to the margin and the dorsal line. There are also some irregular surface-spots in the cephalic region; but the cephalic ridge, and the place of the nuchal ridges, are traversed and obscured by local crush-fracture.

The surface of the valves bears numerous parallel, slightly raised lines, oblique and sinuous ("raised, oblique, recurved, and divaricating," *Etheridge*), passing from the dorsal to the ventral border; those reaching its hinder part are there bent forwards. Close to the posterior angles, over a limited area, these lines are lost among small tubercles (visible in a photograph). The two moieties of the carapace together present an elegant symmetrical pattern. In each valve the lines converge at the antero-dorsal region.

The abdominal segments exposed in this specimen are much obscured by pressure; and have been so squeezed as, at first sight, to look like numerous (eight or more) very short rings (such as those in *Apus* and *Lepidurus*); and are crushed in along the middle line. This false appearance of many rings, however, is due to the relative prominence of the transverse, sinuous, overlapping lines of growth on the segments being emphasised by pressure.

The style and stylets are stout, fluted, and have traces of granulation on the riblets. They are of nearly equal length. They have had their position reversed, showing their ventral and not their dorsal surface.

Fig. 7 is from Dr. Scouler's original specimen, described by him in 1835. It is in hard black earthy limestone, from the Carboniferous Limestone series, "about a mile [1] to the east of Paisley" ('Records, &c.,' p. 136).

It was also described and figured by Woodward and Etheridge in 1873, and has been lent to us by the Trustees of the Andersonian Museum (Technical College) at Glasgow.

Pl. XIX, fig. 7; and Pl. XXII, fig. 3 (front end magnified). Brit. Mus. No. 59541, No. 15.

Size.—Length of carapace 27 mm.; breadth of carapace 20 mm.

Characters.—Carapace, with its two moieties, or pair of valves, flattened out, but in natural apposition at their dorsal margins. Damaged in the middle; it is broadly oval in outline. Indented in front by a small notch at the junction of the valves; its edges are there fringed with minute spines (Pl. XXII, fig. 3). Posteriorly each valve has a strong spine, continuous with the ventral border; and curving in between them, with two gently convex curves, the one valve meets the other in a central notch. There is a faint trace of the marginal fringe on each valve. The surface exhibits the peculiar oblique lineation of the species; also some gastric tubercles, and traces of the two mesolateral ridges.

In black shale, slightly calcareous. Probably from East Kilbride.

Pl. XIX, fig. 8; Pl. XXXI, fig. 1 (ornament). Brit. Mus. No. I.109, No. 21.

Size.—Length of valve about 50 mm.; breadth of valve about 23 mm.

Characters.—Two valves, showing their insides, displaced, but lying back to back; neither of them perfect. A part of the anterior notch is traceable. The

1 At a place now called "Inkermann," where Mr. R. Dunlop has lately most obligingly sought for further indications of these fossils, but without success.

hinder edge of the right valve (on the left-hand side of the figure) retains its spine and part of the posterior notch. The hollow inside of a strong mesolateral ridge is distinct in each valve.

These insides show also the usual oblique lineation, due apparently to successive overlapping of the flaky tissue of the test in its growth. The spaces between the lines are pierced with close-set minute perforations (Pl. XXIX, fig. 1), individually blackened by the infilling of the black shale of the matrix. This appearance is probably due to the removal, by decomposition, of both the outer and inner filmy coatings of the test. Pl. XVIII, fig. 1 *b*, shows such a structure in the test of *Dithyrocaris glabra*, in which the removal of the delicately pitted surface-layer exposes equivalent perforations in the next layer below.

In hard grey calcareous shale. From the Lingula-Limestone at Jock's Burn, below Hallcraig Bridge, about one mile west of Carluke. Dr. Rankin Coll.

Pl. XIX, fig. 9. Mus. Pract. Geol., No. 6368.

Size.—Length of valve about 34 mm.; breadth of valve about 18 mm.

Characters.—Two valves, lying one on another; the dorsal edge of the left (uppermost) valve shifted on and beyond that of the other valve. The ventral border of the right valve (undermost) shows the serrated edge, or fringe, thinning away forwards. Bounded inside by a thin definite parallel ridge, this corresponds to the "double margin" of other species. Each valve has a mesial ridge, somewhat rugose here and there. Postero-ventral spines are well shown. The surface obliquely striated as usual.

A little obliquely sub-oblong *Posidonomya*, looking almost silky with its numerous delicate, concentric striæ, lies on the same piece of hard, grey-black, micaceous shale, non-calcareous, from the Glasgow Coal-field.

Pl. XXI, fig. 1. Brit. Mus. No. 59451, No. 17.

Size.—Length of valve 50 mm.; breadth of valve 20 mm.

Characters.—A large left valve, perfect in outline, but filmy in substance; dorsally apposed to an imperfect right valve; the junction indicated by the position of the front and hinder notches. The mesolateral ridge is rugose in its posterior portion; the ventral border retains some of its fringed outer margin, and its posterior spine.

In black shale, very slightly calcareous. From East Kilbride.

Pl. XXI, fig. 2. Brit. Mus. No. 46395, No. 18.

Size.—Length of valve 45 mm.; breadth of valve about 18 mm.

Characters.—Two imperfect valves, closely adpressed and obscurely overlapping on the dorsal border. The ventral border of the left valve has left no mark of its fringe; but the impression of the longitudinal striæ of its under surface is present.

In "Coal-shale," black and calcareous, Carluke. Morris Coll.

Pl. XXI, fig. 3; Pl. XXXI, fig. 2 (ornament). Mus. Sci. and Art Edinb., Coutts, 1887, $\frac{25}{15}$, No. 13.

Size.—Length of valve, imperfect in front, 28 mm.; breadth of valve 15 mm.

Characters.—Right valve (or moiety of carapace) semi-elliptical; with a very thin film of the test, flattened, smooth, bearing numerous delicate, sinuous lines passing obliquely from the dorsal region to the mesial ridge, and, coinciding with the angular lines of its chevron-like rugæ; passing on to the ventral border, they are deflected forwards, as usual in *D. testudinea.* The spaces between the lines are closely pitted with very minute puncta (Pl. XXXI, fig. 2). There are the usual small sigmoidal cephalic ridge and thin short nuchal ridge; not clear in the figure.

The dorsal edge is simple; very slightly bent at the nuchal ridge, and damaged at its posterior end. The postero-ventral spine is proportionally strong; the ventral edge is fringed as far as it is clear of the matrix.

Black slightly calcareous shale. Probably from East Kilbride.

Pl. XXI, fig. 4. Mus. Sci. and Art Edinb., Coutts, 1887, $\frac{25}{15}$, No. 11.

Size.—Length of one valve (the right), including the spine, 38 mm.; breadth of valve about 18 mm.; of the abdominal segments exposed, the ultimate and part of penultimate, 10 mm.; style, 11 mm.; stylets about 15 mm.

Characters.—This specimen represents a right and a left valve and the caudal extremity, all displaced and crushed. The abdominal segments and tail have not been removed far from the posterior extremity of the left valve; and the hinder part of the right valve lies at a right angle over the postero-dorsal region of the left valve, near both of which, indeed, the caudal portion is situated. Both valves show evidences of the ventral fringe, the ridges, and the peculiar lineation of *D. testudinea.*

The abdominal (ultimate) segment that is exposed has been turned over, so as to show its lower or ventral aspect. It has rather sinuous chevron-lines crossing it, with their bluntish angles looking backwards. Of the three tail-spines the style (in the middle) is the shortest; it shows a flat, smooth surface (ventral), and probably was of a bayonet-shape. The others are much longer, convex, and striated, coarsely at top, but more delicately towards the ends. The relative position of the three spines shows that all the tail exposes the ventral aspect. The mesolateral ridge of the left valve appears, by some accident, to be much stronger (or better preserved) than that of the right valve.

A small *Posidonomya* lies in the shale near the end of one of the stylets, and another at the ventral edge of the right valve near by.

In black shale, slightly calcareous. From East Kilbride.

Pl. XXI, fig. 5; Pl. XXXI, fig. 4 (magnified). Brit. Mus. 59541, No. 27.

Size.—All the three caudal spines are imperfect at the distal ends. The longest stylet is about 30 mm.; the style 20 mm. without the head and the tip.

Characters.—This specimen shows an impression of the dorsal surface of part of the ultimate segment, and the under (ventral) surfaces of three tail-spines. The impress of the segment is smooth in appearance, but bears the characteristic chevron-lines and obliquely striated interspaces. The caudal plate at the head of the trifid is lost.

The spines are apparently smooth, but really delicately striated or ridged. The style shows by the impress of upper (forward) part that it was striate; and its lower moiety bears a single smooth ridge on its ventral aspect, with a broad smooth furrow on each side of it. By their impressions the stylets were evidently costulate on the dorsal face, with fine, oblique, subsidiary striæ on the sides of the four or five riblets; and on the ventral face each has three costulæ, marked with delicate, close-set chevrons, pointing downwards (backwards), their side-lines making oblique subsidiary striæ. They show pits for bases of hairs.

In black non-calcareous shale; East Kilbride. There is a *Posidonomya* on the shale, small, with concentric irregular undulations.

Pl. XXI, fig. 6; Pl. XXXI, fig. 3 (ornament). Mus. Sci. and Art Edinb., Coutts, 1887, $\frac{25}{15}$, No. 12.

Size.—Length of valve, imperfect, 30 mm.; breadth of valve about 16 mm.

Characters.—A right valve (or moiety of carapace) imperfect in front and at the dorsal edge; more convex than fig. 3, and with thicker test; it has similar characteristic lineation and minutely punctate interspaces (Pl. XXXI, fig. 3). Ventral fringe strong in the posterior part, and narrowing forwards as far as seen.

In black calcareous shale. From East Kilbride.

Pl. XXIII, fig. 7. Brit. Mus. 59541, No. 30.

Size.—Carapace 27 mm. long, 18 mm. wide; style 10 mm. long; stylets (probably shortened by fracture) 9 mm. long.

Characters.—This small trifid tail-piece is attached to a subconvex, oval cast (not figured) of a little *Dithyrocaris testudinea*, badly preserved, but retaining its length and width, and some of the characteristic lineation, directed obliquely backwards, outside the mesolateral ridges. The details of character are rather obscure. The distal parts of the trifid have left impressions of the lower or ventral faces on the shale, and these appear to have been sulcate, with granulations (possibly adventitious) on the median ridge. The dorsal faces have only a small portion of the top end of each preserved, showing a median ridge, and otherwise sulcate.

This may belong to a small variety or a young form of the normal *D. testudinea.*

It is comparable in size with the trifid of *Ceratiocaris minuta* of our 'Monograph Brit. Palæoz. Phyll.,' 1888, p. 47, pl. x, fig. 11, and pl. xi, fig. 10.

In black shale, non-calcareous. East Kilbride. Paton Coll.

Pl. XXIII, fig. 8. Brit. Mus. 59541, No. 29.

Size.—Penultimate segment 3 mm. long in its most perfect part. Ultimate segment 6 mm. long; style obscure; stylets 13 mm. long.

Characters.—The penultimate segment is marked with transverse wavy lines and the ultimate with oblique lines; thus comparable with *D. testudinea.*

In this small tail-piece the three spines have been pressed together, and one of them (the style) is quite obscured as to character and relative size. The two largest spines are cercopods (stylets) of equal length, and are sulcate.

This little specimen, in dark-grey calcareous shale, was collected by the late Dr. Rankin in Lanarkshire.

Pl. XXVII, figs. 3 *a*, *b*. Neilson Coll., H.

Size.—Length about 34 mm.; width about 2 mm.

Characters.—A small, delicate specimen of an isolated dorsal crest like that attached to the valve shown in Pl. XXVIII, fig. 1.

In black shale, slightly calcareous. Kirktonholm, East Kilbride.

Pl. XXVIII, figs. 1 *a*, *b*. Neilson Coll., D.

Size.—Length, including the spine, about 85 mm.; width about 37 mm.

Characters.—The right-hand moiety (magnified) of a good carapace of *D. testudinea*, having besides its usual characteristics a well-marked cristate dorsal ridge, which is absent in all the specimens hitherto described. A separate example, however, of such a dorsal ridge is also preserved in Mr. Neilson's cabinet (Pl. XXVII, fig. 3).

Black shale, non-calcareous. East Kilbride.

Pl. XXVIII, fig. 2. Neilson Coll., C.

Size.—Width at the top of the piece about 35 mm.; width between the points of the two spines 24 mm.; width between the bases of the two spines 20 mm.

Characters.—The posterior portion of a well-preserved right-hand moiety or valve of *D. testudinea*, showing the exact form of the hinder edge and the two posterior spines.

Black calcareous shale. East Kilbride.

Pl. XXVIII, figs. 3 *a*, *b*, Neilson Coll., E.

Size.—Length 13 mm.; width at top of the piece 11 mm.

Characters.—The posterior portion of the left-hand moiety of *D. testudinea*, magnified to show the characters of its ventral fringe and spine, its mesolateral ridge, and the usual obliquely curved transverse lineation. This has a very sharp mesolateral ridge. The ventral fringe seems to be broad all the way forward. Gastric tooth in place; and two, separate, in the shale.

Black shale, non-calcareous. East Kilbride.

Pl. XXVIII, fig. 4. Mus. Geol. Survey Scotland, F. $\frac{22}{10}$, No. 10.

DITHYROCARIS TESTUDINEUS [EA], *Woodward and Etheridge*, 1873. Geol. Mag., vol. x, p. 482.

Size.—Length 22 mm.; breadth of the valve, narrowed by lateral pressure, 8 mm.

Characters.—This left-hand half of a carapace, from shale above the Main Limestone (Lower Limestone group) in an old quarry on North Lickprivick[1] Farm, at the site of Lickprivick Castle, near East Kilbride, was described, but not figured, by Woodward and Etheridge in 1873 (*op. cit.*). Crumpled and narrowed by lateral pressure, it possesses the usual "raised, oblique, recurved, and divaricating lines" characteristic of *D. testudinea*. It shows also that "a lateral median [mesolateral] ridge (seen on each side in Dr. Scouler's specimen) marks the centre intermediate between the margin and the dorsal line of the carapace." See page 146, Pl. XXIV, fig. 7.

Pl. XXVIII, figs. 5 *a*—*c*. Mus. Sc. and Art Edinb., Coutts, 1887, $\frac{25}{15}$, No. 10.

Size.—Length of carapace 36 mm.; width of carapace 30 mm.

Characters.—This is the cast of a fairly perfect carapace, flattened out. It shows on the inside the impression of the external surface of the original test. This had very delicate, interlinear, sinuous, anastomosing striæ, obliquely transverse to the interspaces; also a minute punctation. The infilling of these little pits of the surface appears in Fig. 5 *c* as minute pimples.

Fig. 5 *b* is a magnified representation of a part of the inturned ventral margin, visible on the right-hand side of fig. 5 *a*. Compare Pl. XXVII, fig. 2, in which analogous features, in a fragment of *D. tricornis*, are seen; namely, the outside of the straight-lined rim of the inturned margin, which is flattened down on the inside of the fringe.

From East Kilbride. In black shale, slightly calcareous.

[1] The Lickprivick locality is noticed at p. 80 of the 'Catal. Western Scot. Fossils,' 1876.

Pl. XXIX, figs. 10 *a*, *b*; 11 *a*—*d*; 12 *a*, *b*; 13 *a*—*c*; 14. Neilson Coll., J.
Size:

Fig. 10.—	8 mm. long,	8 mm. wide.	A fragment.
,, 11.—	11 ,,	8 ,,	Imperfect in length.
,, 12.—	11·50 ,,	6 ,,	Nearly perfect in length, imperfect in width.
,, 13.—	7·50 ,,	5·50 ,,	A fragment.
,, 14.—	Diagram of the ornament.		

Characters.—These four abdominal (caudal) segments (more or less imperfect) are cylindrical, and bear chevron-lines similar to those of *D. testudinea* in Pl. XXI, fig. 4. Similar ornament is present in Pl. XXI, fig. 10, which we refer with some doubt to *D. Scouleri*.

Judging from Pl. XXI, fig. 4 (page 149), in which the ventral face is upwards, fig. 11 *a*, having the chevrons pointing downwards (backwards in the living animal), presents its under side. Its interstitial ornament (fig. 11 *b*) consists of an extremely delicate porous reticulation, with larger pores widely scattered.

Figs. 10 *a* and 12 *a*, for the same reason, must be taken as dorsal aspects. A delicately crimped edge or fringe marks the lowest part of the test of these segments just above the distal joint, to which the trifid spines were probably attached. The ornament (fig. 12 *d*) consists of the smooth raised striæ (chevron-lines) and punctate interspaces. These segments have been somewhat crushed, so that the lower end is broken (fig. 12 *b*), and the sectional area (figs. 10 *c* and 12 *c*) is suboval.

Figs. 13 *a*, *b*, retain a part of the top of the segment complete, but otherwise the specimen has been damaged at the end and side (figs. 13 *a*, *b*). The spines of the crimped edge of the test have been broken off. Figs. 13 *a*—*c* show a short cylindrical fragment.

In all of these four segments it is observable of the chevrons that those on one face point in an opposite direction to those on the other face, so that one chevron continuing on the two sides forms an elegant lozenge pattern with rather blunt angles, as shown in the diagram, Pl. XXIX, fig. 14.

In black shale. Two from Calderside; and two from Kirktonholme.

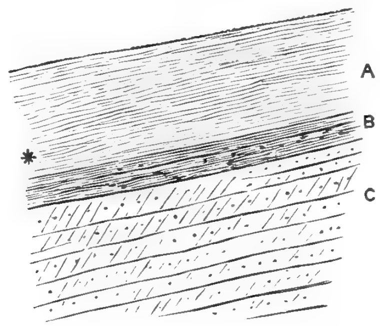
Dithyrocaris testudinea, Scouler; W. Hind, 1897, 'Geol. Magaz.,' dec. 4, vol. iv, p. 208; and 'Monograph Carbonif. Lamellib.,' Pal. Soc., p. 93.

A specimen obtained by Dr. Wheelton Hind, F.G.S., from a quarry on Congleton Edge, Cheshire, was noticed by him in 1897, in his memoirs above referred to.

It is too much broken by pressure and crush to be serviceable as a figured specimen; but we may notice that it has remains of the gastric teeth.

The fossiliferous horizon in the quarry is not far below the base of the Millstone-grit at this place.

In a letter dated December 4th, 1897, Dr. W. Hind has favoured us with the following section of the strata shown in this quarry:



A. Shales with marine fauna and *Dithyrocaris*.
* Indicates the horizon at which *D. testudinea* was found.
B. Shales with *Glyphoceras spirale*.
C. Quartzose gannister-like sandstone with plant-remains.

In Dr. W. Hind's opinion these do not belong to the so-called Yoredale series, and he describes them in detail thus:

The quarry shows the following strata downwards:

A. Dark shales, with thin bands of concretionary limestone or seams of calcareous nodules, all more or less fossiliferous; with *Glyphoceras diadema*, and the fauna noted in Dr. W. Hind's Monograph, and in the 'Geol. Mag.,' 1897, pages 207, 208: 15′.

It was in the lower part of these shales that the *Dithyrocaris* (*D. testudinea*) was found, together with *Ceratiocaris Ortonensis*.

B. Thin carbonaceous shales with *Glyphoceras spirale*, *Posidoniella lævis*, *Productus cora*, and *Streptorhynchus crenistria*: 1′.

C. Hard gannister-like quartzite, with shale-partings and plant-remains: 20′. Loamy shale: 4′. Hard compact fine-grained quartzite: 4′. Dark shales a few feet to the floor.

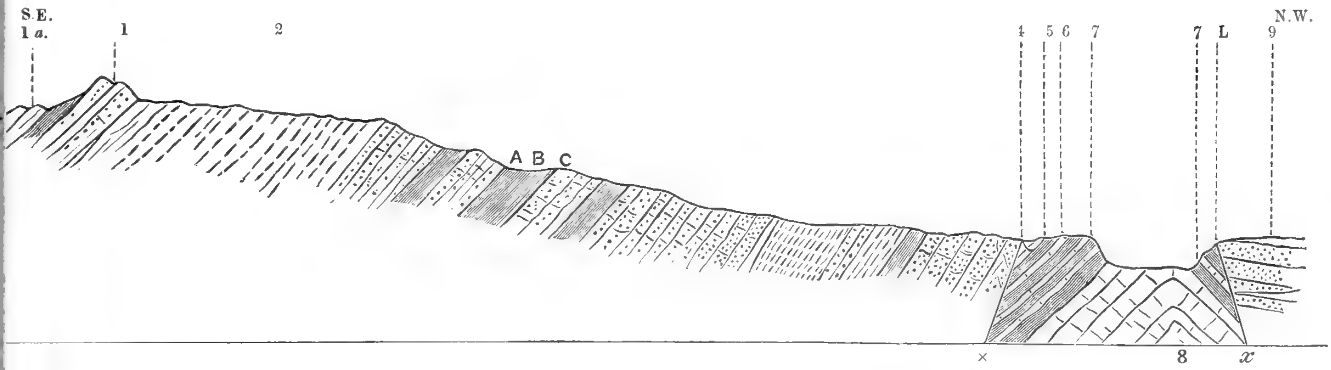
At page 72 of the 'Mem. Geol. Survey: Country round Stockport, &c.,' 1866, the strata seen in this quarry at A, B, C, are thus described:

In a quarry by the road-side, south-west of Holly Wood, we have—

Dark shale, with fossil-bearing nodules of limestones: 15′. Hard, dark-grey quartz rock (gannister), with thin partings of dark shale, containing layers of coal, from one-eighth to one-fourth of an inch thick; large Stigmaria with rootlets: 20′.

The following is a section of the Lower Carboniferous strata in Cheshire, where the roadside quarry, south-west of Holly Wood, referred to by Dr. W. Hind, is situated.

SECTION BETWEEN CONGLETON EDGE AND ASTBURY LIME-WORKS.



Excepting the beds 1 *a* at the south-east end this section is taken from p. 72, 'Memoir Geol. Survey: Country round Stockport, Macclesfield, Congleton, and Leek.'

A, B, C. The approximate position of the quarry above referred to.

1 *a*. First Grit; clay, grit, shale, and sandstone, 55′; shale, 57′; shale with a coal-seam, 102′ (see the 'Mem. Geol. Survey' here alluded to, p. 70).

1. Third Grit, 100′.
2. Shales (?), 500′.
3. Thin-bedded hard sandstones and shale, 1400′.
4. Sandstone, hard, reddish-yellow (?).
5. Dark, sandy shale, 20′.
6. Impure cannel coal, 1′.
7. Shales, with thin earthy limestones, 120′.
8. Limestone, with thin shaly partings.

× Fault. *x*. Red Rock fault. L. Limekiln Farm.

9. Lower Keuper Sandstone.

5. DITHYROCARIS SCOULERI, *M'Coy*, 1844. Plate XXI, figs. 7 *a*, *b* (?), 10 (?); Plate XXV, figs. 6 *a*—*c*, and fig. 7 (?).

DITHYROCARIS SCOULERI, *M'Coy*, 1844. Synops. Char. Carb. Foss. Ireland, p. 163, pl. xxiii, fig. 2; and 1862, ibid., edit. 2, p. 224.

— — *Morris*, 1854. Catal. Brit. Foss., edit. 2, p. 107.

— — *Griffith*, 1862. Journ. Geol. Soc. Dublin, vol. ix, p. 48.

— — *Salter and Woodward*, 1865. Chart Foss. Crust., p. 17, fig. 10.

— — *H. Woodward*, 1865. Intellect. Observer, vol. viii, pp. 323, 324, pl. o, fig. 9; 1872, Popul. Sc. Rev., vol. xi, pp. 391 and 396, pl. xc, fig. 10.

— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.

? — TESTUDINEUS [EA], *R. Etheridge, jun.*, 1879. Quart. Journ. Geol. Soc., vol. xxxv, p. 465, pl. xxiii, fig. 1.

— SCOULERI, *Nicholson*, 1879. Palæontology, edit. 2, vol. i, p. 349, fig. 204.

— — *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.

Specific Characters.—We have not seen the original specimen of *D. Scouleri*, nor are we quite certain that we have met with any specimen truly representing that species. From the description and figure[1] published in the 'Synops. Char. Carb. Foss. Ireland' this species seems to have the following characters:—A nearly round clypeiform test (36 mm. long, 34 mm. wide), slightly convex, with a strong rugose dorsal ridge, two ocular or gastric ridges, and two rugose meso-lateral ridges; otherwise smooth. A double ventral border is shown, with a marginal fringe extending from the subtriangular frontal notch to the two strong posterior spines; between these the posterior border is almost straight.

The last abdominal segment (or rather what represents its right-hand moiety), 14 mm. long, is ornamented with sinuous lines, passing obliquely backwards, from the outer edges to the centre. At the end of this segment is a broad-headed style (6 mm. wide), and a stylet on each side of it. The style, 25 mm. long in the figure, is bayonet-shaped, with oblique fine striæ on its sloping faces. The stylets (each showing a length of 22 mm.) are blade-like and tapering (about 3 mm. broad near their articulation) and coarsely striate.

The caudal spines indicate the *dorsal* aspect by their arrangement, the stylets passing under and behind the top of the style; but the piece of test at the place of the ultimate segment shows the oblique lines arranged as on the *ventral* surface. See *D. testudinea*, Pl. XXI, fig. 4.

In his 'Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland,'[2] 1844, Professor (now Sir Frederick) M'Coy refers at p. 163 to *Dithyrocaris Scouleri*, M'Coy (pl. xxiii, fig. 2), as follows:

"The characteristic length of expanded pair of valves very slightly exceeding the width; surface smooth; central and lateral ridges transversely wrinkled; frontal notch as deep as wide, rounded. Valves, when spread flat, forming a nearly orbicular shield, the length very slightly exceeding the width, and having a deep rounded notch in front; central ridge or hinge strong, rounded, regularly marked with transverse wrinkles [Pl. XXV, fig. 6 *b*]; lateral ridges marked with irregular, flat, scale-like undulations [Pl. XXV, fig. 6 *c*]; intermediate short ridges nearly straight, slightly bent towards the central ridge above and towards the lateral ridges below; surface smooth, margin of the valves narrow, fringed or obliquely striated, immediately within which, on the lateral margins, is a plain rounded ridge, divided longitudinally by a nearly mesial sulcus; it is close to and parallel with the outer margin for about the upper half of its length, then gradually turning in towards the lateral ridge, where it widens; tail exactly equalling the body in length, terminating as usual in three spines of nearly equal length, the central one triangular, marked with very fine oblique striæ, meeting at an acute angle on the central ridge; two lateral spines rounded, coarsely sulcated longitudinally. Width of the expanded pair of valves one inch four lines; length to tip of posterior spine one inch five lines; length of central spine of tail one inch."

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[1] This has been photographed from M'Coy's figure, and reproduced in Pl. XXV, figs. 6 *a*—*c*.

[2] Reprinted in 1862, with Table of Fossils and Localities.

In his 'Systematic Description of the British Palæozoic Fossils in the Geological Museum of the University of Cambridge,' 1851, Fasciculus I, pp. 81, 82, after mentioning "*Dithyrocaris*, Scouler, MS.," as one of the *Apodiadæ*, M'Coy gave a generic description of it, from his knowledge evidently of *D. Colei* and *D. Scouleri*, thus:

"*Gen. Char.*—*Carapace* semi-oval, the two sides meeting along the middle at a very obtuse angle; anterior end rounded, often with an obscure notch in front; posterior end subtruncate, with the lateral angles produced backwards into short, flat, angular spines; surface faintly marked with irregular imbricating striæ, the margins being usually thickened and corrugated, and with three well-marked longitudinal ridges, one in the middle extending the entire length, and one on each side not reaching the front margin; within and anterior to the ends of these latter are two small, obliquely longitudinal, sigmoid ridges, extending inwards and forwards towards the mesial ridge; posterior part of the body naked, tail terminating in three long, strong, equal, triangular spines, the middle one bayonet-shaped with a triangular section, the lateral ones flattened. I have not yet detected any trace of eyes in this genus, which seems closely allied to *Apus*."

He then passingly alluded to *D. Scouleri*, M'Coy, but added no particulars. Our friends at Dublin and elsewhere have not been able to find the original specimen figured and described by Sir Frederick M'Coy.

In response to our inquiry respecting the original specimen, the trustees of the Griffith Collection have obligingly sent to us, as the only evidence they can find of M'Coy's *D. Scouleri* in that Collection, a plaster cast and a photograph of the slab labelled as representing that species, from Aughnaclogh. It shows only a feeble outline of what may be a *Dithyrocaris;* and we have given a representation of it in Pl. XXV, fig. 7. The outline seems to represent an imperfect suboblong carapace; one moiety is about 32 mm. long and 13 mm. wide. As far as recognisable this may have belonged to a small *D. Colei*, such as Pl. XXII, fig. 7, and Pl. XXVII, fig. 5.

By some writers on *Dithyrocaris*, *D. Scouleri*, M'Coy, has been referred to *D. testudinea* of Scouler,[1] to which the published figure bears some resemblance in general appearance. The peculiar linear ornamentation of the valves or lateral moieties, however, is altogether wanting in M'Coy's elaborate description, and in the figure which he gave of the species, reproduced here in Pl. XXV, figs. 6 *a*, *b*, *c*. The obliquely marked abdominal plate in fig. 6 *a* is doubtful in character.

Sir Richard Griffith, in the 'Journ. Geol. Soc. Dublin,' vol. ix, 1862, p. 48, refers *D. Scouleri* to the Carboniferous Slate, or Lower Limestone Shale, of the Yellow Sandstone Group (at page 100—the Arenaceous Shale of that group), at Aughnaclogh, Clogher, co. Tyrone.

[1] See p. 485, foot-note, 'Geol. Mag.,' vol. x, 1873; and dec. 2, vol. i, 1874, p. 109.

Pl. XXI, figs. 7 *a*, *b*. Mus. Geol. Surv. Scotl., *m* 4273[b], No. 16, and *m* 4274[b], F $\frac{XX}{2}$ (bis), (counterparts).

DITHYROCARIS TESTUDINEUS, *R. Etheridge, jun.*, 1879. Quart. Journ. Geol. Soc., vol. xxxv, p. 465, pl. xxiii, fig. 1.

Size.—Length of the valve in fig. 7 *b*, imperfect, 30 mm.; breadth of the valve about 15 mm.

Characters.—Two counterparts; an embedded left valve (fig. 7 *a*), and its cast (fig. 7 *b*). Both ends of the valve are imperfect. The mesolateral ridge is rugose, and stands up sharp on fig. 7 *a*; its hollow mould is seen in fig. 7 *b*.

The fringed edge of the ventral margin extends as far as the fracture, narrowing forwards; as it is impressed on both of the counterparts, it must have stood out free. The smooth ribbon-like band within the ventral margin is slightly convex in fig. 7 *b*, and slightly hollow in fig. 7 *a*.

These two casts of one moiety of a carapace were regarded by Mr. R. Etheridge, jun., as representing two separate valves. It was from its general shape probably that Mr. Etheridge referred this specimen to *Dithyrocaris testudinea;* but there are no remains of the peculiar ornaments of that species. Possibly it may belong to *D. Scouleri*, M'Coy, which also had smooth valves (or moieties); and in shape the hind part of the valve agrees sufficiently well.

This left half of a carapace is embedded in a split piece of brown, semi-bituminous, calcareous shale, which is micaceous, and largely composed of small, obscure, compressed Ostracoda.[1] It is from the Cement-stone group of the Calciferous Sandstone series, in the Tweeden Burn, near its junction with the Liddel Water, by New Castleton, Roxburghshire. *Posidonomyæ* occur also in this specimen of shale.

6. DITHYROCARIS FUNICULATA, sp. nov. Plate XXII, figs. 6 *a*—*d*. Mus. Geol. Surv. Scotland, F $\frac{XX}{7}$, No. 21.

Size.—The fragment of a black filmy right valve 45 mm. long, probably 50 mm. or more when it was perfect. From the ventral margin to the mesolateral ridge 15 mm.; the whole valve was probably 30 mm. wide.

Specific Characters.—One of two displaced valves. A rather narrow moiety with rather straight ventral edge. Anterior portion lost; the ventral margin strongly marked with close-set oblique striæ, not forming a fringe, but a cord-like pattern throughout (figs. 6 *a* and *c*); its posterior angle (fig. 6 *b*) shows a sub-

[1] Just as some of the oil-shales are constituted.

reticular surface, having lines parallel with the lower edge, and feeble transverse striæ. A straight mesolateral rugose ridge is present, ending at the notch above the postero-ventral spine; the filmy surface of the valve bears a faint reticulation (fig. 6 *d*), and there are some irregular accidental superficial inequalities.

The funiculate pattern of the ventral margin is peculiar, though essentially of the same nature as the more usual fringe. This form is apparently distinct from the other specimens, and we may name it *D. funiculata*. The narrow rigid shape of the valve also distinguishes it from *D. Colei* (compare fig. 7 on the same plate). On the same piece of thin black calcareous shale there is a filmy and imperfect carapace of the same species. From the Calciferous Sandstone Group; Tweeden Burn, 250 yards above its mouth, New Castleton, Roxburghshire. There is a fragment of the same species, from Tyrone, in the Brit. Mus., I 280.

7. Dithyrocaris insignis, sp. nov. Plate XXV, figs. 3 *a*—*c*, 4, 5 *a*, *b*; Plate XXVII, figs. 1 *a*, *b*, *c*; Plate XXX, figs. 1—3; Plate XXXI, figs. 6, 7; and var. multijugata, figs. 8 *a*, *b*, *c*, 9.

Specific Characters.—Carapace relatively large, suborbicular or suboval; with broad ventral margin ending in a long sharp spine on each side; strong mesolateral, and weaker dorsal ridge. Posterior border straight between the two postero-ventral spines, but projecting in the middle with the dorsal spine. The surface has linear and reticulate ornament.

Pl. XXV, figs. 3, 4, and 5. Leeds Mus. Coll., Nos. 33 a and 44 a.

Size.—From the mesolateral ridge to the ventral border 16 mm.

Characters.—Crushed and much displaced fragments of one or more large suborbicular carapaces on one slab. The mesolateral ridge and the fringed ventral border are well marked, and are like those in *D. tricornis*, &c. There is a faint and rather curved elevation lying obliquely in the middle of the valve, probably due to the test accidentally overlying some narrow fragment. The postero-ventral border and its spine have been much damaged. The dorsal ridge has been broken away in this specimen.

The reticulation on one part of the surface (fig. 3 *b*) consists of delicate raised, oblique, and sinuous striæ, interrupted and inosculating to form an irregular network; but on the right-hand side of the mesolateral ridge the main striæ are parallel with that ridge, and the network is therefore straighter. Figs. 4 *a*—*e* show the features of the mesolateral ridge, the rugæ passing down into the general reticulation of the surface. When highly magnified, the meshes are seen to be punctate. Figs. 5 *a*, *b*, indicate the passage of the striæ of the upper (forward) part of the ventral fringe into the meshwork of the superficial ornament.

The history and geological position of the specimens in Pl. XXV (which were kindly sent to us by Mr. P. F. Kendall, F.G.S., of the Yorkshire College, Leeds), and of others shown in Pls. XXX and XXXI, which were obligingly communicated by Mr. E. J. Garwood, F.G.S., are recorded by Mr. Garwood in the 'Geol. Mag.,' dec. 4, vol. iv (1897), p. 556, as follows:

"At present a collector is engaged upon the fauna of the Millstone-grit at Eccup, five miles north of Leeds, where a fossiliferous black shale has been met with during the excavation of a puddle-trench for a reservoir. The bed occurs about the centre of the 'Middle Grits' of the Yorkshire Millstone-grit. The bed, which was discovered by Mr. Percy Kendall some three years ago, contains a rich marine fauna, which has not yet, however, been properly worked out. The fauna includes species of *Nucula* and *Leda* in great abundance and in excellent preservation, also numerous individual specimens of *Lingula* and *Discina*. Gasteropods occur, and a few specimens of *Goniatites*, together with well-preserved specimens of *Conularia*.

"Several specimens of *Dithyrocaris* have been found, and a single specimen of a minute Trilobite, cf. *Brachymetopus Ouralicus*. Fish-remains referable to two genera have been identified.

"The fauna appears to bear little resemblance to that of the Cayton-Gill beds of Nidderdale, which lie at approximately the same horizon in the Millstone-grit. On the whole the fauna appears to resemble in many points that of the Ridsdale Ironstone Shale of the Bernician beds of South Northumberland."

Pl. XXVII, figs. 1 *a*, *b*, *c*. Neilson Coll., B.

Size.—Fragment of a right-hand moiety, measuring 20 mm. by 20 mm. From the ventral border to the mesolateral ridge, 12 mm.

Characters.—This is a part of the postero-ventral region of the right moiety of a carapace, retaining a portion of the mesolateral ridge, with its angular rugæ; also some of the thick ventral border, with its broad margin; this passes into a narrow and almost cord-like edge in the upper (forward) part of the border (not shown in the figure).

The carapace is delicately ornamented with numerous oblique, thin, sinuous, interrupted rugulæ or wrinkles, parallel and anastomosing, having irregular interspaces (figs. 1 *b*, *c*). It is possible that in some other parts of the test these wrinkly striæ may have become more definitely reticulate; and may have approached the pattern shown by Pl. XXV, fig. 3 *b*.

In some respects this specimen approaches *D. Scouleri*, M'Coy (Pl. XXV, fig. 6); but its proportions and its ornament distinguish it.

Brownish non-calcareous shale, East Kilbride.

Leeds Mus. Coll., No. 36. Not figured.

Fragment of a large valve of *D. insignis*, measuring 20 mm. from the ventral edge to the mesolateral ridge; the latter is strong, and the former has a simple fringe as in other species (for instance, fig. 3 *a*, Pl. XXVIII). The ornament of the surface consists of simple oblique striæ, parallel, but interrupted, with punctate interspaces, and probably passed into meshwork on other parts of the test. The specimens from Eccup occur in a hard, dark-blue, non-calcareous shale, with Posidonomya, Aviculopecten, Goniatites, &c.

Leeds Mus. Coll., No. 39 B.

This is a small right valve of *D. insignis*, 43 mm. long and 20 mm. wide; from the dorsal to the mesolateral 10 mm., and the same from that to the ventral. A neat ogee curve in its front edge resembles that in fig. 3 *a*, Pl. XVIII; and figs. 1 and 2, Pl. XXIV, have a similar feature.

The superficial ornament is a freely irregular reticulation coming off from the oblique lines crossing the ridges.

Pl. XXX, figs. 1 and 2 *a*, *b*. Leeds Mus. Coll., No. 33 A.

Characters and Size.—Two valves displaced; the right valve, turned over, has left the impression of its outside (fig. 1); the outside of the other is exposed (fig. 2 *a*).

Fig. 1, the impression of the outside of an imperfect right valve, 73 mm. long and 35 mm. wide. It shows a thick ventral rim and a strong mesolateral ridge. The posterior border, with its spines, ventral and dorsal, is well indicated, but the spines have been damaged.

Fig. 2 *a* is the outside of a left valve, 71 mm. long and 37 mm. wide. The mesolateral ridge is prominent and rugose as usual; the dorsal ridge is feebly crested. The gastric and nuchal ridges are in their places. The ventral border is broad and thick, and does not show any fringe.

Pl. XXX, figs. 3 *a*, *b*, *c*, *d*, *e*. Leeds Mus. Coll., No. 44A and 44B (counterparts).

Size.—Length of carapace, with the spines (10 mm.), 60 mm.; width 50 mm.

Character.—A nearly perfect suborbicular carapace, somewhat damaged anteriorly. Ventral border broad; much obscured by being inturned and broken. A little portion of the usual fringe is traceable on the counterpart (not figured); the different patterns of the inside and outside free edge of the ventral margin can be seen both in it and in fig. 3 *a*. The postero-ventral spines are long and sharp. Mesolateral ridges rugose and strong, especially shown by deep furrows on the counterpart, in which a gastric tooth projects at the front end of the right-hand mesolateral. The dorsal ridge is relatively weak, but ends behind in a distinct triangular spine (4 mm. long).

The ornament of the surface near the mesolateral consists of sinuous, parallel, wrinkly striæ (like those in fig. 1 *b*, Pl. XXVII), with obscure, minute interstitial network; passing into a definite but irregular reticulation with punctate meshes (figs. 3 *b*—*e*); see the postero-ventral angle of the test, where the head of the right-hand border-spine has been slightly shifted away from its place.

Pl. XXXI, fig. 6. Leeds Mus. Coll., No. 44 B. (A trifid.)

Size.—Style 15 mm. long; 4 mm. broad at top. Left-hand stylet about 30 mm. long; 5 mm. broad at top.

Character.—This trifid shows its ventral aspect. The style is shorter than the stylets. The latter appear to have had smooth and strongly grooved surfaces. The style seems to be smooth, with a deep central sulcus, and is probably triangular in section.

This tail-piece lies close to the front end of the carapace, fig. 3 *a*, and may have belonged to that individual.

A similar trifid, specifically the same, most likely, but imperfect, is embedded in specimen No 95 A.

Plate XXXI, figs. 7 *a*, *b*. Leeds Mus. Coll., No. 602. (A caudal plate.)

Size.—Length 13 mm.; width at top 9 mm.; width at bottom 4 mm.

Characters.—This small tongue-shaped plate, tapering downwards to a rounded end, was probably part of the ultimate abdominal segment. It may have been a separate plate coating the outside of the head of the style. The ornament of chevron-lines with the angles downwards is that of the *ventral* aspect of the abdominal segments (see Pl. XXIX, figs. 10 *b*, 11 *a*, 12 *b*, and 13 *b*). The interstices are irregularly and sparsely punctate. The edges of this little plate being somewhat damaged are ragged all round.

7*. Dithyrocaris insignis, sp. nov. Var. multijugata, nov. Plate XXXI, figs. 8 *a*, *b*, *c*, and 9.

Characters.—Besides a strong mesolateral ridge on each valve, and the usual dorsal ridge, these specimens have another rugose ridge between the mesolateral and dorsal ridges. This ridge is not strange to *Dithyrocaris*, for it is feebly represented in the very distinct species *D. tricornis*, Pl. XXIV, fig. 1; and is traceable in *D. Colei*, fig. 2. It is a feature also in *Chænocaris tenuistriata*, Pl. XXI, figs. 8, 9, and 11, stronger than in the foregoing.

The presence of this *juxtadorsal* ridge on each side characterises some of the specimens from Eccup as a variety of *D. insignis* in that locality, inasmuch as the carapace has five instead of three prominent ridges; and we have named it accordingly. It is smaller than the type-form, and its carapace must have been rather oval, like figs. 1 and 2, Pl. XXX, and not so orbicular as fig. 3.

Figs. 8 *a*, *b*, *c*. Leeds Mus. Coll., No. 43.

An imperfect posterior half of a left valve (about 14 mm. wide), showing the wide ventral border (as in Pl. XXX, fig. 3), with the mesolateral, juxtadorsal, and dorsal ridges very distinct. The juxtadorsal is oblique (as also in fig. 9). The left-hand edge of the dorsal ridge seems to have been squeezed in under the neighbouring part of the test. The postero-ventral spine is long and sharp; the medio-dorsal spine is much shorter.

The ornament of lines and network in fig. 8 *b* extends over the dorsal ridge and the test in its vicinity; the pattern of linear chevrons pointing downwards (backwards) passes sideways into the general reticulation. The parallel sinuous lines on one side of the limit of the dorsal ridge differ, but not essentially, from those on the left-hand side of that limit. The irregular meshes are punctate (fig. 8 *c*).

Pl. XXXI, fig. 9. Leeds Mus. Coll., No. 40.

Size.—Valve, length about 35 mm. probably when perfect; width 15 mm.

Characters.—Rather more than half of the left moiety of a carapace; imperfect at the front end. Besides the ventral border, partly fringed, the mesolateral, juxtadorsal, dorsal, and the right-hand juxtadorsal are distinct. The two juxtadorsals are set obliquely (see also fig. 8 *a*), and thus appear to be in their normal position and not squeezed out of place. They are parallel one to the other.

The gastric ridge on the left side, and the nuchal ridges on both valves, are all apparent.

8. Dithyrocaris Colei, *Portlock*, 1843. Plate XXII, fig. 7; Plate XXIII, figs. 1—4; Plate XXIV, figs. 2, 4; Plate XXV, figs. 9 *a*, *b*, *c* (?); Plate XXVII, fig. 5.

Dithyrocaris Colei, *Portlock*, 1843. Report Geol. Londonderry, &c., pp. 314, 565, 570, pl. xii.
— — *Morris*, 1843. Catal. Brit. Foss., p. 73.
— — *M'Coy*, 1844. Synops. Char. Carb. Foss. Ireland, p. 163.
— — *Bronn*, 1848. Index Palæont., vol. i, p. 135.
— — *Morris*, 1854. Catal. Brit. Foss., edit. 2, p. 107.
— — *R. Griffith*, 1862. Journ. Geol. Soc. Dublin, vol. ix, p. 48.
— — *M'Coy*, 1862. Synops. Char. Carb. Foss. Ireland, edit. 2, p. 224.
? — — *J. Young*, 1868. Trans. Geol. Soc. Glasgow, vol. i, p. 58.

? Dithyrocaris Colei, *J. Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 29; and 1876, Catal. W.-Scot. Foss., p. 45.
— — *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 72.
— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.
— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886 (1887), p. 63.
— — *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.

Specific Characters.—A relatively large oval-oblong carapace (laid out flat in Pl. XXIV, fig. 2; halved in Pl. XXIII, fig. 1), with strong features of rugose dorsal and mesolateral ridges, weak juxtadorsals, ventral fringe (especially posteriorly), and posterior spines (two ventral and one dorsal). Delicate superficial ornament reticulate and subaculeate. Dorsal junction of the carapace-moieties surmounted by a serrated crest, with narrow side-flanges. In the separate half (Pl. XXIII, fig. 1) this cristate ridge, remaining prominent, shows its side-view.

All the specimens referred to above (excepting Pl. XXII, fig. 7) formed part of the original Irish series collected and described by General Portlock in 1843.

Pl. XXIII, fig. 1. Mus. Pract. Geol., 6262. 'Catal. M. P. G. Fossils,' 1865, p. 116.

Size.—Moiety of valve 75 mm. long, 41 mm. wide. The whole carapace was probably about 82 mm. wide.

Characters.—This is a right valve, showing (1) a broad ventral margin, dwindling away forwards, from which the fringe has been broken away; (2) the rugose mesolateral ridge; (3) the almost straight posterior edge; and (4) a posterior portion of the dorsal rugose ridge, terminating in the postero-dorsal spine. This ridge is rather too regular and too delicate in the drawing; only the rough ends of the chevrons come to the surface.

Overlapping the antero-dorsal (upper in the figure) region of this valve is the postero-ventral portion of another right valve, fig. 4 of Pl. XXIV.

In a black shale, micaceous and calcareous; being almost wholly composed of compressed small Ostracods. In a similar shale (some with less of the small Ostracods) are the specimens Pl. XXIII, figs. 2, 3, 4; Pl. XXIV, figs. 2, 4; and Pl. XXVII, fig. 5.

Pl. XXIII, figs. 2, 3, 4. (Tail-pieces.) Mus. Pract. Geol., Fig. 2, $\frac{36}{7}$, 6261; Fig. 3, $\frac{36}{7}$, 6261; Fig. 4, $\frac{36}{6}$, 6265.

Size.—Fig. 2. Length 80 mm. Exposed segments 35 mm.; penultimate 10 mm.; ultimate 25 mm. Style 37 mm. Stylets 39 mm.

Fig. 3. Exposed segments 40 mm.; ultimate 30 mm. Style 26 mm. Stylet 30 mm.

Fig. 4. Exposed segments 40 mm.; antepenultimate 6 mm.; penultimate 12 mm.; ultimate 22 mm.? Style 22 mm. Stylets broken at tips.

Owing to the crushed and imperfect state of the several parts these measurements are for the most part only approximate.

Characters.—Fig. 2 shows the same specimen as that represented by fig. 4, pl. xii, of Portlock's 'Report Geol. Londonderry,' 1843; with the remains of two abdominal segments and three well-preserved caudal appendages of probably normal characters and proportions; the dorsal aspect is exposed. The segments are imperfect and crushed, but the joint between the ultimate and the penultimate supplies a definite datum for their measurement. The ultimate segment bears chevron-lines, with their angles pointing forwards (upwards in the figure). The telson or style is rather shorter than the two cercopods or stylets, and all these are longitudinally striate; the style, having a median ridge, was bayonet-shaped.

Fig. 3 is the same specimen as that in fig. 5, pl. xii, *op. cit.* It has been widened and broken by pressure, so that it is difficult to measure its parts with exactness. It has been mixed up in the shale with a fragment of ventral margin, and perhaps other fragments obscure the ultimate segment, which seems to be broad and chevroned with finer lines than those in fig. 2. The tail-spines are also shorter; but the style is the shortest, as in the other examples. They are sulcate rather than striate, and somewhat granulated on the ridges, a condition due perhaps to fossilisation. Their relative position gives a ventral aspect.

Fig. 4. The same specimen as fig. 3 *a*, *op. cit.*, is also flattened and much widened by pressure. The oblique lines on the ultimate segment are directed backwards (downwards in the figure) and inwards towards the centre, thus in a contrary direction to those in figs. 2 and 3. This is the ventral feature in *D. testudinea.* The three spines may also be said to show their ventral aspect. They are broken at the tips, but resemble those of the other specimens, except that at the head of the stylets a few of the striæ converge at a sharp angle for a short distance—not nearly so far as this feature is continued in fig. 3 *a*, *op. cit.*

The surface of the segments bears patches of an attached kind of *Spirorbis* (fig. 3 *b*, *op. cit.*); minute, discoidal, and smooth; perhaps near *Sp. pusillus*, Martin.

Pl. XXIV, fig. 2. Mus. Pract. Geol., 6263.

Size.—Carapace flattened out and imperfect (the same as Portlock's pl. xii, fig. 1). Originally about 85 mm. long and 70 mm. wide. . . . . And Pl. XXIV, fig. 4. Mus. Pract. Geol., 6262 (bis). Cat. M. P. G., 1865, p. 116.

Size.—Moiety or valve 68 mm. long; including posterior spine 74 mm. About 35 mm. wide. The whole carapace was originally about 70 mm. wide.

Characters.—The flattened carapace (Pl. XXIV, fig. 2) is suboval, anteriorly contracted, and showing a relatively broad, shallow, central notch, where the edges of the two valves (or lateral moieties) turn slightly inwards and backwards to their junction.

In the separate subelliptical moieties the ventral edge is elliptically curved and depressed. The dorsal edge is straight, and provided with a rugose ridge (Pl. XXIV, fig. 2), which is seen in its side view (Pl. XXIII, fig. 1) to be crested, and to end behind in a broad triangular spine. The dorsal edge of each valve, when in apposition seems to have been overridden by the straight, narrow, rugose crest, which had narrow lateral flanges, and constituted the *medial* or *dorsal* ridge of the carapace. There is also on each valve a straight *mesial rugose* ridge, besides a shorter, coarser, and rather sinuous *cephalic* ridge, a weak *juxtadorsal*, and a thin, short, *nuchal* ridge. This last is more distinct in Pl. XXIV, fig. 4, than in fig. 2, where the two small nuchal ridges, usually parallel with each other and with the dorsal ridge between them, are somewhat displaced, probably by unequal pressure at that spot, as evidenced by the apparent local disturbance of the specimen.

The *mesolateral* ridges are attenuated in front, and curve towards the *cephalic* ridges in Pl. XXIV, fig. 2; but in fig. 4, and Pl. XXIII, fig. 1, they are straight as far as they go. They end posteriorly just above (in front of) the postero-ventral notch and spine, Pl. XXIII, fig. 1, and Pl. XXIV, fig. 4. This spine is relatively long, triangular, flat (?), and sharp; and is continuous with the depressed edge of the ventral margin. This, marked off by a smooth, thin ridge (the real solid rim of the valve, partially preserved in figs. 1 and 4), becomes narrower forward, and is furnished with a fringe, or strongly and obliquely striated border along the hinder two-thirds of its length, perfectly shown in Portlock's fig. 2, pl. xii. This narrow, flat, or depressed portion of the ventral margin appears to have been a free edge, and to have been longitudinally striated on its under side.

The fringed border of the left moiety is for the most part preserved as a narrow whitish rim of the test, with the striæ lying close together, adpressed and almost cord-like, with a partial film of shining black shale, which emphasises the minute granulation on each fibre of the fringe.

The posterior edge of the valve is nearly straight between the dorsal and the (larger) ventral spine (Pl. XXIII, fig. 1, and Pl. XXIV, fig. 4).

In the specimen illustrated by fig. 2, Pl. XXIV, the surface has a faint and delicate reticulation in the anterior part of each valve between the cephalic and dorsal ridges. It is much obscured elsewhere in the compressed shale, which has coated or replaced the test. Wherever this permits the original surface to assert its presence, it is seen to be profusely spotted with minute triangular tubercles, or obsolete prickles; their angles pointing backwards.

General Portlock remarked, at page 315, *op. cit.*, with regard to the shape that, "As a further means of distinguishing the species, the position of the lateral lines may be noted, and the following dimensions taken into account:

Length of buckler of large specimen . .	3·5 inches.
Total breadth of buckler . . .	2·6 ,,
Breadth of single valve . . .	1·3 ,,

The lateral line is nearer to the margin than to the axis, though with some variation; if, therefore, it be prolonged through the valve and considered a chord, the length would be 3·1 inches, and the versed sine or perpendicular from that line to the margin, ·7 inch, or less than one-fourth of the chord."

General Portlock's specimens, all belonging to the Lower Carboniferous Series, came from the Tyrone Shales at Clogher, and the Derry Shales at Ballynascreen; and Sir R. Griffith referred *D. Colei* to a Lower Carboniferous Shale in the Yellow-Sandstone group at Auchmaclogh, Clogher, co. Tyrone.

In 1863 Professor (now Sir Frederick) M'Coy described some specimens of *D. Colei* from Auchmaclogh, Clogher, Tyrone, which were in the Griffith Collection (Dublin). The Trustees of that Collection have kindly sent us two plaster casts of the original specimens. One of them bears also the impression of a trifid tail, like those in Pl. XXIII, figs. 2—4.

In his 'Synopsis Carb. Fossils Ireland,' M'Coy thus described the species at page 163 (without figures):

"*Sp. Ch.*—Longitudinally oval; anterior end narrow, having a shallow rounded sinus in front, posterior end broader; margins sigmoidally curved, forming an acute sinus towards the centre; sides terminating in acute, angular, flattened spines; the mesial [dorsal] ridge strongly crenated; lateral ridges almost as large as the mesial one, and similarly crenated; short, sigmoidal, anterior ones also similar; margins of the valves obliquely striated; surface otherwise perfectly smooth.

"This large species is very closely allied to the *Argas tricornis*, Scouler. Taking one half of the shield, or one valve, its length is about twice and a half the width. Length of single valves three inches seven lines, width one inch six lines."

Pl. XXII, fig. 7. Mus. Geol. Surv. Scotland, *m* 4271^b, F $\frac{xx}{6}$, No. 21.

Characters and Size.—This is a filmy black remnant of a left valve, 43 mm. long (formerly about 45 mm.) and 18 mm. wide. The fringed ventral margin and its posterior spine, the mesolateral rugose ridge, the indications of the posterior edge, and the spine terminating the dorsal margin are present.

These features are very like those of *D. Colei* (compare Pl. XXIII, fig. 1; XXIV, fig. 4), and we regard this Scotch specimen as a small representative of the large Irish *D. Colei*, although the latter measures 80 × 45 mm. in contrast with 45 × 18 mm.

In dark grey micaceous calcareous shale, containing some obscure small Ostracods. From the Cement-stone Group, Tweeden Burn, 250 yards above its mouth, near New Castleton, Roxburghshire.

Another specimen, also from Tweeden Burn (F $\frac{xx}{3}$, No. 18, Mus. Geol. Surv. Scotland), is also *D. Colei*, similar to Pl. XXII, fig. 7, but a fragment of a larger carapace crushed flat. Remaining fragments of ridge and ventral edge, each 45 mm. long. The distance between dorsal and mesolateral ridges 20 mm.

Pl. XXVII, fig. 5. Mus. Pract. Geol., 6260, Derry, Sheet 40, 13.

Size.—This is a fragmentary left-hand moiety; length 40 mm., width 18 mm.; both measurements being imperfect.

Character.—This imperfect half-carapace has the characteristics of a small *Dithyrocaris Colei*, and is almost exactly like the specimen shown in Pl. XXII, fig. 7. It is evidently one of the original specimens collected by the Geological Surveyors in Ireland, and described by General Portlock.

In both Pl. XXII, fig. 7, and Pl. XXVII, fig. 5, the posterior edge is well defined for half of its length as a narrow flat band, tapering slowly from the postero-ventral spine to the place of the dorso-medial spine.

9. Dithyrocaris orbicularis, *Portlock*, 1843. Plate XXIV, fig. 3. Mus. Pract. Geol., 6266.

Dithyrocaris orbicularis, *Portlock*, 1843. Report on the Geology of Londonderry, &c., p. 316 (not figured).
— — *Morris*, 1843. Catal. Brit. Foss., p. 73.
— — *Bronn*, 1848. Index Palæont., vol. i, p. 135.
— — *Morris*, 1854. Catal. Brit. Foss., edit. 2, p. 107.
— — *M'Coy*, 1863. Synops. Char. Carb. Fossils Ireland, p. 163.
— — *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 63.
— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.
— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886, p. 64.
— — *Etheridge*, 1888. Foss. Brit., vol. i, Pal., p. 238.

Size.—Length of carapace 18 mm.; width of carapace 24 mm.—approximately.

Specific Characters.—This represents the specimen which was described but not figured by General Portlock. The outline of its left moiety is almost semicircular, and the probably similar edge of the right valve may be regarded as conterminous with the right-hand broken edge of the specimen. This is in accordance with Portlock's view also. Its postero-ventral spine is still traceable in places. From this, across to the opposite angle (of left valve), is the obscure posterior edge of the carapace, with faint traces of the medio-dorsal and postero-ventral spines.

From the left edge the first ridge is 7 mm. From the first to the second ridge is 5 mm. From the second ridge to the right-hand edge of the specimen is 10 mm. Taking the first ridge for a *mesolateral*, and the second ridge for the *mid-dorsal* (and evidently so regarded by Portlock), the width of the valve is nearly 12 mm., and its length (and that of the carapace) is about 18 mm. (without the spines). The whole width of the carapace was probably about 24 mm.

The right valve is unfortunately hidden, and perhaps broken up under the matrix on that side, its hinder spine only remaining in evidence. The anterior edge, like that of the left valve, is lost. Besides the two prominent crenulated rugose ridges, there is a small (cephalic?) ridge between the front end of the left mesolateral ridge and the ventral edge, and some displaced fragments of similar but thinner ridges in the posterior region. The left valve, besides having an obscure trace of its posterior spine, is characterised by its fringed edge being continuous throughout.

General Portlock particularly points out the differences between the shape of this form and that of his *D. Colei.* "The length of the single valve ·6 inch, breadth ·4 inch. The lateral line prolonged, would form a chord nearly as long as the axis, and the versed sine would be ·25 inch, or more than one-third of the chord, a proportion very different from that of the preceding species." See above, page 167.

A somewhat similar orbicular carapace may be noticed in *Lepidurus bilobatus*, Packard, 'North American Phyllopods,' 1883, p. 318, pl. xv, fig. 3.

This interesting and rare Irish fossil was obtained by General Portlock and his colleagues on the Geological Survey, in the Lower Carboniferous Shale at Ballynascreen, on the Whitewater River, Derry. The shale is black, calcareous, containing a few small obscure Ostracods.

Sir Frederick M'Coy stated in his 'Carb. Foss. Ireland,' p. 163, that—

"I have only seen a few fragments probably of this species along with the last [*D. Colei*]; it is distinguished by its nearly circular outline, and its tuberculated lateral and mesial ridges and margin."

10. DITHYROCARIS TRICORNIS, *Scouler*, 1835. Plate XXII, fig. 4 (magnified part), figs. 5 *a*—*e*; Plate XXIV, figs. 1, 5 *a*, *b*, and 6; Plate XXV, figs. 9 *a*, *b*, *c* (?); Plate XXVII, figs. 2 *a*, *b*, *c*, 4 *a*—*e*.

ARGAS TRICORNIS, *Scouler*,[1] 1835. Records of General Science (Thomson's), vol. i, p. 137, fig. 2; and p. 141.
— — *Bronn*, 1848. Index Palæont., vol. i, p. 102.
DITHYROCARIS TRICORNIS, *Bronn*, 1848. Ibid., vol. i, p. 433.
— — *Morris*, 1854. Catal. Brit. Foss., edit. 2, p. 107.
— — *Salter and Woodward*, 1865. Chart Foss. Crust., p. 17, fig. 12.
— — *J. Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 30; and Catal. W.-Scotl. Fossils, 1876, p. 45.
— — *H. Woodward and R. Etheridge, jun.*, 1873. Mem. Geol. Surv. Scotl., Expl. Sheet 23, Appendix, p. 99; Geol. Mag., vol. x, pp. 483, 486, pl. xvi, figs. 2 and 3.
— — *H. Woodward*, 1877. Catal. Brit. Foss. Crust., p. 73.
— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 249.
— — *R. Etheridge, jun.*, 1879. Quart. Journ. Geol. Soc., vol. xxxv, p. 466.
— — *J. Coutts*, 1884. Trans. Geol. Soc. Glasgow, vol. vii, pp. 200 and 327.
— — *E., W., and J.*, 1887. Rep. Brit. Assoc. for 1886, p. 63.
— — *Etheridge*, 1888. Foss. Brit., vol. i, Palæoz., p. 238.
— — *J. Neilson*, 1894. Trans. Geol. Soc. Glasgow, vol. x, pt. 1, p. 71.

Specific Characters.—Subquadrate carapace, occurring in both an expanded (Pl. XXIV, figs. 1 and 5) and a folded state (Pl. XXIV, fig. 6); strongly ridged, both dorsally and laterally and in the cephalic region; weak *juxtadorsal* ridges are also present; the two ventral margins and the dorsal line all end with a strong triangular spine; and these three, coming into a line at the hinder end of the folded specimen, Pl. XXIV, fig. 6, originated the name "*tricornis*." Surface covered with a delicate reticulation, with thin irregular meshes, which thicken at frequent intervals into small, short, blunt spines.

[1] According to Portlock ('Report Geol. Londonderry,' 1843, p. 313), Dr. Scouler described this and another species (*A. testudineus ?*) at the meeting of the British Association at Glasgow in 1840. Not mentioned in the Report for that year.

Pl. XXIV, fig. 1. Mus. Geol. Surv. Scotl., B 3095 *a*, No. 12.

Size.—Length of each moiety or valve 63 mm., including their posterior spines. Breadth of the two valves 63 mm.

Characters.—A nearly perfect subquadrate carapace, consisting of two moieties or valves. Ventral border elliptically rounded; its thickened (double) margin, as shown by its strong impression, was marked on the inside with longitudinal delicate striæ. On the edge it bore a fringe of strong oblique striæ, or compressed prickles, pointing backwards, especially at the posterior curve, where they form a sharp serrated edge; and they are less strong at the anterior region.

The anterior margin had a gently curved medial hollow, where the two valves meet. Dorsal junction along a ridged line, which is obscurely indicated as having been a long, thin, separate (probably overriding) part of the test, with a narrow flat flange along each side, somewhat like the ridge-tiles on the roof of a house.

In Pl. XXIV, fig. 1, the flange on one side (spectator's left hand) of the dorsal ridge is definitely indicated by a thin line; but on the other side it is covered up by the black shale having been squeezed up over it inside the long thin rugose ridge (*juxtadorsal*) parallel with the thick *dorsal* ridge.

Besides the central ridge, there are two slight tuberculate ridges (*juxtadorsal*), parallel and near to it, one on each side; on the left reaching up to the *nuchal* ridge, but interrupted on the right side. These two *nuchal* ridges are thin and tuberculate, parallel, and close to the anterior part of the central (*dorsal*) ridge, and between it and the sinuous *cephalic* (*gastric* or *optic*) ridge on each moiety of the carapace.

On each valve there is also a strong, straight, and rugose or tuberculate (*meso-lateral*) ridge, between the dorsal ridge and the ventral border, passing from near the gastric ridge to the posterior border just above the large spine at the postero-ventral angle. There may have been also a middle posterior spine, terminating the dorsal ridge, as in figs. 4 and 6, and Pl. XXIII, fig. 1. The rugosity of all the ridges is due to the sharp prominences of imbricated chevron-shaped scales, or successive angular outgrowths of the test.

The whole surface is sprinkled over with minute triangular tubercles, having the apex pointing backwards. The posterior corners of the test, and some parts of the ventral region, bear numerous round tubercles.

All the ridges consist of numerous overlapping, raised, chevron-like layers of test, pointing backwards. The surface of the specimen, Pl. XXIV, fig. 1, is partially obscured by thicker or thinner layers of black shale. On the outer division of the moiety on the left hand there is mostly a thick layer, leaving bare the postero-ventral angle and spine. On the inner division is a rather thinner layer, leaving its anterior third bare, with its delicate reticulation. The inner division of the right-hand valve carries a thick layer along the narrow area between the dorsal and the neighbouring thin parallel ridge; and a thin layer or film on the rest of that part of the test allows the blunt little prickles to be recognisable, and leaves bare the anterior fourth part and some of the posterior surface.

On the outer division of the right valve a narrow thick layer of the black shale lies between the mesolateral ridge and the ventral border. The latter here shows the impression of a narrow rim, marked with very fine and silky, longitudinal, parallel striæ. This tapers forwards, and widens backward towards the root of the postero-ventral spine. A remnant of this striated rim is visible on the other (left-hand) side of the carapace, passing from beneath the fringed edge up to the anterior border, where the striæ of the fringe are closer together and pressed nearly parallel with the edge.

An *inturned* part of the ventral margin has been seen in a fragment to consist of a finely reticulated band (about 5 mm. broad), tapering backwards and bordered by a narrow, but thick, striated rim.

This reticulated band and its rim were once a part of the outside of the test, but turned down at an angle. As now seen from underneath, they lie compressed on the inside of the fringe and a narrow smooth band, Pl. XXVII, figs. 2 *a—c*.

In Pl. XXIV, fig. 1, there is also the relic of an abdominal segment, marked with deep sinuous transverse lines, due to the overlapping flakes of the test. In the 'Geol. Mag.,' vol. x, p. 485, pl. xv, fig. 3, the remains of three abdominal segments are indicated, but they have been partly broken away since 1873.

From black, non-calcareous shale above the Calderwood Cement-stone, Lower Carboniferous Limestone Group, East Kilbride. At the Kirktonholm Cement Works, East Kilbride. The counterpart of this remarkably fine specimen is in the Museum of Practical Geology, London. It bears the original mark of the Geol. Surv. Scotl., "B 3096 *a*," and the following label:—" Lower Carboniferous Limestone Group. Shales above Calder Wood Cement-stone, Kirkstone Holme Cement Works, East Kilbride, Lanarkshire. Cast of *Dithyrocaris tricornis*, Scouler." It is this specimen that exhibited a portion of the outer part of the ventral border, infolded and pressed flat. In hard black non-calcareous shale, Pl. XXVII, figs. 2 *a*, *b*, *c*.

Pl. XXIV, fig. 6. Mus. Techn. Coll. Glasgow. This is the original of Dr. Scouler's fig. 2, p. 137, 'Records,' &c., 1835.

Size.—Length of carapace (including spikes) 80 mm., breadth of carapace 36 mm., abdominal segments 28 mm. long, 12 mm. broad, longest spine 42 mm. long, middle spine 25 mm. long, lowest spine 28 mm., not quite perfect.

The two valves or moieties of an oblong carapace, folded together, and somewhat damaged by crush. They lie almost symmetrically, but by a transposition of parts usual in decayed and floating Phyllopods, the three rather obscure abdominal segments, and a trifid caudal appendage, project from the lower part of the front of the carapace.

The test was sufficiently thin (probably by the loss of the external layer) to allow of the gastric teeth being exposed, together with some other (obscure) internal organs.

There is also a curved object standing out at the antero-dorsal region, and continued backwards into the cephalic region with a straight (somewhat solid, but apparently broken) stem. Whether it be a disconnected portion of the margin, or quite adventitious, is doubtful.

The thick and double ventral margin is brought out in relief, with its strong, flat, triangular spine.

The dorsal edge of this (the right) valve is distinct; possibly tuberculated anteriorly, and decidedly marked on its posterior third with a row of oblique striæ or close-set prickles, pointing backwards; and though similar to the fringe usually present on the ventral edge, it is the side view of a dorsal ridge or crest of sharp, chevron-like rugæ, and ends in a strong, flat, triangular spine, such as is seen in the allied species, *D. Colei*, Pl. XXIII, fig. 1, and Pl. XXIV, fig. 4, though not so strong. Another posterior spine of the carapace stands out below that of the dorsal margin (between it and the ventral spine), and makes the third "horn" of Scouler's *D. tricornis*. This latter spine is probably that of the left valve, which (as seen through the thin and compressed carapace) has been shifted, and broken along its mesolateral ridge.

This fossil has been described and figured in the 'Geological Magazine,' vol. x, pp. 483, pl. xvi, fig. 2. It was found one mile east of Paisley, Renfrewshire, in the same black, thin-bedded earthy limestone from which Dr. Scouler's *D. testudinea* (Pl. XXIV, fig. 7) was obtained. Both of these unique specimens have been lent to us for illustration and description by the Trustees of the Andersonian Museum in Glasgow.

Pl. XXII, figs. 5 *a—e*. Dunn Coll., C. 14, 29. Redesdale.

Size.—A fragment 50 mm. long by 27 mm. broad. The whole valve was probably more than 65 mm. long and 30 mm. broad.

Characters.—The antero-dorsal portion of the front end has been broken away, leaving a small part of the antero-ventral region, which retains an indication of the approximately real curvature of that portion of the ventral border. The straight edge of a portion of the middle of the crested dorsal border is evident (compare fig. 6, Pl. XXIV), and was probably continued forwards (upwards in the plate). A relatively long, sinuous, rugose *nuchal* ridge lies near the front end of the dorsal line, and joins on (with a curve) to the long, thin, rugose, *juxtadorsal* ridge, parallel to and inside the dorsal edge (just as in fig. 1, Pl. XXIV). A curved *cephalic* ridge with its little crater-like end, and some protuberances near by, lie between the *nuchal* ridge and the remaining anterior end of the *mesolateral* rugose ridge of this right-hand valve.

The surface is minutely reticulate, and frequent trigonal outgrowths of the meshes form obscure or abortive prickles (figs. 5 *b*, *d*, *e*). The dorsal crest is very prominent (compare Pl. XXIII, fig. 1), showing both of its sides (figs. 5 *a*, *b*, *c*, *d*). Its chevron-like and imbricated rugæ rise out of its reticulate sides, one of which is shown in the fig. 5 *d*. Clearly marked off from the rest of the surface is one *flange* of the overriding crest, as in Pl. XXIV, fig. 1, and Pl. XX, figs. 1 *a*, 2 *a*, *b*, 3 *a* and *g*. In the arrangement of the ridges (cephalic and others) and in its subaculeate ornament this specimen closely resembles *D. tricornis* (Pl. XXIV, fig. 1); also in its reticulation, which is well preserved.

Two counterparts in a split calcareous nodule; from the shales of the Redesdale Ironstone of the Lower Carboniferous series, Northumberland. Collected by Mr. Dunn.

Pl. XXIV, figs. 5 *a*, *b*; Pl. XXII, fig. 4 (magnified part). Mus. Geol. Surv. Scotl., F $\frac{22}{9}$, No. 9.

Size.—Length 13 mm., breadth 10 mm., depth or thickness 4 mm.

Characters.—A small specimen referable to *D. tricornis.* It exhibits three obscurely rugose ridges (one dorsal and two mesolateral) along the surface, and two cephalic ridges in front. Some distortion from pressure has narrowed the right moiety, and made its mesial ridge oblique to its ventral border and to the dorsal ridge. The end view (fig. 5 *b*) shows a subquadrate outline, with sloping sides, which are the down-folded and inturned lateral expansions of the ventral margins outside the mesolateral ridges.

Pl. XXII, fig. 4, exhibits a magnified view of a part of the surface of fig. 5 *a*, comprising the right *cephalic* ridge and its crater-like *ocular* spot, and the front end of the right *mesolateral* ridge, formed, like the other ridges, of imbricating chevrons. The coarse (worn?) reticulation is also shown, and the irregularly scattered tubercles or false prickles.

This interesting little fossil has been referred to and figured in the 'Geol. Mag.,' vol. x, p. 485; and dec. 2, vol. i, p. 111, pl. v, fig. 7.

In black calcareous shale. From the Lower Limestone group, Kirktonholme Cement Works, East Kilbride. Mr. A. Patton Coll.

Pl. XXVII, figs. 4 *a*—*e*. Neilson Coll., F.

Size.—Length of carapace 17 mm., breadth 13 mm., depth 5 mm.

Characters.—A small individual like *D. tricornis*, of a neat suboval shape, and retaining the carapace whole, having its dorsal and two mesolateral ridges, and other characteristic features, including a reticulate and subaculeate ornament of the surface.

Compare Pl. XXII, figs. 5 *d*, *e* (for the ornament); Pl. XXIV, figs. 5 *a*, *b* (for shape and outline).

This well-preserved specimen clearly exhibits the clypeiform test, with its dorsal convexity (fig. 4 *b*), when looked at sideways, and its suboblong and angulate shape when viewed from front or behind (figs. 4 *c*, *d*). Its dorsal ridge and ornament are magnified in fig. 4 *e*.

From Kirktonholme, East Kilbride.

Pl. XXV, figs. 9 *a*—*c*. Mus. Geol. Surv. Scotland, F $\frac{XX}{5}$, No. 20.

This is a large separate dorsal ridge, possibly belonging to *D. tricornis* or *D. Colei*, or even to a different species.

Size.—Length probably about 60 mm. when perfect; width in the middle 5 mm.

Characters.—A long, narrow, fusiform, rugose ridge, with a flat narrow flange along each side. Thus it matches such a dorsal ridge as belongs to *D. tricornis* (Pl. XXIV, figs. 1 and 6) or *D. Colei* (Pl. XXIV, fig. 2). The latter seems to have had a rather longer carapace and ridge than the former, but its ridge is not so thick.

The rugosity of fig. 9, Pl. XXV, has a slight difference of structure from that of the other rugose ridges (Pl. XX, figs. 2 *b*, 3 *g*), due to the divisions of the chevrons being more exactly alternate in their distances and in their extent over the ridge, so that there appears to be almost a double row of rounded rugæ along this ridge. This, however, may have been the character of an individual, not of a species (see *D. granulata*, Pl. XX, figs. 2 *b* and 3 *g*).

In brownish calcareous shale. From the Calciferous Sandstone group at Larriston Burn, near New Castleton, Roxburghshire.

If this dorsal ridge belonged to either *D. tricornis* or *D. Colei*, both species are also represented in the Roxburghshire beds.

Pl. XXV, figs. 10 *a*—*c*. Mus. Geol. Surv. Scotland, F $\frac{XX}{5}$, No. 20.

The surface of the piece of hard shale in which the foregoing dorsal ridge is embedded is covered with scattered carapaces of small Ostracoda, mainly if not entirely belonging to *Kirkbya plicata* (figs. 10 *a*, side view; 10 *b*, edge view; and 10 *c*, end view).

My friend Mr. J. W. Kirkby tells me that from this locality (Larriston Quarry) the Geological Surveyors of Scotland have obtained several good sets of Ostracoda, which he has determined as *Leperditia Okeni* (and varieties), *Kirkbya costata*, *K.*

plicata, *Kirkbya*, sp., *Argillœcia æqualis*, and *Cytherella*, sp. Also that *K. plicata* and other species occur at other localities near New Castleton.

Mr. Dunn has favoured us with the following note on the succession of strata comprised in the "Redesdale Limestone and Shale." The late Mr. George Tate, of Alnwick, divided the Carboniferous rocks of Northumberland into the—

1. Coal-measures		about	2000 feet.
2. Mountain-limestone	Calcareous	,,	900 ,,
	Carbonaceous	,,	1700 ,,
3. Tuedian		,,	1000 ,,

The "Redesdale beds" belong to the base of the "Calcareous" division, and they are as follow :

1. Shale, containing "Leaf" ironstone nodules. Often replaced by red Boulder-clay, 10 feet.

2. Redesdale Limestone, 14 feet.

3. Clayey Sandstone, containing *Stigmaria* with rootlets, 16 inches.

4. Yellow, fine-grained Sandstone, calcareous in many places, 9 feet.

5. Ironstone Shale, 30 feet. Near the top is an ironstone band, about 4 inches thick, and full of organic remains. Fossiliferous ironstone nodules, sometimes in beds, are scattered throughout this shale.

6. Sandstone, 60 feet. A coal-seam,[1] 14 inches thick, occurs in this sandstone.

From the Shales and Ironstones of Redesdale Mr. J. Dunn has collected *Dithyrocaris glabra*, *D. tricornis* (Pl. XXII, fig. 5), *D. Dunnii* (tail-pieces, Pl. XXIII, figs. 9 and 10), several Gastric Teeth of *Dithyrocaris* (Pl. XXVI, figs. 21—26, 35, 36), Trilobites (*Phillipsia*, &c.), and some fish remains, besides other fossils, obscure and fragmentary.

11. Dithyrocaris Belli, *H. Woodward*, 1871. Plate XVIII, figs. 8 *a*, *b*, *c*.

Dithyrocaris striatus, *H. Woodward*, 1871. Rep. Brit. Assoc. for 1870, Sections, p. 90.
— Belli, *H. Woodward*, 1871. Geol. Mag., vol. viii, p. 106, pl. iii, fig. 5.
— — — 1872. Canadian Naturalist, vol. vi, pp. 18, 19.
— — *S. A. Miller*, 1877. Americ. Palæoz. Foss., p. 217.
— — *Bigsby*, 1878. Thesaur. Dev.-Carb., p. 27.

[1] See also G. A. Lebour's 'Outlines of the Geology of Northumberland,' 1878, pp. 38, &c.

PLATE XVIII.

Fig. 1 *a.*—*Dithyrocaris glabra*, H. Woodward and R. Etheridge, jun. Left moiety or valve. Mus. Geol. Survey Scotland, 4368, F $\frac{22}{11}$, No. 11 (= 'Geol. Mag.,' 1874, pl. v, fig. 4). (Page 136.)

Fig. 1 *b.*—The same. Part of the surface, with and without the outermost film. $\times$ 40.

Fig. 2.—*D. glabra*, W. & E. Right valve. M. G. S. Sc., 4078, F $\frac{22}{11}$, No. 12 (= 'Geol. Mag.,' 1874, pl. v, fig. 5). (Page 137.)

Fig. 3 *a.*—*D. ovalis*, W. & E. Carapace, crushed and open. M. G. S. Sc., F $\frac{22}{4}$, No. 4 (= 'Geol. Mag.,' 1874, pl. v, fig. 1). (Page 140.)

Fig. 3 *b.*—The same. Part of the surface. $\times$ 40.

Fig. 4.—*D. granulata*, W. & E. Left valve. M. G. S. Sc., F $\frac{22}{6}$, No. 6; also Pl. XX, fig. 2, magnified (= 'Geol. Mag.,' 1874, pl. v, fig. 2). (Page 142.)

Fig. 5 *a.*—*D. granulata*, W. & E. Left valve. M. G. S. Sc., 4076, F $\frac{22}{11}$, No. 13 (= 'Geol. Mag.,' 1874, pl. v, fig. 3). (Page 144.)

Fig. 5 *b.*—The same. Antero-dorsal region. $\times 3\frac{1}{2}$.

Fig. 6.—*D. granulata*, W. & E. Carapace. Brit. Mus., 59541, No. 9; also Pl. XX, fig. 1, magnified. (Page 144.)

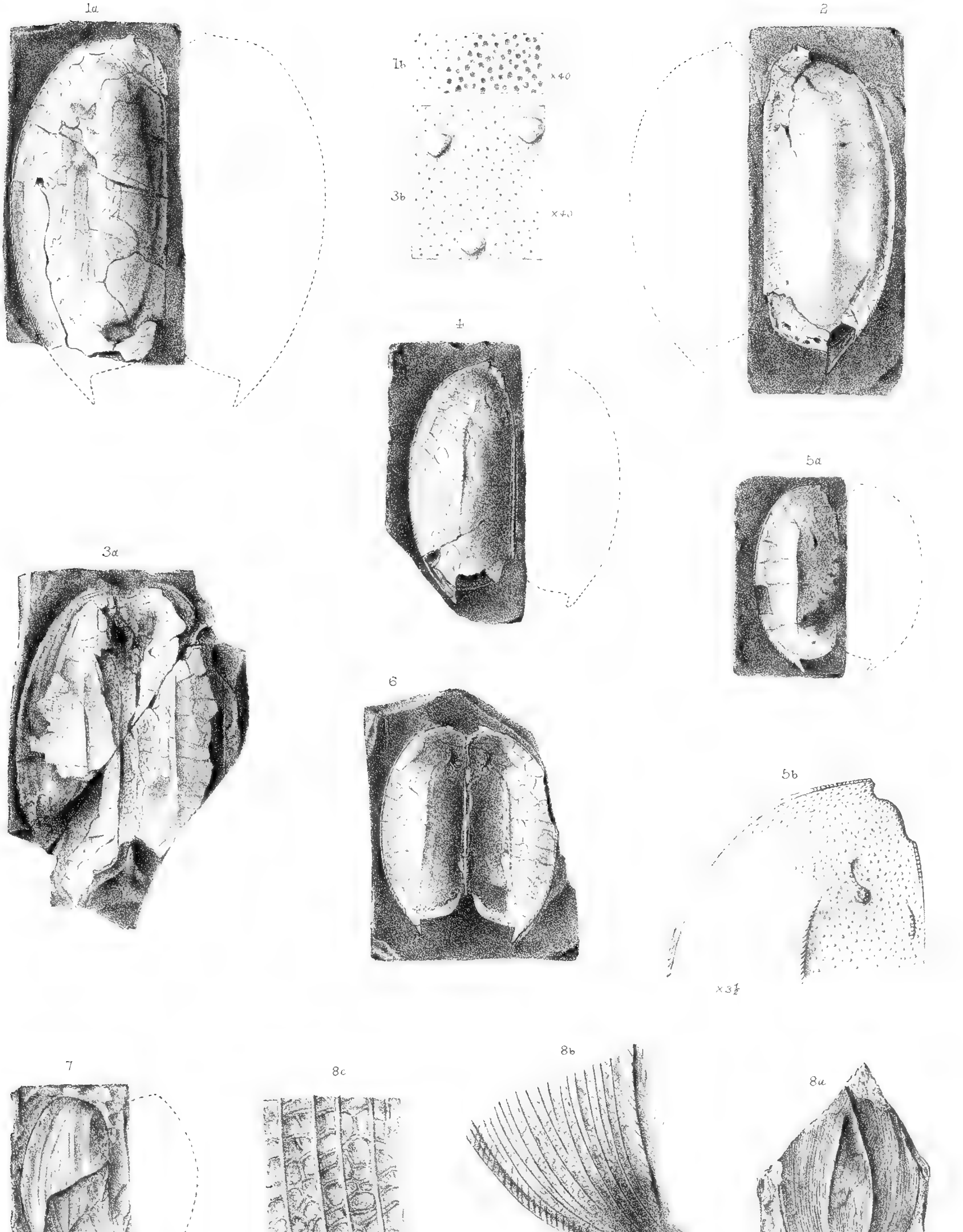
Fig. 7.—*Calyptocaris striata*, Woodward, sp. M. G. S. Sc., M 576 *a*, F $\frac{12}{96}$, No. 15 (= 'Geol. Mag.,' 1874, pl. v, fig. 6). Two valves pressed together, showing the left imperfect.

Fig. 8 *a.*—*Dithyrocaris Belli*, Woodward. Two valves overlapping, imperfect. B. M., No. 25 (= 'Geol. Mag.,' 1871, pl. iii, fig. 5). (Page 176.)

Fig. 8 *b.*—The same. Postero-ventral region of the left valve. $\times$ 5.

Fig. 8 *c.*—The same. Part of surface. $\times$ 15.

PLATE XVIII.



T.R.J. direxit. Geo. West & Sons lith et imp.

BRITISH FOSSIL PHYLLOPODA.

PLATE XIX.

(All the figures of the natural size except Fig. 6 *b*.)

Fig. 1.—*Dithyrocaris glabra*, H. Woodward and R. Etheridge, jun. Left valve. Brit. Mus., 59541, No. 1. (Page 138.)

Fig. 2.—*D. glabra*, W. & E. Two displaced and partly overlapping valves. Mus. Sci. and Art, Edinburgh, 1883, 23, 5, No. 1. (Page 138.)

Fig. 3.—*D. glabra*, W. & E. Right valve and tail. M. Sc. A. Edin., 1883, 23, 5, No. 4. (Page 138.)

Fig. 4.—*D. glabra*, W. & E. Crushed carapace and tail. B. M., 59541, No. 28. (Page 139.)

Fig. 5.—*D. granulata*, W. & E. Right valve, imperfect. M. Sc. A. Edinb., Coutts, 1887, $\frac{25}{15}$, No. 9. (Page 145.)

Fig. 6 *a*.—*D. granulata*, W. & E. Carapace, somewhat crushed and imperfect. B. M., 59541, No. 10; also Pl. XX, fig. 3, magnified. (Page 144.)

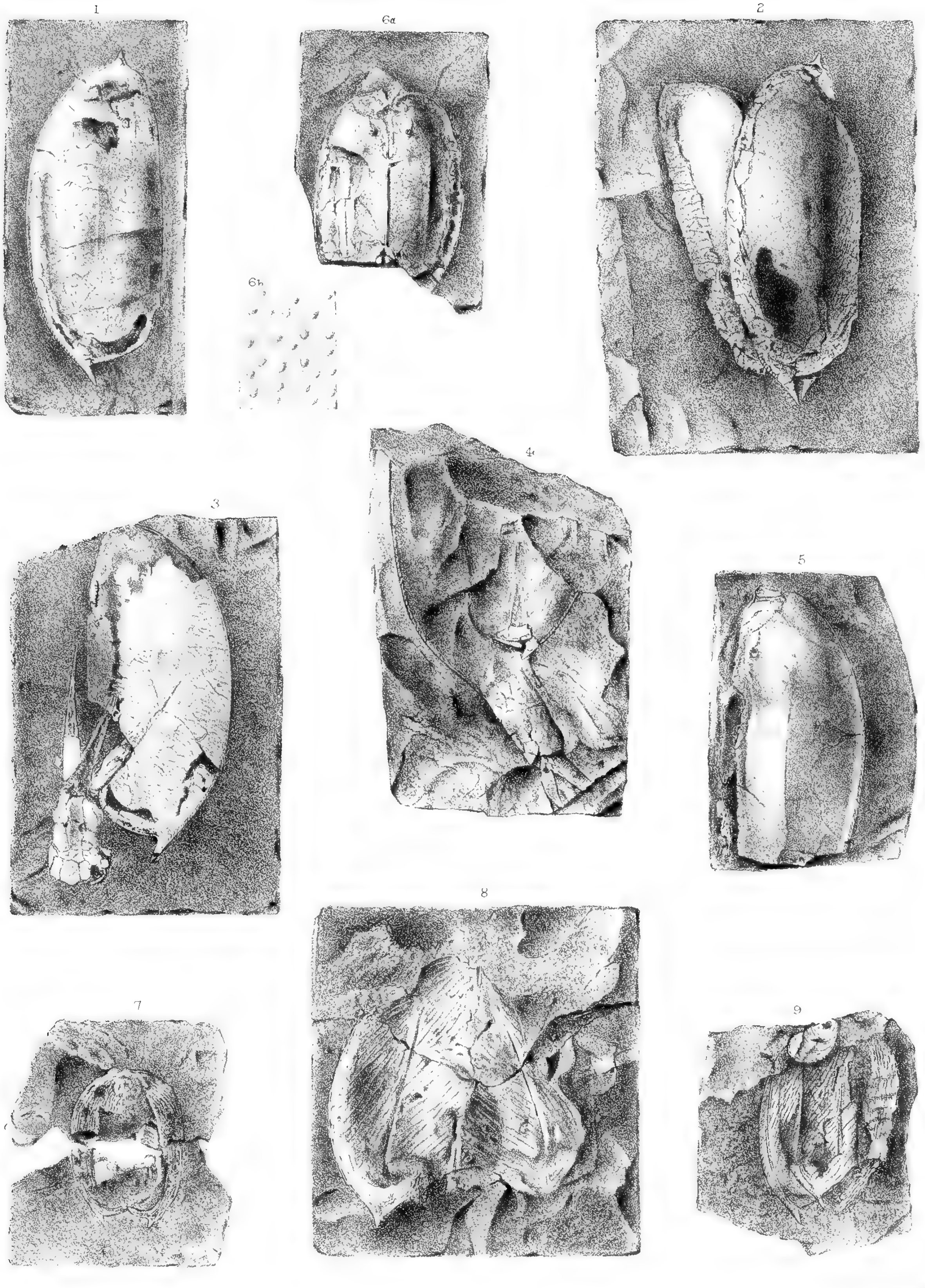
Fig. 6 *b*.—The same. Part of the surface. $\times$ 20.

Fig. 7.—*D. testudinea*, Scouler. Carapace crushed and imperfect. B. M., 59541, No. 15. See also Pl. XXII, fig. 3, cephalic part magnified. (Page 147.)

Fig. 8.—*D. testudinea*, Scouler. Two valves crushed and displaced. B. M., I, 109, No. 21. (Page 147.)

Fig. 9.—*D. testudinea*, Scouler. Two valves overlapping. Museum of Practical Geology, 6268, $\frac{36}{10}$. (Page 148.)

PLATE XIX.



BRITISH FOSSIL PHYLLOPODA

PLATE XX.

Fig. 1 *a.*—*Dithyrocaris granulata*, W. & E. Carapace flattened, open. × $2\frac{1}{2}$. B. M., 59541, No. 9; also Pl. XVIII, fig. 6. (Page 144.)

Fig. 1 *b*—The same. Two *cephalic* and one *nuchal* ridge. × 5.

Fig. 2 *a.*—*D. granulata*, W. & E. Left valve. × $2\frac{1}{2}$. M. G. S. Sc., F $\frac{22}{6}$, No. 6; also Pl. XVIII, fig. 4. (Page 142.)

Fig. 2 *b.*—The same. Part of surface, including the dorsal ridge. × 14.

Fig. 2 *c.*—The same. Outline of the ridge. × 14.

Fig. 2 *d.*—The same. Part of the surface. × 40.

Fig. 3 *a.*—*D. granulata*, W. & E. Carapace, somewhat crushed. × $2\frac{1}{2}$. B. M., 59541, No. 10; also Pl. XIX, fig. 6. (Page 144.)

Fig. 3 *b.*—The same. Outline of the elevation of the carapace. × $2\frac{1}{2}$.

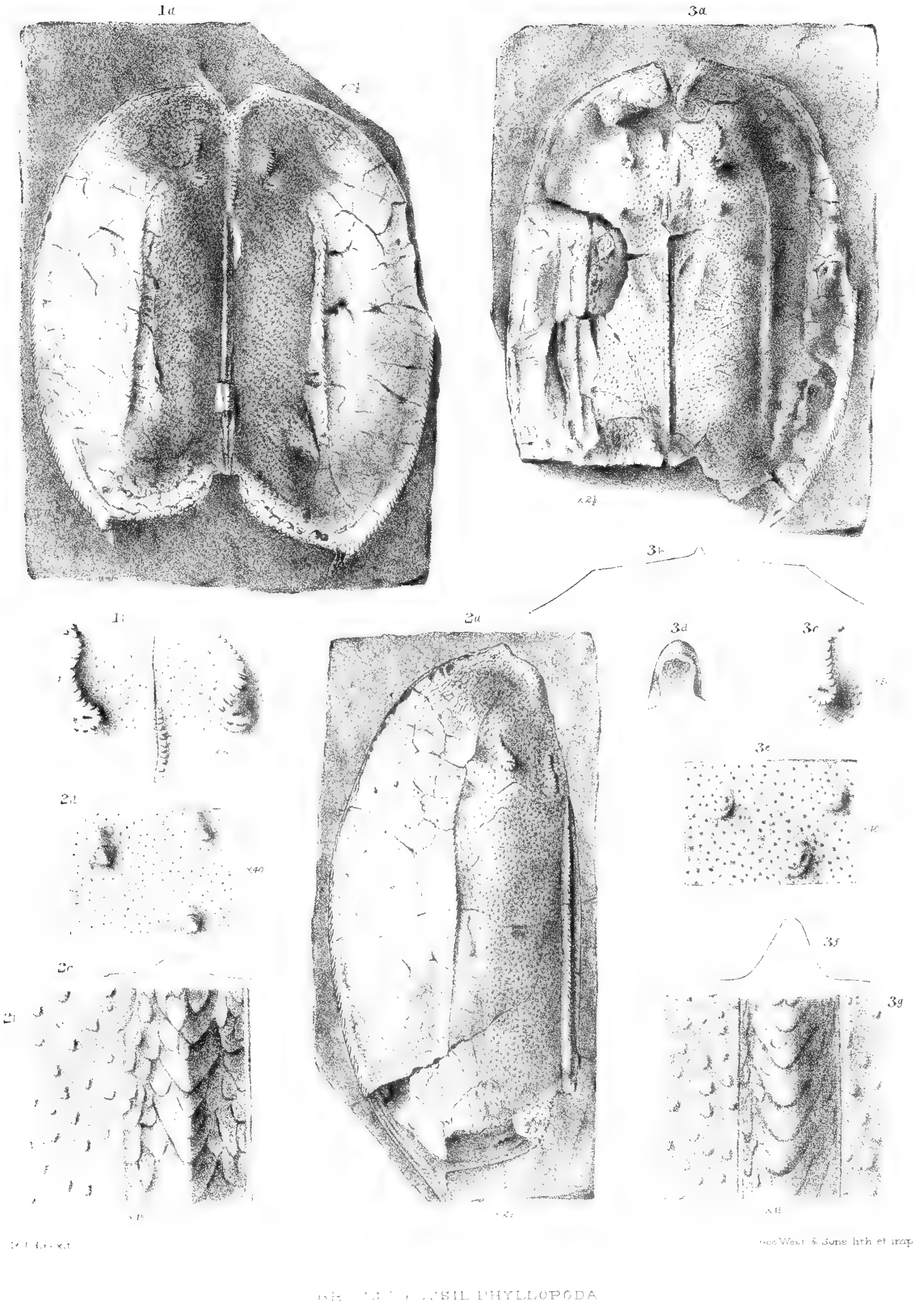
Fig. 3 *c.*—The same. One of the cephalic ridges. × 5.

Fig. 3 *d.*—The same. View of the broken end of the dorsal ridge. × 10.

Fig. 3 *e.*—The same. Part of the surface. × 40.

Fig. 3 *f.*—The same. Outline of the elevation of the dorsal ridge. × 15.

Fig. 3 *g.*—The same. Part of the dorsal ridge. × 15.



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BR[illegible] [illegible]SIL PHYLLOPODA

PLATE XXI.

(All of the natural size except Figs. 11 *d*, 11 *e*, and 11 *f*.)

Fig. 1.—*Dithyrocaris testudinea,* Scouler. Left valve. B. M., 59541, No. 17. (Page 148.)

Fig. 2.—*D. testudinea,* Scouler. Inperfect carapace. B. M., 59541, No. 18. (Page 148.)

Fig. 3.—*D. testudinea,* Scouler. Right valve. M. Sc. A. Edin., Coutts, 1887, $\frac{25}{15}$, No. 13; also Pl. XXXI, fig. 2. (Page 149.)

Fig. 4.—*D. testudinea,* Scouler. Two displaced valves and tail. M. Sc. A. Edin., Coutts, 1887, $\frac{25}{15}$, No. 11. (Page 149.)

Fig. 5.—*D. testudinea,* Scouler. Abdominal segments and tail. B. M., 59541, No. 27; also Pl. XXXI, fig. 4. (Page 150.)

Fig. 6.—*D. testudinea,* Scouler. Right valve. M. Sc. A. Edin., Coutts, 1887, $\frac{25}{15}$, No. 12; also Pl. XXXI, fig. 3. (Page 150.)

Fig. 7 *a.*—*D. Scouleri* (*?*), M'Coy. Left valve.
Fig. 7 *b.*—*D. Scouleri* (*?*), M'Coy. Counterpart of fig. 7 *a.* } M. G. S. Sc., F $\frac{\text{II}}{2}$ (*bis*), No. 17. (Page 155.)

Fig. 8.—*Chænocaris tenuistriata,* M'Coy, sp. Left valve. B. M., 32938, No. 23. (Visé.)

Fig. 9.—*Chænocaris tenuistriata,* M'Coy. Left valve. B. M., 44987, No. 24. (Settle.)

Fig. 10.—*Dithyrocaris Scouleri* (*?*), M'Coy. Caudal extremity. B. M., 59541, No. 22. (Page 155.)

Fig. 11 *a.*—*Chænocaris tenuistriata,* M'Coy, sp. Right valve. Mus. Cambridge. (Settle.)

Fig. 11 *b.*—The same. Edge view.

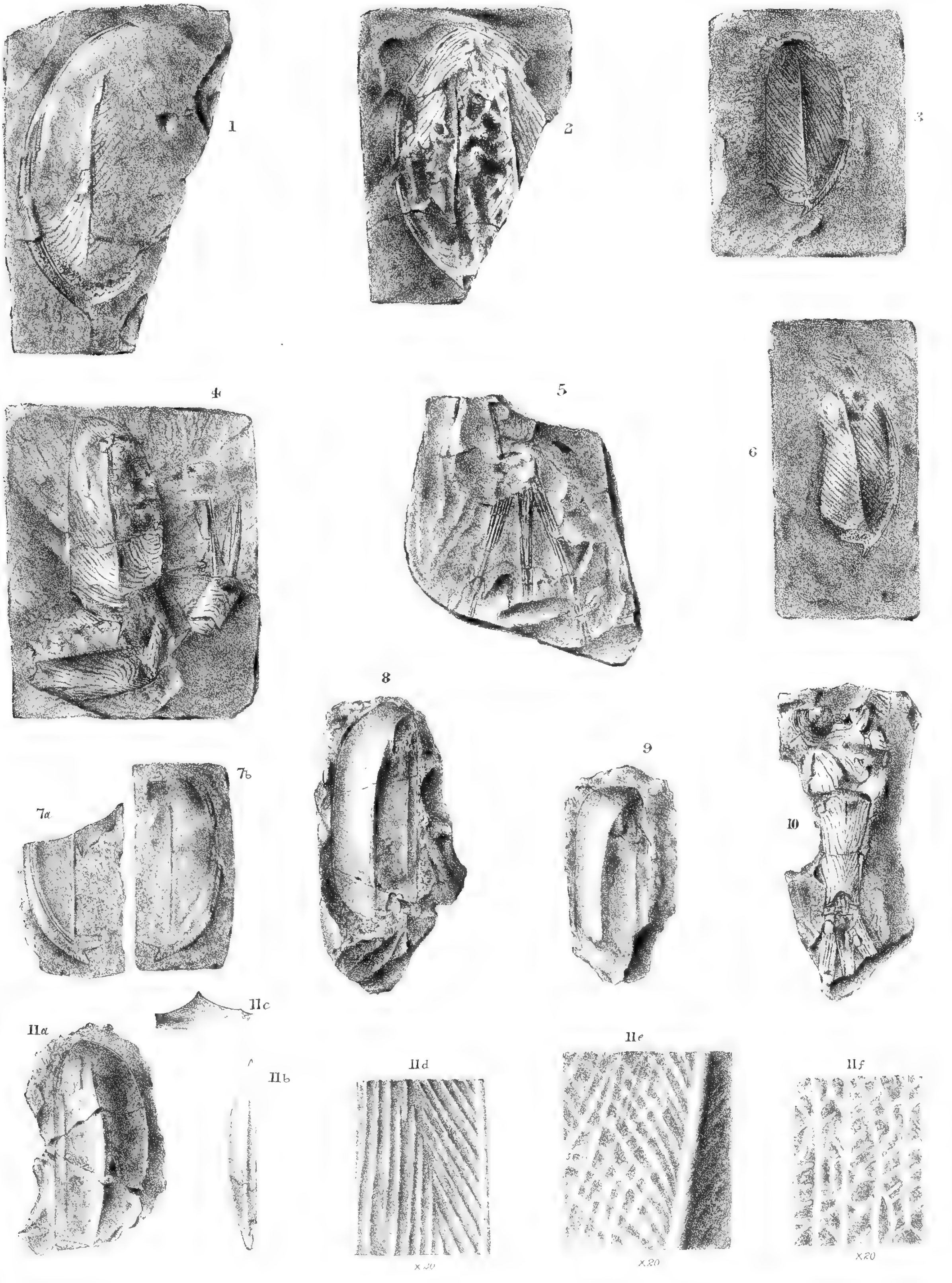
Fig. 11 *c.*—The same. End view.

Fig. 11 *d.*—The same. Part of surface at the ventral margin. × 20.

Fig. 11 *e.*—The same. Part of surface at the mesolateral ridge. × 20.

Fig. 11 *f.*—The same. Part of surface near one end of the valve. × 20.

PLATE XXI.



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BRITISH FOSSIL PHYLLOPODA.

PLATE XXII.

Fig. 1 *a.*—*Chænocaris Youngii*, sp. nov. Carapace, showing the left valve. J. Young Coll. (Robroystone.) × 7.

Fig. 1 *b.*—The same. Carapace, showing the right valve. × 7.

Fig. 1 *c.*—The same. Carapace, end view. × 7.

Fig. 1 *d.*—The same. Carapace, back view. × 7.

Fig. 1 *e.*—The same. Part of surface at the mesolateral ridge. × 30.

Fig. 2.—*Chænocaris? Richteriana*, sp. nov. One valve, imperfect at the edges. × 5. From Saalfeld.

Fig. 3.—*D. testudinea*, Scouler. Cephalic portion. × 3. B. M., 59541, No. 15; also Pl. XIX, fig. 7. (Page 147.)

Fig. 4.—*D. tricornis*, Scouler. Part of surface of fig. 5, Pl. XXIV. × 30. (Page 174.)

Fig. 5 *a.*—*D. tricornis*, Scouler. Part of right valve. Dunn Coll. C 14. (Redesdale.) (Page 173.)

Fig. 5 *b.*—The same. Part of the dorsal ridge. × 5.

Fig. 5 *c.*—The same. End view of the dorsal ridge. × 5.

Fig. 5 *d.*—The same. Left-hand side of part of the dorsal ridge. × 10.

Fig. 5 *e.*—The same. Part of the surface. × 15.

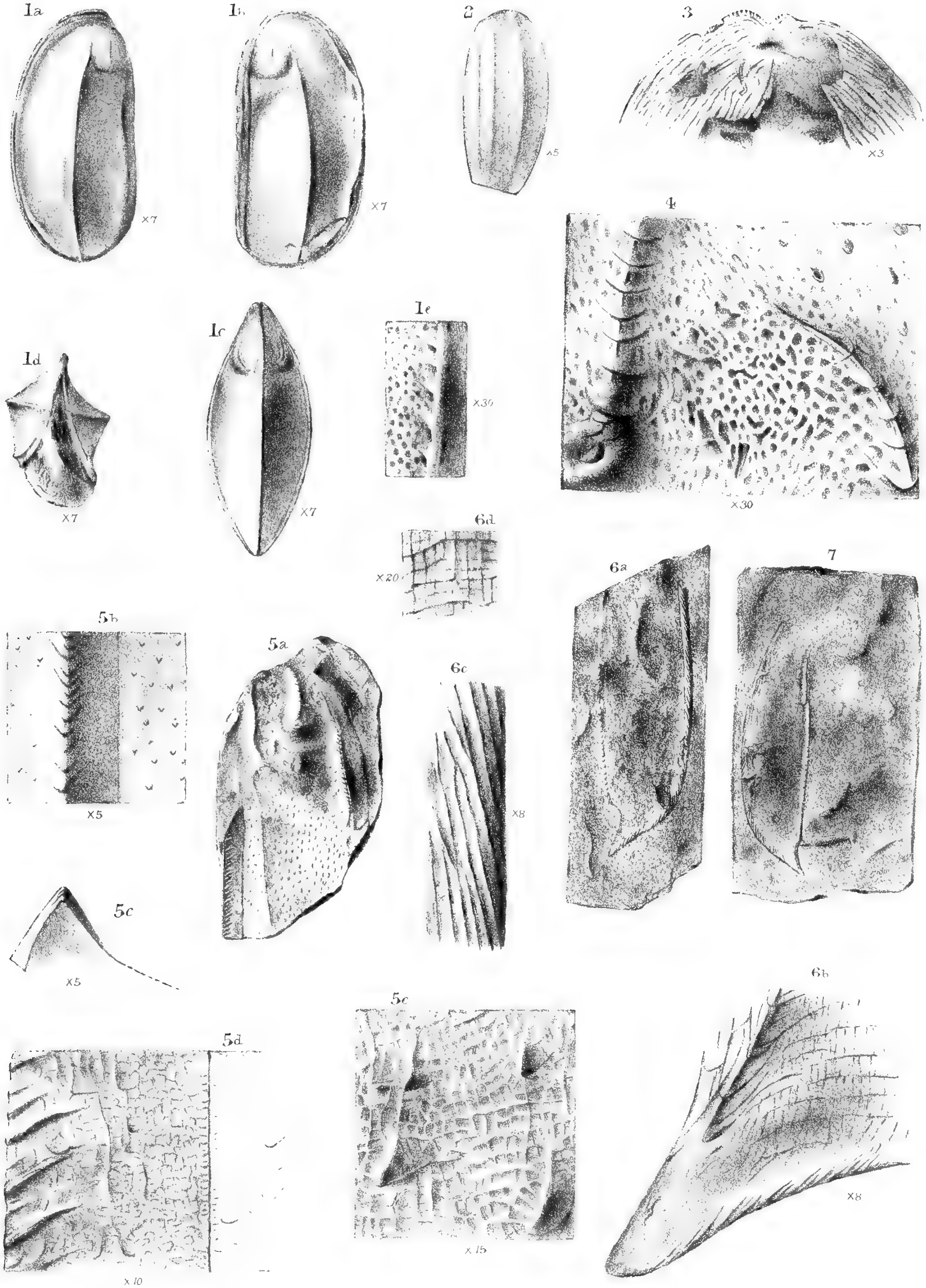
Fig. 6 *a.*—*D. funiculata*, sp. nov. Right valve. M. G. S. Sc., F $\frac{\text{xx}}{7}$, No. 7. (Page 158.)

Fig. 6 *b.*—The same. Part of the postero-ventral region. × 8.

Fig. 6 *c.*—The same. Part of the ventral edge. × 8.

Fig. 6 *d.*—The same. Part of the surface. × 20.

Fig. 7.—*D. Colei*, Portlock. Imperfect left valve of small individual. M. G. Surv. Scot., *m* 4271, F $\frac{\text{xx}}{6}$, No. 21. (Page 167.)



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BRITISH FOSSIL PHYLLOPODA.

PLATE XXIII.

(All the figures are of the natural size.)

Fig. 1.—*Dithyrocaris Colei*, Portlock. Right valve nearly perfect, and part of another overlying; also Pl. XXIV, fig. 4. M. P. G., 6262, $\frac{36}{3}$ (= Portlock's pl. xii, fig. 2). (Page 164.)

Fig. 2.—*D. Colei*, Portlock. Tail. M. P. G., 6261, $\frac{36}{7}$ (Portlock's pl. xii, fig. 4).

Fig. 3.—*D. Colei*, Portlock. Tail. M. P. G., 6261, $\frac{36}{7}$ (Portlock's pl. xii, fig. 5).

Fig. 4.—*D. Colei*, Portlock. Tail. M. P. G., 6265, $\frac{36}{6}$ (Portlock's pl. xii, fig. 3 *a*).

Fig. 5.—*D. lateralis*, M'Coy. Tail. M. G. S. Sc., m 4268 *b*, and counterpart, m 42667 *b*, No. 26.

Fig. 6.—*D. lateralis*, M'Coy. Tail. Mus. Cambridge.

Fig. 7.—*D. testudinea* (?), Scouler. Tail. B. M., 59541, No. 30. (Page 150.)

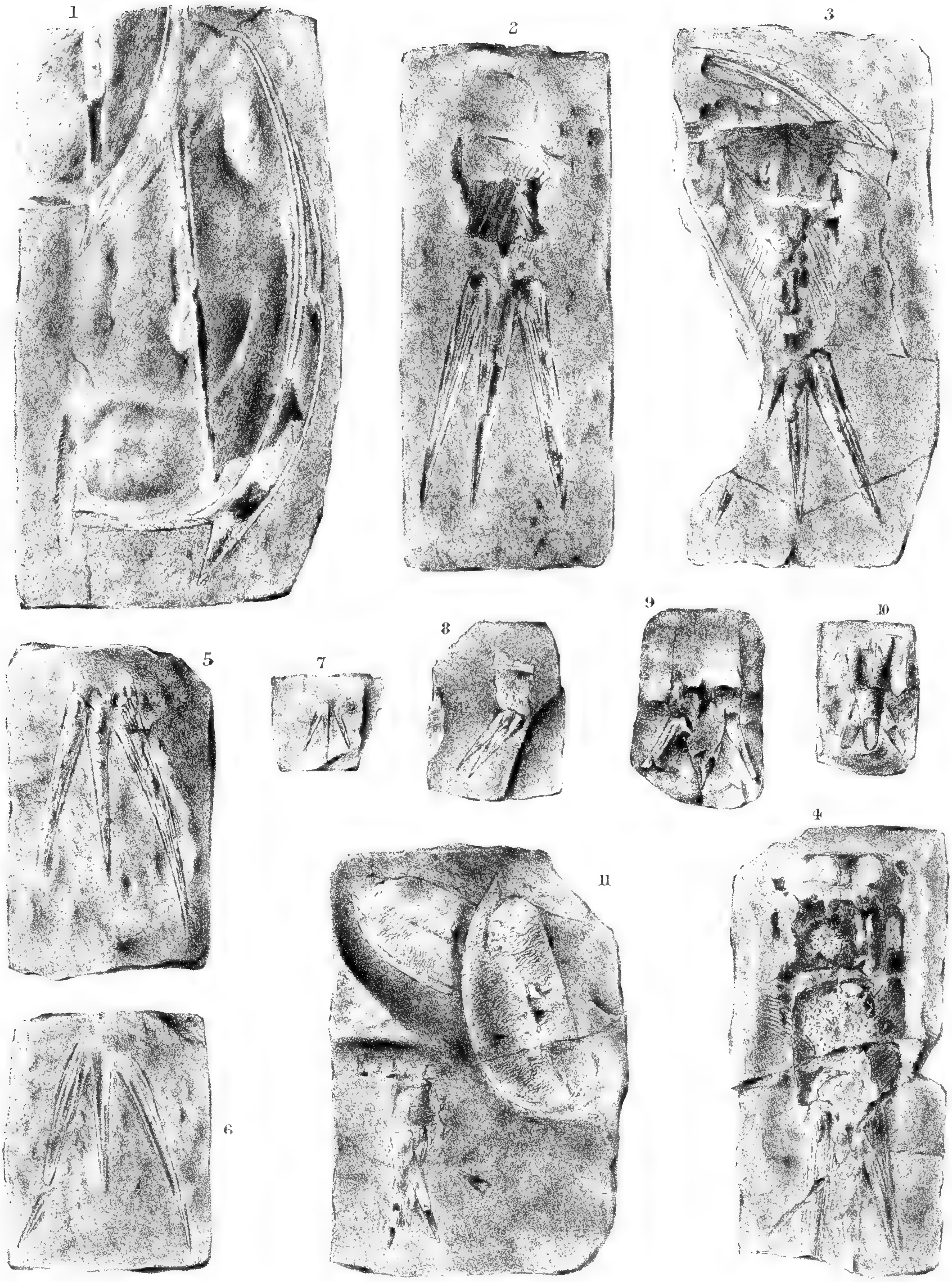
Fig. 8.—*D. testudinea*, Scouler. Tail. B. M., Rankin, No. 29. (Page 151.)

Fig. 9.—*D. Dunnii*, sp. nov. Tail. Dunn Coll., $\frac{28}{6}$.

Fig. 10.—*D. Dunnii*, sp. nov. Tail. Dunn Coll., $\frac{28}{1}$.

Fig. 11.—*D. glabra*, W. & E. Two displaced valves and a tail. M. Sc. A. Edinb., 1886, 91, 1, No. 5. (Page 140.)

PLATE XXIII



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BRITISH FOSSIL PHYLLOPODA.

PLATE XXIV.

(All the figures are of the natural size).

Fig. 1.—*Dithyrocaris tricornis*, Scouler. Carapace and abdominal segments. Mus. Geol. Surv. Scotl., F $\frac{22}{12}$, No. 14. (Page 171.)

Fig. 2.—*D. Colei*, Portlock. Carapace, imperfect. (The type.) Mus. Pract. Geol. 6263, $\frac{36}{8}$. (Page 165.)

Fig. 3.—*D. orbicularis*, Portlock. Carapace, crushed. (The type.) M. P. G., 6266, $\frac{36}{11}$. (Page 168.)

Fig. 4.—*D. Colei*, Portlock. Right moiety or valve. M. P. G., 6262 (part). (Overlapping fig. 1, Pl. XXIII.) (Page 166.)

Fig. 5 *a*.—*D. tricornis*, Scouler. Carapace of small individual. M. G. S. Sc., F $\frac{22}{9}$, No. 9. (Page 174.)

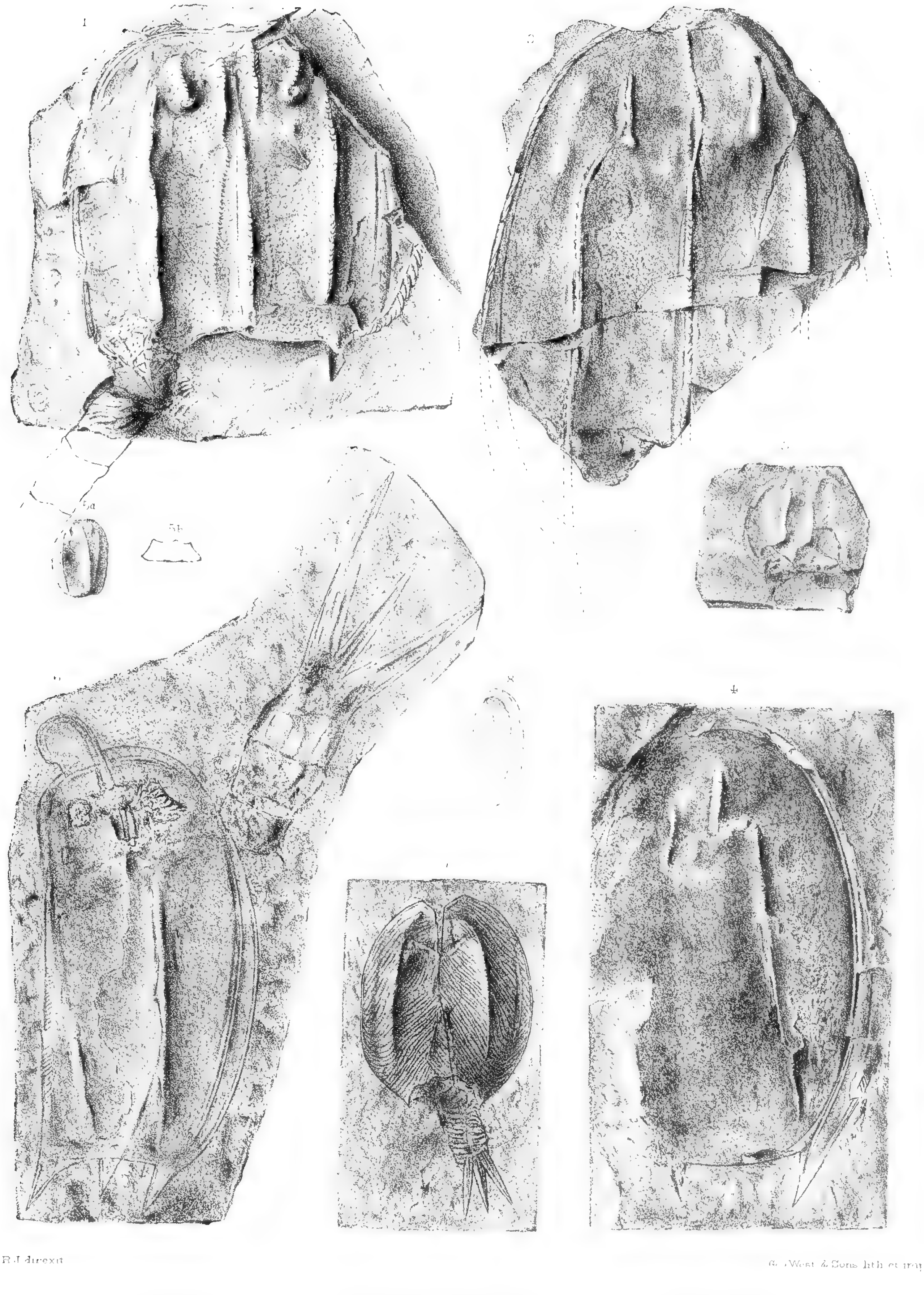
Fig. 5 *b*.—The same. End view in outline.

Fig. 6.—*D. tricornis*, Scouler. Folded and compressed carapace and tail. (The type.) Mus. Tech. Coll. Glasgow. (Page 172.)

Fig. 7.—*D. testudinea*, Scouler. Carapace, abdominal segments, and tail. (The type.) Mus. Tech. Coll. Glasgow. (Page 146.)

Fig. 8.—*Chænocaris tenuistriata*, M'Coy, sp. Right valve. (The type.) Copied from M'Coy's 'Carb. Fossils Ireland,' pl. xxiii, fig. 3.

PLATE XXIV.



T. R. J. direxit

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BRITISH FOSSIL PHYLLOPODA.

PLATE XXV.

Fig. 1.—*Dithyrocaris glabra*, W. & E. Part of the dorsal ridge of one of two valves. × 2½. B. M., 59541, No. 6. (Page 139.)

Fig. 2.—*D. glabra*, W. & E. Part of the dorsal ridge of the left valve. × 2½. B. M., 59541, No. 8. (Page 139.)

Fig. 3 *a*.—*D. insignis*, sp. nov. Part of right valve among displaced fragments of two valves. Mus. Leeds Coll. × 2½. (Page 159.)

Fig. 3 *b*.—The same. Part of the surface. × 10.

Fig. 3 *c*.—The same. Part of the surface. × 50.

Fig. 4 *a*.—Possibly from the same specimen. Part of a dorsal ridge. × 3.

Fig. 4 *b*.—The same. Part of its surface. × 10.

Fig. 4 *c*.—The same. Outline of its elevation. × 10.

Fig. 4 *d*.—The same. Part of its surface. × 10.

Fig. 4 *e*.—The same. Part of its surface. × 50.

Fig. 5 *a*.—Probably from the same specimen. Fragment of a valve. × 10.

Fig. 5 *b*.—The same. Part of its surface. × 50.

Fig. 6 *a*.—*D. Scouleri*, M'Coy. Carapace and tail. Copied from M'Coy's 'Carb. Foss. Ireland,' pl. xxiii, fig. 2. (Page 155.)

Fig. 6 *b*.—The same. } Parts of the ridges.
Fig. 6 *c*.—The same. }

Fig. 7.—*D.* sp. (?). From a plaster cast. Griffith Coll. Dublin. (Page 157.)

Fig. 8 *a*.—*Hibbertia orbicularis*, gen. and sp. nov. × 2. (Burdiehouse.)

Fig. 8 *b*.—The left-hand postero-ventral angle. × 5.

Fig. 9 *a*.—*D. Colei* (*?*) vel *tricornis* (*?*). A separate dorsal ridge. M. G. S. Sc., F $\frac{xx}{5}$, No. 20. (Page 175.)

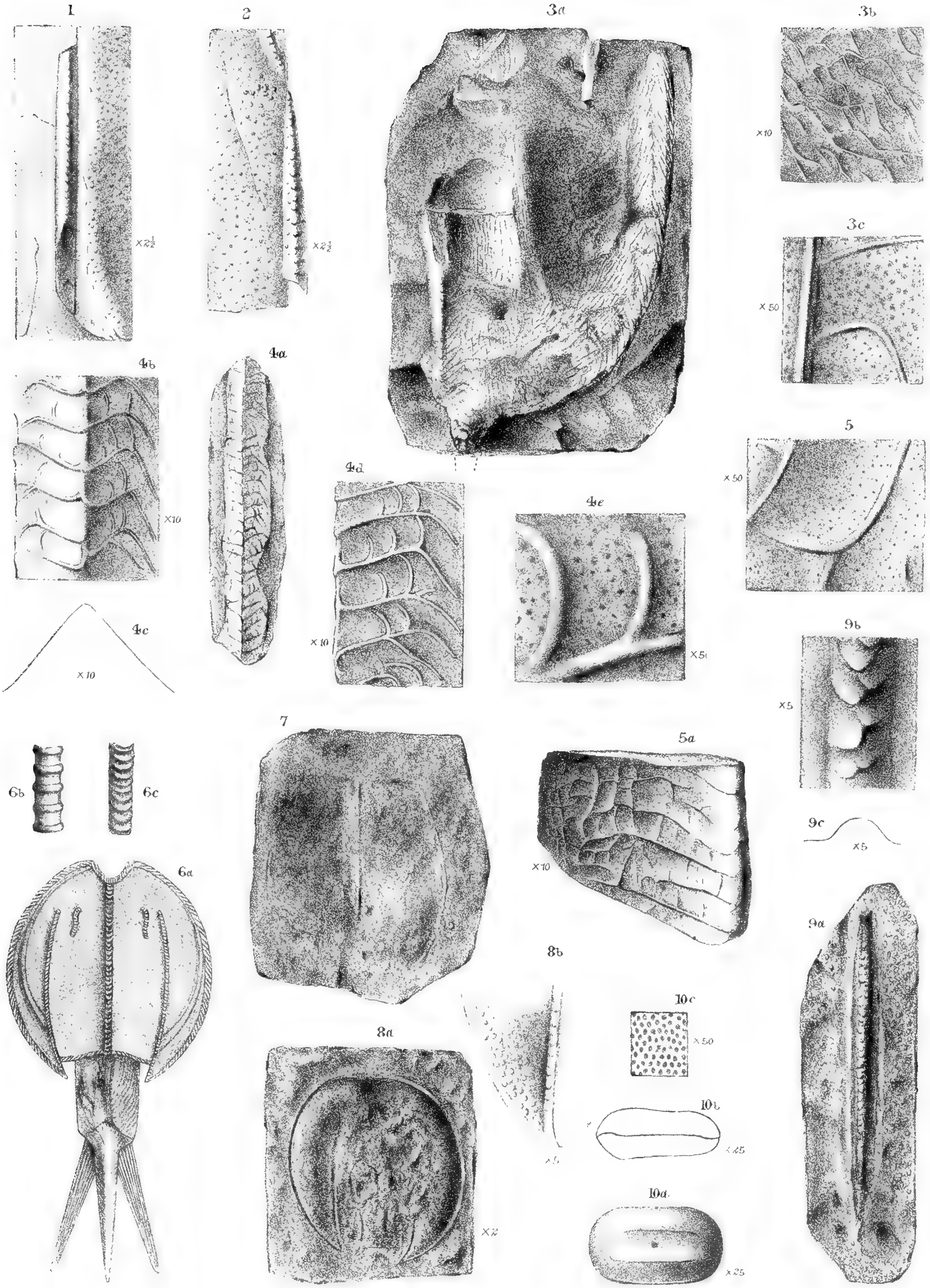
Fig. 9 *b*.—The same. Part of its surface. × 5.

Fig. 9 *c*.—The same. Outline of its elevation. × 5.

Fig. 10 *a*.—*Kirkbya plicata*, J. & K. Carapace, showing the right valve. × 25. On the same specimen with fig. 9. (Page 175.)

Fig. 10 *b*.—The same. Dorsal view. × 25.

Fig. 10 *c*.—The same. Part of the surface. × 50.



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BRITISH FOSSIL PHYLLOPODA.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

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MDCCCXCVIII.

A MONOGRAPH

OF THE

BRITISH CARBONIFEROUS LAMELLIBRANCHIATA.

BY

WHEELTON HIND, M.D., B.S.Lond., F.R.C.S., F.G.S.

MEMB. SOC. GEOL. BELGIUM.

PART III.

NUCULIDÆ, TRIGONIDÆ, UNIONIDÆ, EDMONDIDÆ.

Pages 209—276; Plates XVI—XXV.

LONDON:

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1898.

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Genus CTENODONTA, *Salter*, 1851.

TELLINOMYA, *Hall*, 1847. Nat. Hist. New York, Pal., vol. i, p. 151.
CTENODONTA, *Salter*, 1851. Rep. Brit. Assoc. for 1851 (1852), Sect. p. 64.
LEDA, *de Ryckholt*, 1853. Mél. Paléontol., partie ii, p. 146.
CTENODONTA, *Salter*, 1859. Geol. Surv. Canada, dec. 1, p. 34.
— *Murchison*, 1851. Siluria, edit. 2, pp. 213 and 546.
Non — *Salter*, 1864. Mem. Geol. Surv., Geol. around Oldham, p. 65.
— — 1866. Mem. Geol. Surv. Gt. Brit., vol. iii, p. 345.
— pars, *Bigsby*, 1878. Thesaurus Devonico-carboniferus, p. 303.
— *Barrois*, 1882. Terr. anciens Asturias et Galice, p. 339.
TELLINOMYA, *de Koninck*, 1885. Ann. Mus. d'Hist. Nat. Belge, tom. xi, p. 138.
CTENODONTA, *Œhlert*, 1888. Bull. Soc. Géol. France, ser. 3, vol. xvi, p. 653.
TELLINOMYA, *Miller*, 1889. North Amer. Geol. and Pal., p. 514.
CTENODONTA, *Beushausen*, 1895. Abh. k. Preuss. Geol., Landesanstalt, neue Folge, Heft 17, p. 65.
— *Whidborne*, 1896. Devonian Fauna, vol. iii, pt. 1, p. 98.
— *Tornquist*, 1896. Das fossilführende Untercarbon in den Süd-Vogesen, pt. 2, p. 74.

Generic Characters.—Shell more or less transverse, ovate; surface smooth, or with regular concentric lines. Hinge consists of a long row of teeth, which become smaller as they approach the centre from either extremity; there is no cartilage-pit below the umbo separating the teeth into an anterior and a posterior set. Pallial line entire.

Observations.—At p. 177 of this Monograph I gave an account of the synonymy of Salter's genus *Ctenodonta*, showing it to be, without doubt, synonymous with *Tellinomya* of Hall, which clearly antedates Salter's name. Following Œhlert, Whidborne, Beushausen, and Tornquist (*op. sup. cit.*), I have adopted *Ctenodonta* in preference to *Tellinomya*, considering the latter name to have been already used for a genus of Lamellibranchs by Brown, who spelt it *Tellimya;* but Agassiz in 1846, considering the orthography incorrect, altered it to *Tellinomya.* It is satisfactory to be able to discard a name which conveys such a very erroneous idea of the generic affinities of the genus for which it was proposed. Although from external characters alone it is impossible to separate shells of this genus from *Nucula;* the hinge is very different, the muscle-scars not so pronounced or so low down, and the accessory scars are absent. At present I am able to recognise only one species in Great Britain, but this occurs pretty abundantly at Congleton Edge, Cheshire, with the peculiar fauna to which I have already drawn attention, *antea*, p. 93.

De Koninck describes two species from the Carboniferous rocks of Belgium, under the name *Tellinomya; C. sinuosa*, de Ryckholt, sp., and *C. pusilla.* The latter species is founded upon a single valve, but both forms are from the same locality and horizon, "Calc-schiste" of Tournai.

Barrois has described one species of this genus from the Carboniferous beds of the Asturias and Gallicia, Spain, under the name *C. Halli*, but this species seems to me to be identical with that described by de Ryckholt and de Koninck.

CTENODONTA SINUOSA, *de Ryckholt*, sp., 1853. Plate XVIII, figs. 1—6.

LEDA SINUOSA, *de Ryckholt*, 1853. Mélanges Pal., pt. 2, p. 151, pl. xvii, figs. 5, 6.
CTENODONTA SINUOSA, *Bigsby*, 1878. Thesaurus Devonico-carboniferus, p. 303.
— HALLI, *Barrois*, 1882. Recherches Terr. anciens des Asturias et de Galice, p. 339, pl. xvii, figs. 2 *a*—*c*.
TELLINOMYA SINUOSA, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belge, tom. xi, p. 139, pl. xxv, figs. 24, 25; pl. xxvi, figs. 22—29, and 42.

Specific Characters.—Shell of moderate size, transversely ovate, moderately convex, produced posteriorly. The anterior side comprises about one-third of the valve, and is regularly swollen, much deeper in a dorso-ventral direction than the posterior end, which is compressed, narrowed, and produced. The anterior border is regularly rounded, passing with a continuous curve into the inferior, which is convex, especially in front, and produced. The posterior border is very short, bluntly pointed, narrowed by the approximation of the ventral border and the hinge-line. The latter is very slightly arcuate, and produced posteriorly. The umbones are small and inconspicuous, contiguous, not elevated, only limited in front; elsewhere they are continuous with the general convexity of the valve. They are situated at the junction of the anterior and middle thirds of the valve. Commencing at the apex of the umbo a narrow ridge passes backwards, almost parallel with the hinge-line, forming with that of the opposite valve a well-marked escutcheon. The valve is regularly convex from before backwards, and above downwards, the point of greatest convexity being midway between the umbo and the ventral border.

Interior.—The anterior adductor muscle-scar is round, large, deep, and situated just within the margin at the anterior-superior angle. The posterior is pear-shaped, situated within the posterior slope, remote from the border, with a deep, elongate, narrow, accessory scar between it and the upper border. The hinge-plate consists of an anterior set of about six teeth, triangular in shape, with the apices directed backwards, and which gradually become smaller as they approach the umbo; the teeth in the posterior set are much more numerous, at times as many as twenty-four, situated with their angles pointing forwards, and becoming gradually smaller as they approach the umbo, where they are very minute and crowded. There is no gap between the two sets, or any internal socket for the cartilage. The umbones are much hollowed out, so that casts of them are acutely pointed, much more so than the shell itself. The pallial line is entire and inconspicuous.

Exterior.—The surface is ornamented with numerous regular concentric lines, separated by bands of very fine striæ.

Dimensions.—Fig. 2, Pl. XVIII, a cast, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	12 mm.
Laterally	8 mm.

Locality.—England: in Calcareous Bullions and Shale below the Third Millstone-grit, Congleton Edge, Cheshire.

Observations.—This species was described by de Ryckholt as *Leda,* and subsequently by de Koninck as *Tellinomya sinuosa.* I have examined the specimens in the type collection at the Royal Natural History Museum, Brussels, and have no doubt as to the identity of the British specimens. I have been fortunate enough to obtain some beautiful impressions of the hinge-teeth in casts, one of which I figure, Pl. XVIII, fig. 1 *a*, which at once shows the absence of the cartilage-pit between the anterior and posterior sets of teeth, which is present in all the Carboniferous species of Nucula and Nuculana.

Externally the species somewhat resembles *Nucula lævirostrum*, Pl. XV, figs. 34—38, but I think that I have satisfied myself of the presence of the internal cartilage-pit in this species; nor does it possess the escutcheon, in the anterior part of which probably was lodged the external ligament which is said to be present in *C. sinuosa.*

De Koninck states that his specimens were obtained from the "calschiste" of Tournai, which is considered to be near the base of the Carboniferous rocks of Belgium. My specimens, curiously, are from an horizon presumably far higher, occurring as they do in calcareous shales some little distance below the Third Millstone-grit, the Fourth and Fifth grits not extending so far south, but dying out a few miles north of Congleton Edge. The fossiliferous bed is situated upon a thick bed of quartzose, gannister-like sandstone with plant remains, and has been described at p. 93 of this Monograph; though the present species is not included in the list, having been only obtained, with several other species new to the horizon, since that part of the work was published. I cannot see any real difference between *C. Halli* of Barrois and *C. sinuosa.* Though de Koninck says (p. 139), "*La Tellinomya* (*Ctenodonta*) *Halli*, C. Barrois, du terrain carbonifère d'Espagne, est à peu près la seule espèce de cette formation qui ait une certaine ressemblance avec celle que je viens de dècrire ; elle en diffère par sa taille, qui est plus grande, par la forte dépression de son côté postérieur, par allongement de sa charnière et la régularité plus grande des deux séries de ses dents cardinales." These differences do not exist, for De Koninck describes the posterior end of *C. sinuosa* as "rétrécie et prolongée en pointe émoussée en arrière;" the length of the hinge depends on the size of the specimen, and the teeth are always regular. A comparison of the figures given by de Koninck and Barrois respectively does not afford a single point for differentiation of the species.

Family TRIGONIDÆ.

Genus SCHIZODUS, *King*, in *De Verneuil*, 1845.

TELLINITES, *Schlötheim*, 1816. Acad. Münch., vol. vi, p. 31.
— — 1820. Petrefactenkunde, p. 189.
AXINUS, *Sowerby*, 1821. Min. Conch., vol. iv, p. 12.
ISOCARDIA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209.
AXINUS, *Rhind*, 1838. The Age of the Earth, p. 167.
DONAX ?, *Sowerby*, 1840. Geol. Coalbrookdale (explan. of plates).
VENUS ?, *Sowerby*, 1840. Ibid.
CUCULLÆA, *Geinitz*, 1841. Neues Jahrbuch, p. 138.
AXINUS, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 80.
ISOCARDIA, *Morris*, 1843. Ibid., p. 88.
PACHYODON, *Brown*, 1843. Ann. Mag. Nat. Hist., vol. xii, p. 396.
Non AXINUS, *M'Coy*, 1843. Carb. Foss. Ireland, p. 63.
CARDIOMORPHA (pars), *M'Coy*, 1843. Ibid., p. 56.
CUCULLÆA, *Geinitz*, 1843. Gaea von Sachsen, p. 96.
SCHIZODUS, *King*, 1844. Ann. Mag. Nat. Hist., p. 313 (*nomen nudum*).
— *de Verneuil*, 1845. Pal. de Russie, vol. ii, p. 308.
— *Howse*, 1848. Trans. T. N. F. C., vol. i, p. 246.
— *Geinitz*, 1848. Versteinerungen Zechsteingebirges, p. 8.
ISOCARDIA, *Brown*, 1849. Illust. Foss. Conch., p. 197.
UNIO (pars), *Brown*, 1849. Ibid., p. 178.
CARDIOMORPHA (pars), *d'Orbigny*, 1850. Prodrome de Paléont., p. 133.
SCHIZODUS, *King*, 1850. Monog. Permian Foss., p. 185.
AXINUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 188.
MYOPHORIA, *M'Coy*, 1855. Brit. Pal. Foss., p. 495.
SCHIZODUS, *Eichwald*, 1856. Bull. Soc. Imp. Nat. Moscou, tome xxix, 2e partie, p. 134.
AXINUS (SCHIZODUS), *Meek and Hayden*, 1858. Proc. Acad. Nat. Sci. Phil., p. 262.
SCHIZODUS, *Eichwald*, 1860. Lethæa Rossica, vol. i, p. 997.

SCHIZODUS, *Salter*, 1860. Trans. Royal Soc. Edin., vol. xxii, p. 385.
— — 1861. Mem. Geol. Surv. Gt. Brit., "Iron Ores Gt. Brit.," pt. 3, pl. i, fig. 30, p. 221.
CYPRICARDIA ?, *Swallow*, 1862. Trans. St. Louis Acad., vol. i, p. 96.
SCHIZODUS, *Meek and Worthen*, 1865. Proc. Acad. Nat. Sci. Phil., p. 457.
— *Meek and Hayden*, 1865. Pal. of Upper Missouri, p. 58.
— *Meek and Worthen*, 1866. Proc. Chicago Acad. Nat. Sci., vol. i, p. 18.
— — — Geol. Surv. Illinois, vol. ii, p. 301.
— *Geinitz*, 1866. Carbon und Dyas in Nebraska, p. 18.
— *Meek and Worthen*, 1870. Proc. Acad. Nat. Sci. Phil., p. 41.
— *Stoliczka*, 1881. Pal. Indica Cret. Faun., vol. iii, p. 309.
Non — *Meek*, 1871. Proc. Acad. N. Sci. Phil., p. 165.
„ AXINUS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Appendix, p. 49.
SCHIZODUS, *Meek and Worthen*, 1873. Geol. Surv. Illinois, vol. v, p. 579.
— *White*, 1875. Rep. Exp. W. of 100th Merid., vol. iv, p. 154.
— *Meek*, 1875. Rep. Geol. Surv. Ohio, vol. ii, pt. 2, p. 336.
— *R. Etheridge, jun.*, 1875. Ann. Mag. Nat. Hist., ser. 4, vol. xv, p. 431.
AXINUS (pars), *Young and Armstrong*, 1876. Carb. Foss. W. of Scotland, p. 53.
SCHIZODUS, *R. Etheridge, jun.*, 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 15.
— *Bigsby*, 1878. Thesaurus Devonico-carboniferus, p. 311.
— *Barrois*, 1882. Terr. anciens des Asturias et de la Galice, p. 341.
— *White*. U.S. Geol. Surv. Indiana, 13th Ann. Rep., p. 147.
— *Walcott*, 1884. Mon. U.S. Geol. Surv. Pal. Eureka District, p. 252.
— *Fischer*, 1887. Manuel de Conch., p. 995.
— *Waagen*, 1887. Pal. Indica, ser. xiii, vol. i, "Salt Range Fossils," p. 230.
— *Etheridge*, 1888. Brit. Foss., vol. i, Palæozoic, p. 290.
— *Miller*, 1889. N. Amer. Geol. and Pal., p. 510.
— *Ward*, 1890. Trans. N. Staff. Inst. Min. and Mech. Eng., vol. x, p. 131.
— *Worthen*, 1890. Geol. Surv. Illinois, vol. viii, p. 107.
NUCULA, sp., *Wild*, 1891. Trans. Manch. Geol. Soc., vol. xxi, pl. ii, fig. 3.
SCHIZODUS, *Miller*, 1891. Geol. Surv. Indiana, 17th Ann. Rep., p. 91.
— *Whitfield*, 1893. Rep. Geol. Surv. Ohio, vol. vii, p. 474.
— *Wöhrman*, 1894. Jahrbuch k. k. Geol. Reichsanstalt, Band xliii, p. 7.
— *Keyes*, 1894. Missouri Geol. Surv., vol. v, pt. 2, p. 123.

Generic Characters.—Equivalve, inequilateral, the posterior side produced. Ovate, trigonal, gibbose. The hinge consists of three teeth in each valve, 1 : 1 : 1, those of the right valve being anterior to those in the left. Adductor muscle-scars well marked but shallow. Pallial line entire.

Surface smooth, or with fine concentric parallel lines, which have the same contour as the margins.

Observations.—Professor King, as early as 1844 (*op. supra cit.*), stated that he proposed to institute the generic term "*Schizodus* for the Permian and Carboniferous Axinuses, to distinguish them from the London Clay *Axinus angulatus*."

Neither description nor figures were given, and the first published diagnosis and description was given by de Verneuil in his work on the 'Paléontologie de la Russie,' who acknowledged that he had had the opportunity of perusing the MS. of King's 'Monograph on the Permian Fossils,' in which volume a full and detailed account of the genus was to appear. The generic name Schizodus must, therefore, date from de Verneuil's work; but as he himself distinctly states that he has used King's MS. account, I have quoted the author as King in de Verneuil.

In a foot-note on p. 185 of his work King stated that he considered the *Sedgwickia gigantea* of M'Coy to be a species of *Schizodus;* but I think he was wrong in this case. He also stated that a large number of shells classed under six different genera by M'Coy were referable to his new genus; these, however, I now refer to *Protoschizodus.*

Sowerby included under his genus *Axinus* two very different shells,—*A. angulatus* from the London Clay, and *A. obscurus* from the Permian; the former had an edentulous hinge, and the latter was shown by King to possess well-marked hinge-teeth, so that there was little or no doubt of the wisdom of erecting a new genus for shells possessing the latter characters; Axinus being now classed in the family Ungulinidæ, Schizodus in the Trigonidæ.

Professor King described the hinge of Schizodus as consisting of two smooth cardinal teeth in the right valve, with three in the left, those of the latter being placed in front of those in the right valve. With this description I am not able entirely to agree, for I find in the best preserved and full-grown specimens that there are three distinct teeth in each valve, only one of which, however, is really a cardinal tooth, the anterior and posterior teeth in each valve being lateral teeth; and that, in direct opposition to King's statement, the teeth of the right valve are always in front of those in the left. This misstatement is fully accounted for by the non-discovery of the anterior tooth of the right valve, for in every other detail the figures of the hinges given in the 'Monograph of Permian Fossils,' pl. xv, fig. 29, are very fairly accurate.

The anterior tooth in the right valve is sessile, and the least apparent of any, being only a thickening of the edge of the hinge-plate (Pl. XVI, fig. 2), but the cardinal tooth of the left valve is the larger, and is comparatively thick, and there is not room enough to receive it in the small hollow between the anterior and cardinal teeth of the right valve; and these two teeth are connected in the right valve by a plate of shell, while the tooth-cavity posterior to the cardinal tooth is large and perfectly free. These details are well shown in a right valve of *S. Pentlandicus*, from Woodhall, Water of Leith (fig. 2, Pl. XVI), and a left valve of *S. Harii*, Miller, from the Upper Coal-measures of Kansas (fig. 1 *a*, Pl. XVI), which

I figure here as it is a large shell, and consequently possesses all the details of the hinge on a large scale; the formula being $\frac{\mathrm{L}\ 010101}{\mathrm{R}\ \ 10101}$ from before backwards.

Waagen says (*op. sup. cit.*), p. 232, " In the right valve the posterior cardinal tooth is generally very small and firmly adpressed to the hinge margin, superseded by a not long but very distinct fulcrum. Anteriorly the hinge margin is somewhat thickened, forming an indistinct third anterior cardinal tooth." In the left valve he describes the three teeth, but states that the cardinal tooth is not always bifid.

De Verneuil (*op. supra cit.*) described only two hinge-teeth in each valve—an error which King pointed out.

De Ryckholt ('Mélanges paléontologiques,' partie ii, p. 79) places Schizodus as a synonym of Dolabra, M'Coy, the hinge of which genus as described by M'Coy consists of " two long diverging cardinal teeth, and two lengthened posterior lateral teeth." M'Coy was of opinion that Schizodus of King was identical with Myophoria, Bronn, from the Muschelkalk, and there is no doubt that the two genera are closely allied. In Myophoria, however, the cardinal teeth are striated, and the anterior adductor muscle is situated upon an elevated prominence, and the surface is ornamented with radiating ribs—characters absent in Schizodus. King, however, seems to have been quite aware of the close similarity of these two genera.

The affinities of the genus *Myophoria* have been discussed by Neumayer, Frech, and others. Their views are discussed in detail by S. Frh. v. Wöhrman in vol. xliii, 1893, of the 'Jahrbuch der k.k. Geol. Reichsanstalt.' He describes the hinge of the left valve of Myophoria as having three teeth; the posterior, commonly long and short, may become short and blunt, and almost entirely disappear in the posterior edge of the valve. The cardinal tooth strongly, slightly, or not at all bifid on its articular surface; and the anterior tooth formed by a narrow thickening of the hinge-plate, which may become strongly developed, and in front of which is a tooth-socket. The hinge of the right valve possesses as a rule two teeth, the posterior, either long and narrow or short and thick; the cardinal tooth always rises below the umbo, and is directed forwards: there is also at times an anterior tooth on the anterior edge, well marked in *M. truncata*, Goldfuss.

It is at once evident that the hinge as here described is identical with those which I figure (Pl. XVI, figs. 1 and 2) as *Schizodus Harii* and *S. Pentlandicus.* When discussing the affinities of Schizodus, v. Wöhrman remarks on the difficulty of distinguishing this genus from Myophoria. He says the tooth formula may be the same in both, but the chief difference in Schizodus is its possession of a deeply bifid Trigonia-like tooth in the left valve. Waagen (' Pal. Indica,' ser. 13, vol. i, " Salt Range Fossils ") appears to have considered that the absence of the muscle ridge, the greater distance of the muscle from the hinge, and the opisthogyrous umbo were not always characteristic of the various forms described as Schizodus, and suggests that probably many species have been erroneously classed in this genus. Von Wöhrman sums up his remarks by stating that it is very questionable whether the genus Schizodus can be retained under the circumstances. Waagen, who admits both Schizodus and Myophoria, says (*op. sup. cit.*, p. 232), "Myophoria is, indeed, very nearly allied to Schizodus; the cardinal teeth in both valves are perfectly identical, and the only point of difference consists in a more or less strongly developed internal ridge surrounding the anterior muscular impression at its upper extremity, and extending from them a short way up towards the apex of the valves. Also in *Schizodus* a certain tendency exists to develop internal ridges inside the valves, but they are mostly posterior." This author traces the descent of Myophoria through Schizodus and through Curtonotus to Pseudaxinus, with its thin shell and slightly developed cardinal apparatus.

Waagen shows that in the Salt Range fossils there are certain forms which are intermediate in character between Schizodus and Myophoria, which are themselves only separated by very minor differences.

Beushausen ("Die Lamellibranchiaten des Rhein'schen Devon," 'Abhandlung. Preuss. Geol. Lands.,' neue Folge, Heft 17, 1895) refers the Trigonidæ of the Devonian to Myophoria, and agrees with Frech that these Devonian shells show a closer resemblance to Myophoria than to the Permian Schizodus. From this it would appear that Beushausen admitted both genera.

Fleming in 1828 ('British Animals,' p. 426) described a new shell from shale connected with Carboniferous Limestone as *Corbula limosa*, which may perhaps have been a specimen of one of the species of Schizodus; but as no figures were given, and the description is very meagre, we cannot be at all certain of what shell is referred to. The description is "transversely subtriangular and longitudinally heart-shaped, beaks gibbous, surface slightly striated by layers of growth, shell thin."

De Koninck in 1885 erected the genus Protoschizodus for certain shells which had been referred to Schizodus by King and others; this was on account of the marked difference in the hinge-characters, the left valve having two cardinal teeth, the right valve one. The general shape of the shell, too, differs from that of Schizodus, being more regularly triangular and compressed.

Many of the British species hitherto placed under Schizodus belong to the Protoschizodus of de Koninck, and I have only retained four species in the former genus. The distribution and the nature of the deposits in which these four species are found are of interest. Never found in pure limestone, they all occur in shales or impure concretionary or argillaceous limestones; one, *S. Pentlandicus*, seems to be peculiar to the Calciferous Sandstone series. *S. axiniformis* has the greatest vertical and horizontal range, being found in the Redesdale Ironstone and in the

Coal-measures of Coalbrookdale. *S. carbonarius* seems limited to the Coal-measures of Coalbrookdale and South Wales, while *S. antiquus* characterises the marine conditions of the Upper Carboniferous division of British rocks, taking the top of the Carboniferous Limestone in Derbyshire, the top of the Yoredale series of Wensleydale, and the top of the Carboniferous Limestone series of Scotland as the upper limit of the lower division. The shaley nature of the deposits in which the species of Schizodus occur probably points to their habitat having been near the mouth of a large river, and possibly at no great depth, but I am not clear as to whether they burrowed in the soft muddy ooze or not.

SCHIZODUS PENTLANDICUS, *Rhind*, sp., 1838. Plate XVI, figs. 2—9.

AXINUS PENTLANDICUS, *Rhind*, 1838. Age of the Earth, p. 167, pl. ii, figs. *a*, *b*.
PACHYODON PYRAMIDATUS, *Capt. T. Brown*, 1843. Ann. Mag. Nat. Hist., vol. xii, p. 396, pl. xvi*, fig. 9.
UNIO PYRAMIDATUS, *Capt. T. Brown*, 1849. Foss. Conch., p. 179, pl. lxxiii, fig. 19.
MYOPHORIA CARBONARIA, *M'Coy*, 1855. Brit. Pal. Foss., p. 495.
SCHIZODUS, sp. (*Salter*), *Rev. T. Brown*, 1861. Trans. Roy. Soc. Edin., vol. xxii, p. 392, figs. 1—3.
— SALTERI, *R. Etheridge, jun*, 1875. Ann. Mag. Nat. Hist., ser. 4, vol. xv, p. 431, pl. xx, figs. 6—9.
— — — 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 16.
— — *Bigsby*, 1878. Thesaurus Devonico-carb., p. 311.
— — *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 290.

Specific Characters.—Shell inequilateral, subquadrate, convexly swollen, especially in the umbonal region. The anterior margin is rounded, and passes with a semicircular curve into the inferior border, which is gently convex downwards. The posterior margin is a little shorter than the anterior, being narrowed by the convergence of the upper and lower margins; it is obliquely truncate from above downwards and backwards, making bluntly rounded, slightly obtuse angles with the hinge-line and ventral margin respectively. The upper border consists of two portions, which slope rapidly upwards from each extremity to meet in the region of the umbo at an acute angle.

The umbones are large, tumid, situated in the anterior third of the upper border, pointed, incurved, contiguous, and pointed very slightly forwards. The valves are very convexly swollen in the umbonal region, and curve rapidly downwards to the ventral margin. In front the umbonal swelling is only marked off from the rest of the valve at the anterior-superior angle; the convexity of the anterior portion of the valve is very steep. Posteriorly, an obtusely rounded obliquely diagonal ridge passes from the extreme apex of the umbo downwards and backwards to the posterior-inferior angle, becoming obsolete in its lower third; above and posterior to this ridge the valve is rapidly compressed, so that the posterior slope becomes slightly concave.

Interior.—The anterior adductor muscle-scar is situated immediately within the antero-superior angle of the valve, and is oval; that of the posterior adductor, somewhat larger, is situated near the upper margin of the valve, some little distance from the posterior border. The pallial line is entire and well marked, submarginal. An internal ridge extends obliquely from the umbonal cavity to the postero-inferior angle.

The Hinge.—Right valve: There is a small and almost obsolete anterior tooth, being simply a thickening of the edge of the valve, directed obliquely downwards and forwards. The cardinal tooth is thin above and swollen below, inclined forwards and downwards. The posterior tooth is long, separated from the margin by a shallow elongate furrow. On either side of the cardinal tooth is a deep, obliquely delta-shaped hollow.

Left valve: The anterior tooth is small, not elongate, projecting backwards. The cardinal tooth is prominent, massive, thicker below and above, and inclined obliquely backwards and downwards, obscurely bifurcate, or with its ventral margin concave below. The posterior lateral tooth is elongate and almost horizontal. When the valves are in apposition the teeth of the right valve are severally anterior to the corresponding teeth of the left.

Exterior.—The surface is ornamented with regular, close, fine, concentric striæ and lines of growth, which become more rugose towards the lower margin.

Dimensions.—Fig. 6, Pl. XVI, measures—

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

Localities.—Scotland: Fifeshire, Ardross Limestone, Ardross, base of Lower Carboniferous Limestone group. Cambo Ness, Kingsbarns; Limestone No. 5, Randerstone. In a 2-foot limestone east of the Target, Billowness, between Pittenween and Anstruther, Fifeshire (zone 12 of Mr. Kirkby); Wardie Shale group, Woodhall, Water of Leith,—all in the Calciferous Sandstone series of Scotland. In a bed of impure limestone above the Cooper's-eye Coal, Scremerston, Northumberland.

Observations.—This species has been long recognised as occurring in the Lower Carboniferous beds of the east of Scotland, and has been alluded to by several authors. The fullest description of the species is that by R. Etheridge, jun., who gave it the specific name *Salteri.* The Rev. T. Brown had prior to this referred the shell, on the authority of Mr. Salter, correctly to the genus Schizodus (*op. sup.*

cit.). But prior even to this, and as early as 1838, Mr. W. Rhind had figured the shell, from specimens obtained at Woodhall, as *Axinus Pentlandicus*, and it is therefore a pity that Mr. Etheridge did not preserve the earliest specific name. Though there is no description there is little doubt as to the identity of Rhind's shells, as the locality is given; and though Etheridge doubts whether the two specimens figured by Rhind are of the same species, I am of opinion that they are, because I have seen numerous examples which appear as in the drawings, in neither of which is the correct outline of the shell shown, because specimens were evidently figured which were not perfectly free from the matrix.

Etheridge makes the following remarks on one of Rhind's types (*op. supra cit.*, p. 432), "One of these (fig. *b*) was afterwards refigured and described by Capt. T. Brown as *Pachyodon pyramidatus*, without any reference to Rhind's figure, and again as *Unio pyramidatus*. I am at present under the impression that Rhind's fig. *b* and Brown's *pyramidatus* are the same shell as the present species, which I have ventured to describe under the name of *S. Salteri*," &c., &c. It is therefore apparent on that author's own showing that his specific name cannot be retained, and I have therefore adopted Rhind's term *Pentlandicus* as the specific name; and indeed Mr. Etheridge goes on to say, "The posterior slope of *S. Salteri* is very frequently broken or crushed when the individuals bear a close resemblance indeed to the above shells, in which there is no slope figured, the posterior side consisting of a blunt acumination. If future investigation should prove them to be identical, Capt. Brown's specific name will have to be adopted." Apparently, therefore, Mr. Etheridge regarded Rhind's specific name as a *nomen nudum*.

I am inclined to believe that this species is of value as a zonal form, for it seems to be confined to Calciferous Sandstone series, and never to be present in the upper beds, which are characterised by the presence of *Productus giganteus*.

I have been fortunate enough to obtain very well-preserved examples of the hinge of this species from Randerstone, Fife, and from Woodhall, near Edinburgh.

The species is easily distinguished by its subquadrate posterior end and moderate gibbosity from *S. axiniformis*. It is relatively much more transverse and more compressed than *S. carbonarius*.

Schizodus axiniformis, *Phillips*, sp., 1836. Plate XVI, figs. 10—15; Plate XVII, figs. 1—6.

Isocardia? axiniformis, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 13.

Donax? sulcatus, *Sowerby*, 1840. Geol. Coalbrookdale, pl. xxxix, fig. 1 (explanation of plates).

Non AMPHIDESMA AXINIFORMIS, *Portlock*, 1843. Geol. Londonderry, p. 439, pl. xxxvi, fig. 6.
Non — — *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 77.
AXINUS SULCATUS, *Morris*, 1843. Ibid., p. 80.
ISOCARDIA AXINIFORMIS, *Morris*, 1843. Ibid., p. 88.
CARDIOMORPHA AXINIFORMIS, *M'Coy*, 1843. Carb. Foss. Ireland, p. 56.
Non AXINUS AXINIFORMIS, *M'Coy*, 1843. Ibid., p. 63.
— OBSCURUS?, *Brown*, 1849. Illust. Foss. Conch., p. 194, pl. lxxix, figs. 5, 6, 7.
ISOCARDIA AXINIFORMIS, *Brown*, 1849. Ibid., p. 197, pl. lxxx, fig. 6.
CARDIOMORPHA AXINIFORMIS, *d'Orbigny*, 1850. Prodrome de Paléont., p. 133.
AXINUS AXINIFORMIS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., 1854, p. 188.
— SULCATUS, *Morris*, 1854. Ibid., p. 189.
? SCHIZODUS CHESTERENSIS, *Meek and Worthen*, 1865. Proc. Acad. Nat. Sci. Phil., p. 457; Geol. Surv. Illinois, Palæontol., vol. ii p. 301, pl. xxiii, figs. 6 *a*, *b*.
? AXINUS AXINIFORMIS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Appendix, p. 49.
? — — — 1876. Cat. West-Scottish Fossils, p. 53.
SCHIZODUS SULCATUS, *Barrois*, 1882. Recherch. sur les Terr. Anciens des Asturias et de la Galice, p. 340.
— AXINIFORMIS, *R. Etheridge*, 1885. Brit. Foss., vol. i, Pal. p. 290.
— SULCATUS, *R. Etheridge*, 1885. Ibid.

Specific Characters.—Subtriangularly ovate, transversely produced, gibbose, inequilateral. The anterior end of the shell is generally convex below, but above it is compressed backwards into the umbones, and flattened, forming a cordate anterior surface, which is separated from the lateral surface of the valve by a rounded angular ridge, from the centre of which the prominent and raised anterior border projects. This border is elliptical, and it passes above and below into the hinge-line and lower border respectively without interruption. The inferior border is regularly but gently curved, with the convexity downwards. The posterior end is obtusely pointed, and its border obliquely truncated from above downwards, joining the lower border at a more or less marked acute angle. The hinge-line is short, curved, and its extent ill-defined.

The umbones are gibbose anterior to the middle line of the valve, elevated above the hinge-line, pointed, incurved, and directed forwards, non-contiguous, with an angulated border in front continuous with the outer edge of the anterior surface. Behind, the posterior border of the umbo is continued downwards as a rounded ridge to the postero-inferior angle; above this line the dorsal slope is depressed, compressed, and hollowed, so as to be concave in transverse section.

Interior.—The anterior adductor muscle-scar is oval, shallow and inconspicuous, and close to the margin. The posterior adductor scar is deeper, ovate, and situated in the hollow of the dorsal slope near the junction of the hinge-line and posterior margin. The pallial line is entire and remote from the margin. The hinge is apparently normal, but I have not been able to expose the whole of it in any one specimen. In casts, several obscure radiating sulci are to be seen on and anterior to the posterior umbonal ridge.

The ligament is external, small, and short.

Exterior.—The surface is adorned with regular, concentric, fine lines of growth, which are crowded in front, but soon become separated and equidistant, dividing the surface of the shell into a series of regular, equal, concentric bands, which are bent sharply at an acute angle along the line of the dorsal ridge; from this point they become linear, and terminate on the upper margin of the valve. Occasionally one of the concentric lines is accentuated, and becomes imbricate.

Dimensions.—Fig. 11, Pl. XVI, measures—

Antero-posteriorly	66 mm.
Dorso-ventrally	46 mm.
From side to side	36 mm.

Localities.—England: the Redesdale Ironstone, Lower Carboniferous, Northumberland; Pennystone Ironstone, Coalbrookdale Coal-measures; Rosser Vein, Cwm Bryn ddu, South Wales Coal-measures. Scotland: in Calcareous Sandstone, Garngad Road, Glasgow; Upper Limestone series.

Observations.—The original specimen on which Phillips founded his species *Isocardia? axiniformis* is stated to have come from Northumberland, though the exact horizon is not noted. The species occurs in abundance in the Redesdale Ironstone Shales. I am unable to differentiate the species described by Phillips from the *Donax? sulcatus* of J. de C. Sowerby, which I have placed as a synonym. King seems to have come to the same conclusion, for he states ('Monograph of Permian Fossils,' p. 185), "Mr. Prestwich kindly allowed me to examine the originals of Mr. Sowerby's species, and I find from my memoranda made at the time that *Donax? sulcatus* . . . is the *Isocardia axiniformis* of Phillips." I, too, have had the same privilege (the Coalbrookdale shells are now in the collection of the British Museum [Nat. Hist.], South Kensington), and have come to the same conclusion. The Coalbrookdale specimens are always in the form of casts, but fortunately a few testiferous examples occur at Redesdale. In the latter locality the shell reaches a much larger size than at Coalbrookdale, and examples occur in all stages of growth, which show that with increasing age the posterior end becomes more pointed and narrower, though there is some variation in contour to be seen in certain individuals.

M'Coy (*op. cit.*, p. 56) refers the *Isocardia axiniformis* of Phillips to *Cardiomorpha*, but he says of it, "This species much resembles an *Axinus* in its depressed hatchet-like form, and obliquely truncated compressed posterior side; the large incurved beaks, however, approximate it more to *Isocardia* or *Cardiomorpha*." This species is at once distinguished from the other Carboniferous forms by its produced and bluntly pointed posterior end, and by the regularity of its lines of growth.

It is probable that Young and Armstrong referred the name *Axinus axiniformis* to quite a different shell; as, from what I can observe, the species is rare in the West of Scotland.

SCHIZODUS CARBONARIUS, *Sowerby*, sp., 1840. Plate XVII, figs 7—9.

VENUS? CARBONARIA, *Sowerby*, 1840. Geol. Coalbrookdale, pl. xxxix, fig. 2.
Non — — (AMPHIDESMA), *Portlock*, 1843. Rep. Geol. Londonderry, p. 438, pl. xxxvi, fig. 8.
AMPHIDESMA CARBONARIA, *Morris*, 1843. Cat. Brit. Foss., p. 77.
— CARBONARIUM, *Brown*, 1849. Illust. Foss. Conch., p. 224, pl. xci, figs. 44, 45.
AXINUS CARBONARIUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 189.
Non MYOPHORIA CARBONARIA, *M'Coy*, 1855. Brit. Pal. Foss., p. 495.
SCHIZODUS CARBONARIUS, *Salter*, 1861. Mem. Geol. Surv. Gt. Brit., Iron Ores Gt. Brit., pt. 3, p. 221, pl. i, fig. 30.
Non AXINUS CARBONARIUS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Appendix, p. 50.
— — — 1876. Cat. West-Scottish Foss., p. 53.
SCHIZODUS CARBONARIUS (pars), *R. Etheridge*, 1888. Brit. Foss., vol. i, Palæozoic, p. 290.

Specific Characters.—Shell subquadrate, gibbose, inequilateral. The anterior portion is regularly swollen, its upper part compressed backwards and flattened to form an anterior surface, cordate in shape, bounded on each side by the anterior umbonal ridge, and slightly elevated in the middle line where the anterior margin of the valves projects forwards. The anterior border is regularly and convexly curved, passing into the hinge-line above and inferior border below without any break. The inferior border is convex downwards, the segment of a larger curve than that which forms the anterior edge of the valve. The posterior border is truncate, nearly straight, and slightly obliquely inclined from above downwards, making an obtuse angle with the hinge-line above and the inferior border below. The hinge-line is short, especially in front, and almost straight. The umbones are prominent, swollen, incurved, non-contiguous, raised above the hinge-line, and situated about the junction of the anterior and middle thirds of the valve. The anterior surface of the umbo is flattened, and from the posterior edge a bluntly rounded oblique ridge descends to the postero-inferior angle, which marks off the posterior slope from the rest of the valve. The lateral surface of the valves is regularly convex, the greatest convexity being near the upper part of the shell; the dorsal slope is compressed and hollowed, the postero-superior angle being somewhat alate.

Interior.—The anterior adductor scar is very shallow and inconspicuous; the posterior large and irregular, elongate from above downwards, and situated along the whole of the dorsal margin just within the edge of the valve. The pallial line is entire and remote from the margin. The hinge has not yet been exposed.

Exterior.—Though the shells are nearly all casts, traces of fine regular concentric lines of growth are to be seen preserved near the margins.

Dimensions.—Fig. 9, Pl. XVII, measures—

Antero-posteriorly	42 mm.
Dorso-ventrally	39 mm.
From side to side	26 mm.

Localities.—England: the Pennystone Ironstone, Coalbrookdale, and Rosser Vein, Cwm Bryn ddu, South Wales Coal-measures.

Observations.—This species, as far as my present knowledge goes, seems to be confined to a single horizon in the Coalbrookdale and South Wales Coal-fields. M'Coy described some shells from the coal shales intercalated in the limestones near Berwick-on-Tweed under the name *Myophoria carbonaria* ('Brit. Pal. Foss.,' p. 495), referring them to the *Venus? carbonaria* of Sowerby. These shells I now refer to *S. Pentlandicus*, Rhind, sp., after the examination of several specimens collected by myself from the shale above the Cooper's-eye Coal, Scremerston, and a fine series in the Woodwardian Museum, Cambridge, on which M'Coy probably founded his description.

Portlock was in error in referring his shell to *Venus? carbonaria*, Sowerby; a comparison of the types at once shows that the former is a much flatter triangular shell, which I am of opinion belongs to the genus Protoschizodus, de Koninck. Portlock's shell is refigured on Pl. XVII, fig. 11, of this Monograph.

A series of shells from Coalbrookdale, among which is the type, which I reproduce (Pl. XVI, fig. 7) by the kindness of the authorities, is preserved in the British Museum (Nat. Hist.), South Kensington. These specimens formed part of the collection made by Sir J. Prestwich when preparing his paper on the Coalbrookdale Coal-field.

The curious fauna of the Pennystone Ironstone of this coal-field has a much lower facies than generally obtains in the Coal-measures, and it is important to note its similarity with that in the Rosser Vein and at the base of the South Wales Coal-field.

S. carbonarius differs very markedly in shape from any of the other species of the genus; unfortunately the shells mostly occur in the form of internal casts, and the hinge has not been preserved. In fig. 9, Pl. XVII, the posterior muscle-scar seems to have been of extraordinary size and strength, but all specimens do not show it so well developed. This specimen is the largest example I have yet seen, and is in the Woodwardian Museum, Cambridge. It shows some faint traces of concentric markings near the lower margin.

SCHIZODUS ANTIQUUS, sp. nov. Plate XVIII, figs. 24—27; Plate XIX, figs. 4, 5.

? CYTHERÆA ANTIQUA, *Brown*, 1841. Trans. Manch. Geol. Soc., vol. i, p. 228, pl. vii, fig. 76.

ANTHRACOSIA, sp., *Wild*, 1892. Trans. Manch. Geol. Soc., vol. xxi, p. 366, pl. ii, fig. 7.

SCHIZODUS CARBONARIUS (pars), *Ward*, 1890. Trans. N. Staff. Inst. Min. and Mech. Engin., vol. x, p. 131.

— SALTERI, *Barnes and Holroyd*, 1897. Trans. Manch. Geol. Soc., vol. xxv, pl.,[1] fig. 12.

Specific Characters.—Shell of moderate size, gibbose, ovate, quadrate, slightly inequivalve. The anterior portion of the valve is much compressed, but soon expands and becomes gibbose. The border is regularly rounded, it sweeps round into the inferior margin, which is more gently convex and extended, terminating abruptly where it meets the posterior border at a well-marked obtuse angle. The posterior border is obliquely truncate from above downwards and straight. The hinge-line is arcuate, and the postero-superior angle obtuse. The umbones are gibbose, incurved, and somewhat elevated, situated a little in front of the middle line. Proceeding backwards and downward towards the postero-inferior angle is a rounded oblique ridge, which gradually becomes less marked, but in large specimens is continued to the very margin. In front of this ridge the valves are evenly convex, but behind it the shell is rapidly compressed and somewhat expanded, forming the dorsal slope.

Interior.—The muscle-scars appear to be normal in position, and the pallial line entire, but somewhat remote from the border. Indications only of the hinge are seen in one of the specimens, a cast, but little can be stated of it precisely.

Exterior.—The surface is smooth, but the microscope reveals fine concentric lines, especially near the margins. Shell thin.

Dimensions.—Fig. 27, Pl. XVIII, measures—

Antero-posteriorly	26 mm.
Dorso-ventrally	21 mm.
Elevation of valve	5 mm.

Localities.—England: the Black Shales below the Millstone-grit of High

[1] In this paper the plates bear no number. The Plate is the third in the paper.

Green Wood, Hebden Bridge, and Pule Hill, Yorkshire; in a bed of ferruginous grit, Pule Hill, Millstone-grit series.

Lower Coal-measures: roof of Bullion Mine, Carre Heys, Colne, Lancashire; above the Gin Mine Coal, Longton, and the 4-foot coal, Wetley Moor, North Staffordshire Coal-field.

Observations.—This species is founded on several specimens which have been collected from the localities mentioned above. One shell (Pl. XIX, fig. 4) from the Manchester Museum, Owens College, is labelled in Capt. Brown's writing as *Sanguinolaria axiniformis* from Todmorden. I cannot find any printed notice of this name, and am unable to retain the specific term on account of it having been already applied by Phillips to a species of the genus. The locality, Todmorden, is somewhat misleading, for the majority of the specimens collected by the late Mr. Gibson, and now in the Geological Collection of Owens College, came from High Green Wood and Horsebridge Clough, a mile or so north of Hebden Bridge. The specimens from Pule Hill were discovered by Messrs. Barnes and Holroyd, who figured one example (*op. sup. cit.*) under the name of *Schizodus Salteri*, for up to the present it has been thought that this species, which occurs in the Calciferous-sandstone series of Fife, survived into Coal-measure times in Central England. The species are quite distinct; *S. Pentlandicus*, under which name the Fifeshire shell is now described, for reasons of priority, is more transverse and more regularly quadrate. Judging from the figure I suspect that the *Cytherea antiqua* of Brown (*op. sup. cit.*) is a young example of the species under description.

Unfortunately the casts (figs. 24 and 25, Pl. XVIII) from the calcareo-ferruginous grit at Pule Hill are not perfect, and the dorsal slope is not visible in fig. 24; but, from what I know of the relation of the shape of the internal cast to the complete shell in this genus, I do not think that there is much doubt that they really belong to the species. Mr. Wild described and figured a very small example from the roof of the Bullion Mine, Carre Heys, Colne, as *Anthracosia*, new angular species. This I figure (Pl. XIX, fig. 6) and consider may be a young example of *S. antiqua*.

This species, though it seems to have a fairly long distribution in time, is very rare; only few specimens have been met with at each locality. It is easily recognised by its rounded antero-ventral contour being much less quadrate than in any other form.

Genus PROTOSCHIZODUS, *de Koninck*, 1885.

AMPHIDESMA, *Portlock*, 1843. Rep. Geol. Londonderry, p. 438.
— *Morris*, 1843. Cat. Brit. Foss., p. 77.
ANATINA (pars), *M'Coy*, 1845. Synops. Carb. Foss. Ireland, p. 51.
AMPHIDESMA, *M'Coy*, 1845. Ibid., p. 53.
AXINUS (pars), *M'Coy*, 1845. Ibid., p. 63.
LEPTODOMUS, *M'Coy*, 1845. Ibid., p. 67.
DOLABRA (pars), *M'Coy*, 1845. Ibid., p. 65.
AMPHIDESMA, *Brown*, 1849. Illust. Foss. Conch., p. 224.
DOLABRA (pars), *de Ryckholt*, 1852. Mélanges paléontol., pt. 2, p. 82.
ANATINA (pars), *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 183.
AXINUS (pars), *Morris*, 1854. Ibid., p. 189.
ANODONTOPSIS, *Morris*, 1854. Ibid., p. 184.
DOLABRA (pars), *Morris*, 1854. Ibid., p. 202.
LEPTODOMUS, *Morris*, 1854. Ibid., p. 202.
SCHIZODUS, *Meek*, 1871. Proc. Acad. Nat. Sci. Philad., p. 165.
AXINUS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, p. 49.
NIOBE, *de Koninck*, 1873. Recherches sur les Anim. foss., vol. ii, p. 77.
SCHIZODUS (pars), *Bigsby*, 1875. Thesaurus Devonico-Carb., p. 311.
AXINUS, *Young and Armstrong*, 1876. Cat. W.-Scot. Foss., p. 53.
PROTOSCHIZODUS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 125.
— *Fischer*, 1887. Mém. Conchyliologie, p. 996.
SCHIZODUS (pars), *Etheridge*, 1888. Brit. Foss., vol. i, Palæozoic, p. 290.
ANODONTOPSIS, *Etheridge*, 1888. Ibid., p. 278.
LEPTODOMUS, *Etheridge*, 1888. Ibid., p. 284.
DOLABRA, *Etheridge*, 1888. Ibid., p. 283.
ANATINA, *Etheridge*, 1888. Ibid., p. 277.
PROTOSCHIZODUS, *Tornquist*, 1896. Fossilführ. Untercarb. Südvosgesen, p. 147.

Generic Characters.—Shell subtriangular, inequilateral, compressed, rounded in front, angular posteriorly. Umbones small, subcentral, with an oblique keel from the umbo to the posterior-inferior angle, closed all round.

Hinge: the left valve with two teeth situated anteriorly, the posterior and larger and most prominent being immediately below the umbo. The right valve has a single tooth situated in front, with a fossa on each side to receive the teeth of the left valve.

Adductor muscle-scars shallow, close to the hinge-line. Pallial line entire. Surface smooth, with fine concentric lines of growth.

Observations.—De Koninck states that he had long had doubts as to the correctness of referring the Carboniferous species included in the genus *Schizodus* by King and others to that genus, on account of the difference in the details of the hinge; and because of this fact, as early as 1873, he had published his views with a descriptive account (*op. cit.*) under the name *Niobe;* but, finding that the name had been proposed by Gerard for a genus of Gasteropoda, he eventually adopted the name *Protoschizodus.* In assuming that King was wrong in referring certain Carboniferous species to *Schizodus* de Koninck also fell into error; for certain Carboniferous species undoubtedly belong to this genus, *e. g. S. axiniformis*, Phillips, sp., *S. carbonarius*, Sowerby, sp., and *S. Pentlandicus*, Rhind, sp. The shells described as *Amphidesma* by Portlock have been referred to *Schizodus* by the authors of catalogues previous to de Koninck's discovery of the hinge characters, and erroneously placed with others typical of that genus, but I cannot find that these species were ever included by King in the genus *Schizodus.*

De Koninck describes eleven species of *Protoschizodus*, nine of which are said to be new; but one of these had been referred by de Ryckholt to another genus. Three of these species are founded on single specimens, and five others are stated to be very rare. It is probable that the species named *P. Halli*, *P. impressus*, and *P. uncinatus* are really one and the same, although they exhibit some slight variation in the degree of truncation and obliquity of the posterior end; but I think that much of the variation of contour seen in the Belgian specimens is due to incomplete filling of the cast of the shell during fossilisation and similar causes.

Tornquist (*op. cit.*), following Frech, thinks that *Protoschizodus* has no real relation to *Trigonia*, and that the genus is more closely connected with *Scaldia*, the edentulous *Edmondidæ*, and *Cardiomorphæ*, and belongs to the family *Astartidæ.* I am unable, however, to agree with him, and consider that de Koninck was more correct in assuming a close family relationship to *Schizodus* (as the name indicates) upon the other characters of the interior.

There is no doubt that many of the species included under the genus *Dolabra* by M'Coy belong to *Protoschizodus*, and that M'Coy's generic name would have been retained had he not selected the Devonian *Cucullæa* of Marwood as the type of his new genus, and to which unfortunately his description does not correctly apply. On the other hand, the diagnosis of *Dolabra* differs very widely from that of *Protoschizodus*, it being stated that the shells are "slightly inequivalve," and that the hinge consists of "two long diverging cardinal teeth, anterior one longest, and two lengthened posterior lateral teeth."

In a later diagnosis of the genus ('British Palæozoic Fossils,' p. 269) there is a considerable difference from that originally given; for example, the hinge is stated to have "one thick, elongate, posterior lateral tooth in each valve, inclining at an acute angle from the hinge-line, that of the left valve sometimes bifid;" and the genus is placed in the family *Mytilidæ.* None of the shells which I now refer to *Protoschizodus* are inequivalve or have any Mytiliform characters.

I am referring the *Leptodomus fragilis*, M'Coy, to *Protoschizodus*. *Leptodomus*, as first defined, was very unsatisfactory, containing the shell mentioned above and *Leptodomus* (*Corbula*) *senilis*, Phillips, which is really an *Edmondia*. Later on ('Brit. Pal. Foss.,' p. 277) *Leptodomus* was emended by M'Coy in such a way as would exclude both his original species. Many of the shells described by M'Coy under the generic name *Axinus* I have now placed under *Protoschizodus*; three out of the four new species described by him as *Axinus* being retained.

King pointed out in a foot-note ('Permian Fossils,' p. 185) that he thought *Sedgwickia gigantea* of M'Coy was a species of *Schizodus*, and that "the same may be said of *Leptodomus fragilis*, M'Coy; *Dolabra securiformis*, M'Coy; *Mactra ovata*, M'Coy; *Amphidesma subtruncata*, M'Coy; *Anatina deltoidea*, M'Coy; *Axinus obliquus*, M'Coy, &c." To a certain extent King was correct in his view, for the majority of these shells belong to the same genus, which is now separated from *Schizodus*, since de Koninck pointed out the essential differences in the structure of the hinge. I propose still to retain the genus *Sedgwickia*, to which *Dolabra securiformis* probably belongs.

PROTOSCHIZODUS AXINIFORMIS, *Portlock*, sp., 1843. Plate XVII, figs. 10, 13, 14, 16—19.

VENUS ? CARBONARIA, *Portlock*, 1843. Rep. Geol. Londonderry, p. 438.
AMPHIDESMA CARBONARIA, *Portlock*, 1843. Ibid., pl. xxxvi, fig. 8.
— DEPRESSA, *Portlock*, 1843. Ibid., p. 439.
— AXINIFORMIS, *Portlock*, 1843. Ibid., p. 439, pl. xxxvi, fig. 6.
— DELTOIDEA, *Portlock*, 1843. Ibid., p. 439, pl. xxxvi, fig. 7.
— CARBONARIA (pars), *Morris*, 1843. Cat. Brit. Foss., p. 77.
— AXINIFORMIS, *Morris*, 1843. Ibid., p. 77.
— DEPRESSA, *Morris*, 1843. Ibid., p. 77.
AXINUS AXINIFORMIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 63.
— CARBONARIUS, *M'Coy*, 1844. Ibid., p. 63.
— DELTOIDEUS, *M'Coy*, 1844. Ibid., p. 63.
AMPHIDESMA PORTLOCKII, *Brown*, 1849. Illus. Foss. Conch., p. 224, pl. xci, fig. 40.
— AXINIFORME,[1] *Brown*, 1849. Ibid., fig. 41.
CYPRICARDIA DELTOIDEA, *Brown*, 1849. Ibid., pl. lxxx, fig. 6.
AXINUS AXINIFORMIS (pars), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 188.
— CARBONARIUS (pars), *Morris*, 1854. Ibid., p. 189.
— DELTOIDEUS (pars), *Morris*, 1854. Ibid., p. 189.
— CARBONARIUS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, p. 50.

[1] The other specific names of *Amphidesma* ought also to be neuter words, because δέσμα is neuter.

Schizodus carbonarius, *Bigsby*, 1875. Thesaurus Devonico-Carbonif., p. 311.
— deltoideus, *Bigsby*, 1875. Ibid., p. 311.
— axiniformis (pars), *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 290.
— carbonarius (pars), *Etheridge*, 1888. Ibid., p. 290.
— deltoideus, *Etheridge*, 1888. Ibid., p. 290.
— depressus, *Etheridge*, 1888. Ibid., p. 290.
Protoschizodus Wortheni, *de Koninck*, 1885. Ann. Mus. Hist. Nat. Belgique, vol. xi, p. 129, pl. xxii, figs. 4, 5, and 9; pl. xiii, figs. 12—16.

Specific Characters.—Shell triangularly ovate, slightly inequilateral, compressed near the margins, moderately gibbose above; transverse and dorso-ventral diameters almost equal. The anterior border is sharp, the margins of the valves being thinned and projecting slightly forwards, and almost semicircularly curved, passing into the inferior border without a break. The latter is regularly curved, but the degree of curvature is less than that of the anterior border. The posterior border is compressed and projecting, almost straight, obliquely truncate from above downwards and backwards, and joins the lower margin at a blunted obtuse angle. The hinge-line is short and arched, its extent not very clearly indicated either in front or behind. The umbones are tumid, pointed, incurved, contiguous, elevated above the hinge-line, and situated in front of the centre of the shell.

Anteriorly the umbonal swelling is not well marked on the surface of the valve, but posteriorly a well-defined and fairly acute ridge passes from the upper point of the umbo obliquely downwards and backwards, terminating at the postero-inferior angle. In front of the ridge the valves are equally and regularly curved, but above it the dorsal slope is very rapidly compressed, so as to become concave both from above downwards and before backwards.

Interior.—The anterior adductor muscle-scar is small, oval, and situated close to the margin at the extreme base of the umbonal swelling. The posterior scar is oval, and situated in the hollow of the dorsal slope close to the margin. In casts some irregular low ridges pass upwards from the scar towards the umbo. The pallial line is entire, strongly marked, and remote from the margin.

The surface of casts is marked with obscure and irregular depressions on the dorsal slope.

The hinge has not yet been exposed in British specimens, but de Koninck has figured specimens (under the name *P. Wortheni*) which are perfectly normal, the hinge having the formula $\frac{\text{L. } 1,\ 0,\ 1.}{\text{R. } 0,\ 1,\ 0.}$

Exterior.—The surface is marked with fine and regular concentric lines of growth, with here and there, towards the inferior margin, two or three deeper concentric sulci.

Dimensions.—Fig. 10, Pl. XVII, the type of Portlock's *Amphidesma axiniformis*, measures—

	Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
	22 mm.	20 mm.	5 mm.
			From side to side.
Fig. 19, Pl. XVII, measures	30 mm.	27 mm.	15 mm.

Localities.—England: ? Limestone, Lowick; the Redesdale Ironstone shales, Redesdale and Bellingham, Northumberland; Black Limestone, Poolvash, Isle of Man. Scotland: Upper Limestone series, Garngad Road, Glasgow; Gare, Carluke; Newfield, High Blantyre. Lower Limestone series in the Lingula Ironstone; Calmy and Main Limestones, Carluke; Kirktonholm, Craigenglen; Langside, Beith. A marine band in the Calciferous-sandstone series, Fife. Ireland: Limestone shales, Clogher, co. Tyrone.

Observations.—The confusion as to the nomenclature of this species has been very great, partly owing to the fact that Portlock gave names to several local varieties of the same species, and was unfortunately mistaken as to their specific identity. Under the name *Venus ? carbonaria* (p. 438) he remarks, "It is probable that the fossils here noticed should be placed either in *Mactra* or *Amphidesma*. Three forms occur closely approximating to each other; and, as the several specimens exhibit considerable variation, they may prove varieties of the same species; I, however, adopt the name *Amphidesma*.

"1st. *Amphidesma carbonaria*, *Venus carbonaria ?* Sow.—This is the variety nearest to Sowerby's species.

"2nd. *Amphidesma depressa.*—The general form the same, but the truncation is less marked and the shell less convex.

"3rd. *Amphidesma axiniformis.*—More convex; beak rather nearer the front; truncation more distinct; less transverse."

A fourth form, *A. deltoidea*, the *Cypricardia deltoidea* of Phillips, is also described (p. 439); but this is only the cast of the interior of the third form; and Phillips's shell came from the Petherwin beds of Devonshire.

The references to *V. carbonaria*, Sow., and *Cypricardia deltoidea*, Phillips, were unfortunately not quite correct. The former shell is *Schizodus carbonarius*, Pl. XVII, figs. 7—9; and the latter the Rev. G. F. Whidborne now refers to *Myophoria deltoidea* ('Devonian Fauna, Pal. Soc.,' vol. iii, 1896, pt. 5, p. 93), which is a totally different shell from Portlock's species.

Of the four species invented by Portlock two only were new; and the first of these, "*depressa*," can hardly stand as the name of the species, because the shell to which it was originally given is a varietal form, and not at all typical of the genus. There are two specimens of this variety in the Collection of the Geological Survey, Jermyn Street, which I have been kindly permitted to figure (Pl. XVII, figs. 11 and 12), and which I describe below.

The name *Amphidesma axiniformis* was given to the shell which I regard as typical of the species, and which I retain, although the *Schizodus axiniformis*, Phillips, sp., has been confused with Portlock's shell by various authors. There is, however, no evidence at all that Portlock had Phillips's shell in his mind, but the very reverse; for a few lines lower down (*op. cit.*, p. 439), under "*Amphidesma deltoidea*," he says, "Phillips suggests of his species that it may be the young of *Isocardia axiniformis*, but such reference appears very doubtful." The figured specimens are preserved in the Geological Survey Museum; but the specimen labelled *Amphidesma depressa* is not the figured specimen, which is, however, present in the Collection.

The type of *A. axiniformis*, Portlock, is represented in the original drawing as having its anterior umbonal slope angulated. This seems to me to be an error, and my artist's drawing (Pl. XVII, fig. 10) shows the absence of this character.

Portlock states of this series of shells, as quoted above, the three forms "may prove varieties of the same species"—*A. deltoidea*, Portlock; the internal cast, was, however, considered as a distinct species.

Unfortunately I have not been able to obtain any more examples from the locality whence the types were obtained, and am unable to decide, owing to the absence of sufficient material, whether the *A. depressa*, Portlock, is really more than a varietal form; I have therefore described it as a variety of *P. axiniformis.* I have not, however, met with similar varieties in other localities where this species occurs.

Although, unfortunately, I have not been able to isolate the hinge in any specimen, I have assigned this shell to the genus *Protoschizodus*, de Koninck, upon the evidence of the muscle-scars and external characters, which agree in every detail with those shells known from their hinge characters to belong to the genus.

The description (*op. cit.*, p. 129) and figures of *P. Wortheni* given by de Koninck leave no room to doubt that his shell is identical with Portlock's type, although he states, "elle a quelque ressemblance avec le *P.* (*Amphidesma*) *axiniformis*, J. E. Portlock, dont il a à peu près la taille, mais le côté postérieur est plus fortement tronqué et son extrémité est plus anguleuse." A comparison of the figures of de Koninck's specimens with those which I give will show, however, that this difference does not exist.

The hinge characters were, it appears, described from this species.

Brown was evidently of opinion that there was some confusion in the nomenclature, for when he published his 'Illustrations of Fossil Conchology' he gave the name *Amphidesma Portlockii* to the shell originally figured as *A. axiniforme*, Portlock.

This species varies considerably in the length of the hinge-line posteriorly, a variation which is accompanied by a change in the posterior slope and the apparent length of the posterior border. In large examples the inferior border seems to become sulcated towards its posterior end, giving a beaked appearance to the postero-inferior angle, and as in figs. 10 and 19, Pl. XVII. *P. axiniformis* is much less convex than *P. rectangularis*, and it also lacks the compressed antero- and postero-superior angles of the latter species. It is less oblique than *P. obliquus*, and has its posterior dorsal slope less obliquely truncate. *P. impressus* is more transverse, and the posterior umbonal ridge is less angular.

P. axiniformis seems to have the largest vertical and horizontal distribution of all the species of the genus. It is not met with in purely organic limestones, but only in shales or earthy calcareous beds.

PROTOSCHIZODUS AXINIFORMIS, var. DEPRESSUS, *Portlock*. Plate XVII, figs. 11, 12.

AMPHIDESMA DEPRESSA, *Portlock*, 1843. Geol. Rep. Londonderry, p. 439.
— CARBONARIA, *Portlock*, 1843. Ibid., p. 438, pl. xxxvi, fig. 8.

Varietal Characters.—Shell compressed, transversely suborbicular, subequilateral. The anterior end is markedly produced, and has a broadly semicircularly curved border, which passes gradually into the lower border, which is more broadly convex. The posterior border is bluntly rounded, with an approach only to angulation above and below. The hinge-line is arcuate. The umbones are small, comparatively broad and flattened, pointed, close, and subcentral. The valves are flattened, and there is only an obscure trace of an oblique line on the slightly compressed dorsal slope.

Exterior.—The surface is covered with regular, scarcely visible, concentric lines of growth. Shell thin.

Dimensions.—The type of Portlock's *Amphidesma depressa*, Pl. XVII, fig. 12, measures—

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

Locality.—Carboniferous shales of Clogher, co. Tyrone, Ireland.

Observations.—Although described, the shell named *Amphidesma depressa* was not figured in Portlock's work. It shows the extreme degree of variation, Portlock's *A. carbonaria* coming midway between it and *P. axiniformis*. The variety differs chiefly in the marked growth of the anterior end, so that it occupies the greater part of the valve. This condition causes a difficulty in determining, at first sight, to which side the valve belongs; but the slight traces of a keel on the dorsal slope settle this question. The labels now on the specimens are somewhat confused, but there is no doubt as to which specimens were the originals of Portlock's drawings. *P. carbonarius*, the type specimen of which is refigured, Pl. XVII, fig. 11, has characters midway between *P. axiniformis* and the variety *depressus*.

PROTOSCHIZODUS IMPRESSUS, *de Koninck*, 1885. Plate XVIII, figs. 7—9; Plate XIX, fig. 1.

The "Cockle," *Ure*, 1793. Nat. Hist. Rutherglen, p. 310, pl. xv, fig. 2.
DOLABRA SECURIFORMIS, *de Ryckholt*, 1853. Mélanges Paléont., pt. 2, p. 83, pl. xvi, figs. 5, 6.
AXINUS CARBONARIUS, *Gray*, 1865. Biograph. Notice of Rev. David Ure, p. 52.
PROTOSCHIZODUS IMPRESSUS, *de Koninck*, 1885. Ann. Mus. Hist. Nat. Belgique, vol. xi, p. 128, pl. xxii, figs. 19—24.
Compare — HALLI, *de Koninck*, 1885. Ibid., p. 127, pl. xxii, figs. 11 and 12.
— UNCINATUS, *de Koninck*, 1885. Ibid., p. 128, pl. xxii, fig. 18.

Specific Characters.—Shell of medium size, subtrigonal, somewhat oblique, compressed, inequilateral, transverse diameter longer than the vertical. The anterior end is depressed, deep in a dorso-ventral direction; its upper border, considerably below the level of the umbones, with a regularly rounded anterior border, the curve of the lower segment being less rapid than the upper, and therefore the lower part of the border is somewhat oblique from above downward and backwards. The inferior border joins the anterior without a break, and is curved, being convex downwards in front; but the posterior moiety is almost straight, and is directed upwards and backwards to join the posterior border, with which it makes a bluntly rounded angle, a little less than a right angle. The posterior border is oblique and almost straight, truncated from above downwards. The hinge-line is arched, its extent not clearly marked off from the anterior border in front, but behind it makes a rounded obtuse angle with the posterior border. The umbones are subcentral, obtuse, gibbose, twisted inwards and forwards, raised above the hinge-line, and not contiguous. The anterior edge of the umbo rises from the body of the shell only just below the hinge-line; the posterior edge is continued obliquely downwards and backwards towards the postero-inferior angle as an obtuse rounded ridge, which gradually becomes lost on the surface of the valve. Posterior to the ridge the valve is compressed rapidly to form the dorsal slope. The greatest gibbosity is subumbonal.

Interior.—The anterior adductor muscle-scar is small, shallow, marginal, and oval, situated at the antero-superior angle of the valve, bounded below and behind by an almost obsolete curved ridge; the posterior is larger, oval, and marginal, situated at the postero-superior angle. There are some obscure radiating, almost obsolete ridges in the hollow of the oblique ridge, represented by grooves in casts. The pallial line is entire, and close to the margin.

The hinge has not yet been exposed in British examples, but de Koninck describes the right valve as having a single tooth anterior to the umbo, and the left valve two teeth, separated by a deep socket, an example of which I figure Pl. XVII, fig. 15 *a*.

Exterior.—For the greater part the surface is almost smooth, but towards the inferior margin irregular concentric grooves with subimbricating lines and ridges appear, which follow the contour of the valves.

Dimensions.—Fig. 7, Pl. XVIII, from Orchard, near Glasgow, a testiferous example, measures—

Antero-posteriorly	32 mm.
Dorso-ventrally	27 mm.
Elevation of valve	8 mm.

Localities.—England: the Limestone of Lowick, Northumberland. Scotland: Upper Limestone series; Orchard, in the Thornliebank district, and East Kilbride, near Glasgow.

Observations.—The Woodwardian Museum, Cambridge, possesses a fine series of this species from the neighbourhood of Lowick, but the exact limestone of the many in this locality from which they were obtained is uncertain. These specimens are all in the form of casts, but have the internal characters of the shell beautifully preserved. Fortunately a testiferous example, from Orchard, in the collection of Mr. J. Neilson, has enabled me to describe the exterior of the valve. I have been favoured with the loan of the shell figured by the Rev. David Ure as a "cockle," from Black Craig, East Kilbride, now in the possession of the Royal Society of Edinburgh, and which is here figured, Pl. XIX, fig. 1. This shell was referred by John Gray to *Axinus carbonarius*, op. cit., but it is quite distinct from the shells figured by Portlock under the same specific title.

Three species—*P. impressus*, *P. Halli*, and *P. uncinatus*—described by de Koninck so closely resemble each other, that I think it very probable that they only represent one species. Of *P. Halli* de Koninck states, "Cette espèce est très voisine du *Protoschizodus impressus*, dont elle ne diffère que par une forme un peu moins longue et moins anguleuse; les dents cardinales de la valve gauche sont aussi un peu moins saillantes que celles de cette même valve de l'espèce qui vient d'être citée" (*P. impressus*). Of the latter species he states, "Elle a aussi des rapports avec le *Protoschizodus uncinatus*, que s'en éloigné par une forme plus allongée et par la corbure plus régulière et plus intense de son bord ventral." I am able to figure the hinge of a left valve from a Belgian example of this species, Pl. XVII, fig. 15 *a*. None of the British examples have any indication of this structure preserved.

This species is distinguished from *P. axiniformis* by the absence of the acute angulated oblique ridge, and by the less regularly triangular and more obliquely transverse shape of the shell. The inferior border is less curved, and the postero-inferior angle less acute, while the anterior end is comparatively much larger, and the umbones less pointed.

Protoschizodus obliquus, *M'Coy*, sp., 1844. Plate XVIII, fig. 10; Plate XIX, figs. 7—9.

Axinus obliquus, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 64, pl. viii, fig. 29.
— ? — *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 189.
Non Myophoria obliqua, *M'Coy*, 1855. Brit. Pal. Foss., p. 496.
Schizodus ? obliquus, *Bigsby*, 1875. Thesaurus Devonico-Carboniferus, p. 311.
— — *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 290.

Specific Characters.—Shell inequilateral, obliquely subtriangularly ovate, only moderately convex. The anterior end forms barely one third of the valve transversely, but is very deep from above downwards; its border is almost semicircular, so that the most anterior point is about the centre, and passes with regular curvature into the inferior border, which is strongly convex downwards, but forms the segment of a larger circle than the anterior border. The posterior border is produced downwards and backwards; very obliquely truncate and almost straight, joining the inferior border at a well-marked, more or less blunted angle. The hinge-line is very arcuate, at the shortest margin of the shell; and the posterior-superior angle is obtuse and fairly well marked. The umbones are situated at the junction of the anterior and middle thirds of the shell, projecting markedly upwards, moderately convex, small, incurved, and twisted forwards, contiguous, only slightly elevated above the hinge-line; excavated in front, so that they appear to stand up high above the anterior part of the shell. Passing downwards and backwards from the umbo close to the posterior margin is a strong angular oblique ridge, which separates a compressed and very much narrowed dorsal slope from the rest of the valve, which is regularly curved from above downwards and before backwards, the greatest convexity being about the centre of the valve. The ligament was external, small, and short.

Interior.—The muscle-scars are normal in position; pallial line entire.

Exterior.—The surface is almost smooth, but in front there are indications of regular concentric striations.

Dimensions—

	Antero-posteriorly.	Dorso-ventrally.	Laterally.
Pl. XIX, fig. 8, from Easter Bucklyvie, Donibristle	18 mm.	15 mm.	—
Pl. XIX, fig. 7, from same locality . .	28 mm.	24 mm.	5 mm.

Localities.—Scotland: Ayrshire, Beith; in shale below the Main Limestone, Lower Limestone series; Woodtop Quarry, Teasses; Easter Bucklyvie, Donibristle; Pathhead, Lambland Quarry; Encrinite bed, Broom Hill, St. Andrews. Ireland: in Arenaceous shale at Mullaghtenny, Clogher, co. Tyrone.

Observations.—I find this species in some Scotch cabinets under the name "*Axinus axiniformis*, Phillips," but it differs from *P. axiniformis* in its obliquity and by the much more strongly pronounced diagonal ridge. It has also a much shorter anterior end and hinge-line, and the umbones are less twisted forwards. I refigure the type specimen of M'Coy's *Axinus obliquus*, Pl. XIX, fig. 9, which is preserved in the Griffith Collection at the Museum of Science and Art, Dublin. This is a left valve, and not, as represented in the original drawing, a right valve.

M'Coy's description states that the shell possesses "a strong ridge from the beak to the posterior angle," and this is well shown in Scotch specimens. The following statement also occurs—"Epidermis produced into long fringes beyond the margin," but on this point I am not able to offer an opinion, as I have not been able to observe this character in any specimen; and the members of this genus do not, as far as I know, possess a periostracum of any thickness. I figure several testiferous examples from the collection of the Geological Survey, Edinburgh.

This species resembles *P. axiniformis* more nearly than any other, but is distinguished from it by its greater degree of obliquity, the very rapid descent of the posterior border, the marked angulation of the oblique ridge, and the very narrow adpressed dorsal slope. It is also less convex. *P. obliquus* is found at about the same horizon as *P. axiniformis* in Scotland, but, as far as I know, does not occur in the Upper Limestone series. In Ireland the species seems to be confined to the Lower Limestone shales, an horizon which I believe, on strong palæontological grounds, to be the equivalent of the Calciferous-sandstone series of Scotland.

M'Coy (*op. cit.*) redescribed his species, taking for a second type some shells from the Limestones of Lowick, Northumberland; but I have never seen this species from that locality, and the fine series of shells in the Woodwardian Museum, Cambridge, have nothing in common with the shell which was the original type. The description, however, agrees in every particular with the original specimen, and with those which I now refigure as typical of the genus, except perhaps that it makes the shell too convex. I am of opinion that specimens of *P. axiniformis*, which are fairly common at Lowick, must have been mistaken for *P. obliquus*.

PROTOSCHIZODUS RECTANGULARIS, *M'Coy*, sp., 1844. Plate XVIII, fig. 20, and Plate XIX, figs. 2, 3.

DOLABRA RECTANGULARIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 66, pl. xi, fig. 10.
— — *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 202.
CUCULLÆA RECTANGULARIS, *Bigsby*, 1878. Thesaurus Devonico-Carbonif., p. 305.
DOLABRA RECTANGULARIS, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 283.

Specific Characters.—Shell triangularly gibbose, subquadrate, of moderate size only, almost equilateral, much compressed and subalate posteriorly. The anterior end is compressed and flattened from before backwards, and has its border semicircularly curved. It is continuous with the inferior border, which is regularly convex downwards, meeting the posterior border at a well-marked, slightly obtuse angle. The posterior border is almost straight, obliquely truncate from above downwards and backwards, and it makes a well-marked angle with the hinge-line above. The hinge-line is short and arcuate. The umbones are small, acutely pointed, contiguous, only slightly raised above the hinge-line, and subcentral. The umbonal swelling is well marked off, both in front and behind, from the rest of the valve, and is triangular and regularly convex; the anterior border being regularly rounded, steep above, but gradually lost in its passage downwards. The posterior umbonal border is very oblique and strongly subangular, and is continued as far as the postero-inferior angle. Posterior to this oblique ridge the valves are markedly and abruptly compressed, and somewhat expanded, so as to be concave transversely.

Interior.—The muscle-scars are normal in position, and the pallial line is entire. The hinge has not been isolated.

Exterior.—The surface is almost smooth, but fine concentric lines of growth are to be seen towards the lower margin. Shell thin.

Dimensions.—Fig. 20, Pl. XVIII, from Settle, measures—

Antero-posteriorly	32 mm.
Dorso-ventrally	28 mm.
Elevation of valve	8 mm.

Localities.—England: the Carboniferous Limestone of Settle, Yorkshire. Ireland: the Carboniferous Limestone of Firog and Ballyhomock, co. Limerick.

Observations.—The type of M'Coy's species is a much smaller shell than those here figured; but he describes very exactly the characters of the shells which I now refer to *P. rectangularis*. There is some curious misprint, I think, in M'Coy's remarks on this species (*op. cit.*, p. 66), as follows:—"This shell much resembles the *Cucullæa angusta*, Sow., in general form, but is much more depressed, and is, moreover, distinguished by its greatly larger beaks and prominent posterior diagonal ridge; the straight rectangular posterior side distinguishes it from every species of *Cypricardia* with which I am acquainted." The word *Cypricardia* must be a misprint, for the shells figured by M'Coy under this generic name have no resemblance at all to *Protoschizodus*.

P. rectangularis resembles *P. axiniformis* in shape, but is much more gibbose, and has a much more compressed and expanded dorsal slope, and a much stronger oblique ridge.

I have at present seen only very few examples of this species; it seems to be rare, but more frequent in Ireland than in England. The shell figured, Pl. XVIII, fig. 20, from Settle is in the Burrow Collection of the Woodwardian Museum, Cambridge. The other, fig. 9, Pl. XIX, is in the collection of the Geological Survey of Ireland, in the Museum of Science and Art, Dublin.

PROTOSCHIZODUS TRIGONALIS, *de Koninck*, 1885. Pl. XVIII, figs. 14, 14*a*.

PROTOSCHIZODUS TRIGONALIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. xi, Appendix, p. 248, pl. xiv, figs. 9, 10.

Specific Characters.—Shell of very moderate size, gibbose, subtrigonal, slightly inequilateral, greatest dorso-ventral and antero-posterior diameters almost equal. The anterior end gibbose above and compressed below, projects forwards inferiorly. Its border slopes rapidly downwards and forwards for half its extent, and then becomes semicircularly curved into the lower border without any interruption. The inferior border is long, very feebly curved in front, but straight in its posterior half, which ascends rapidly towards its termination and joins the posterior border at a bluntly rounded angle. The posterior border is straight, obliquely truncate from above downwards and backwards, making an obscurely marked obtuse angle with the hinge-line. The hinge-line is arched in front, but its posterior part, slightly produced, is straight. The umbones are gibbose, incurved, twisted forwards, contiguous, raised above the hinge-line, and situated in front of the middle point of the hinge-line. Proceeding obliquely downwards and backwards to the inferior border, in front of the postero-inferior angle, is a very well-marked, obtusely rounded ridge, behind which the valves are very rapidly bent on themselves, so that the dorsal slope is very broad and hollow transversely, and the extreme edges of the valve are compressed and project backwards. The surface of the valves is convexly swollen above and for half the dorso-ventral diameter, the lower half being gradually flattened and expanded laterally. The greatest gibbosity of the valve is subumbonal.

Interior.—The anterior adductor muscle-scar is very shallow, elongate, and situated immediately within the antero-superior angle; the posterior, better marked, is situated in the hollow of the dorsal slope, remote from the postero-superior angle. The hinge has not yet been observed.

Exterior.—The surface is almost smooth, but there are occasionally very indistinct concentric lines of growth, better marked in front. Shell thin.

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

Antero-posteriorly	20·5 mm.
Dorso-ventrally	19 mm.
From side to side	13 mm.

Localities.—England: the upper beds of the Carboniferous Limestone, Castleton, Derbyshire.

Observations.—This species is described by de Koninck in the Appendix to his great work (*supra cit.*). In his observations on the species he says, "Cette espèce, qui par sa taille et sa forme trigonale, a quelques rapports avec le *P. Wortheni*, s'en distingue par le prolongement et la forme beaucoup plus anguleuse de son côté antérieur." To this I would add that *P. trigonalis* is more gibbose, the posterior border more nearly vertical, the postero-inferior angle less acute, and the inferior border less curved than in *P. axiniformis.*

As far as can be ascertained at present, the two species mentioned above do not occur together, either in Belgium or in Great Britain, *P. axiniformis* occurring in Étage I, Tournai, and *P. trigonalis* in Étage II, Panquys. In Great Britain, however, this species occurs at the top of the *zone of Productus giganteus*, which shell is considered in Belgium to be typical of the Viséen, or upper division of the Carboniferous Limestone. I have obtained only one specimen of this species in Great Britain, and that from the fossiliferous beds at the top of the Carboniferous Limestone series at Castleton.

The species is easily distinguished from *P. subæqualis* by its triangular form having its greatest transverse diameter at the lower border, the great expansion laterally of the dorsal slope, and absence of any alation at the postero-superior angle.

Protoschizodus subæqualis, *de Koninck*, 1885. Plate XVIII, figs. 15—19.

Protoschizodus subæqualis, *de Koninck*, 1885. Ann. Mus. Hist. Nat. Belgique, vol. xi, p. 130, pl. xxii, figs. 30, 31.

Specific Characters.—Shell somewhat transverse, small, moderately gibbose, inequilateral, ovately subtriangular. The anterior end is somewhat shorter than the posterior, regularly gibbose, and has an evenly rounded border, passing with a single curve into the inferior border, which is regularly but less convex. The posterior border is somewhat elongate, obliquely truncated, and straight in the upper two thirds, bluntly rounded below, where it joins the ventral edge at a rounded obtuse angle. The hinge-line is short, arcuate in front, produced and straight behind. The umbones are small, convex, pointed, contiguous, curved, and pointing slightly forwards, and situated about the centre of the hinge-line. The posterior edge of the umbo is acute, and produced obliquely downwards and backwards to the postero-inferior angle, dividing the shell into a larger regularly gibbose and a smaller much compressed portion, which forms the hollowed posterior slope. The greatest convexity is about the junction of the upper and middle thirds of the valve.

Interior.—The anterior adductor muscle-scar is small and shallow; the posterior rounded, comparatively large, and situated within the dorsal slope. The pallial line is very faint, but entire. The hinge has not as yet been exposed.

Exterior.—The surface is smooth, the very faintest traces only of concentric markings being observable with a glass. Shell very thin.

Dimensions.—Fig. 17, Pl. XVIII, measures—

Antero-posteriorly	15 mm.
Dorso-ventrally	13 mm.
Elevation of valve	5 mm.

Localities.—England: the upper beds of the Carboniferous Limestone of Thorpe Cloud, Derbyshire; Wetton, Staffordshire; and Thorpe, near Grassington, Yorkshire.

Observations.—The species *P. subæqualis* was founded by de Koninck on a single shell from the Limestone of Namèche, stated to be in the Étage III, Viséen, in the text, and Étage II in the explanation of the plate; the latter is probably a misprint, as Étage Viséen is given in the table of distribution at the end of the volume. I have obtained a large number of specimens from the Limestone of Thorpe Cloud, at the entrance to Dovedale, which agree so closely with the figure and description of de Koninck's shell that I have no hesitation in adopting his name for the British shells.

As far as I can ascertain, *P. subæqualis* never seems to attain to a greater size than the specimens figured in Pl. XVIII, figs. 15—19. I have been able to ascertain the internal characters from the cast of an interior from Thorpe by Grassington, fig. 15, Pl. XVIII; but unfortunately as yet the hinge-line has not been exposed.

This species comes between *P. trigonalis* and *P. rectangularis* in shape, and is distinguished from the former by its less triangular and less gibbose form, and by the marked alation of the postero-superior angle. The contour of the anterior and inferior border is much more convex. It is, however, less circular in outline, and more convex than *P. orbicularis*.

PROTOSCHIZODUS ORBICULARIS, *M'Coy*, 1844. Plate XVIII, figs. 21—23.

Cf. AXINUS ORBICULARIS, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 64, pl. viii, fig. 28.
" DOLABRA ORBICULARIS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 202.
" CUCULLÆA ORBICULARIS, *Bigsby*, 1878. Thesaurus Devonico-Carbonif., p. 305.
" SCHIZODUS ORBICULARIS, *Etheridge*, 1885. Brit. Foss., vol. i, Palæozoic, p. 290.

Specific Characters.—Shell small, compressed, suborbicular, equilateral. The anterior end is comparatively well developed, compressed, its border semicircular, passing with a continuous curvature into the ventral border, which is only a little less convex. The posterior border is regularly rounded, about as long as the anterior; its upper limit is obscure, but there is an approach towards angulation at the postero-inferior angle. The hinge-line is arcuate and short. The umbones are small, triangular, pointed, very slightly convex, not raised, and median. Proceeding obliquely downwards and backwards towards the postero-inferior angle is a distinct ridge, which marks off a small compressed portion of the valve as the posterior slope. Elsewhere the valve is slightly but regularly curved.

Interior.—The anterior adductor muscle-scar is small, round, and situated in the hollow between the umbo and the antero-superior angle. The posterior, elongate and fairly conspicuous, is placed in the hollow of the dorsal slope. The pallial line is entire and remote from the margin. The hinge appears from casts to be normal. There are some oblique ridges on the dorsal slope of casts, which indicate hollows in the interior of the valve in this position.

Exterior.—The surface is almost smooth even under the microscope, and the shell is very thin.

Dimensions.—Fig. 21, Pl. XVIII, measures—

Antero-posteriorly	13 mm.
Dorso-ventrally	12 mm.
Elevation of valve	3 mm.

Locality.—England: in calcareous bullions some hundred yards below the third bed of Millstone-grit (Roaches), Congleton Edge, Cheshire.

Observations.—I have referred to this species three specimens from a bed some distance below the third Millstone-grit at Congleton Edge. One of the specimens, fig. 22, Pl. XVIII, is a cast, and gives a more perfect contour than the testiferous example, fig. 21, which, owing to a loss of a small portion of the lower part of the posterior end, gives an exaggerated idea of the angulation of the lower portion. I have been fortunately able to identify in the casts the hinge and internal characters which are typical of the genus. This species is more orbicular than any other, and seems to attain to no great size.

De Koninck describes a form (*P. donaciformis*) which has some similarity to my species; but he states that his shell is thicker transversely than *P. Wortheni*, whereas mine is more flattened than that species, but the two species agree in having the anterior end equal to, or slightly larger than, the posterior. De Koninck's shell is stated to occur in the Waulsortian stage, and therefore at a much lower horizon than *P. orbicularis*.

M'Coy described a shell under the title *Axinus orbicularis* in his 'Synopsis of the Carboniferous Limestone Fossils of Ireland,' p. 64, but unfortunately the type is lost, and nothing is now known about the specimen. The figure has very much the contour of my shells, and it is represented as possessing a slightly marked diagonal ridge, which also characterises mine. There is unfortunately no means of establishing the identity, but I have retained the specific name because description and figure agree very closely with my shells.

PROTOSCHIZODUS TRIANGULARIS, sp. nov., *Hind*, 1898. Plate XVIII, figs. 11—13.

? AXINUS CARBONARIUS, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Appendix, Carb. Foss. West of Scotland, p. 50.

Specific Characters.—Shell almost equilateral, triangular, compressed. The anterior end is moderately swollen almost to the anterior border, where it becomes rapidly compressed into the edge of the valve. The anterior border is almost straight, obliquely truncate in its upper portion, but semicircularly rounded below, where it passes with regular curve into the inferior border, which is gently but regularly convex; the posterior border is straight for the greater part of its extent, obliquely truncate from above downwards and backwards; but below it joins the inferior border at a bluntly rounded obtuse angle. The hinge-line is very angular and short, its limits not well defined. The umbones are small, elevated, pointed, and twisted forwards, almost contiguous, and sub-central; not well marked off from the valve either in front or behind. The dorsal slope is very slightly compressed, because the general convexity of the valve is continued almost to the edge of the shell. The valves are regularly and interruptedly convex above downwards, and before backwards; the greatest convexity is subumbonal.

Interior.—The anterior adductor muscle-scar is small, shallow, and marginal; the posterior elongated and submarginal. The pallial line is entire. The hinge has not yet been exposed.

Exterior.—The surface appears to be smooth.

Dimensions.—Fig. 11, Pl. XVIII, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	26 mm.
From side to side	12 mm.

Locality.—Scotland: Ayrshire, the shale under the Main Limestone, Beith, Lower Limestone series.

Observations.—To Mr. R. Craig of Beith I am indebted for the kind gift of the shell on which this species is founded, and which I am unable to identify with any other form yet described. He tells me that this is the shell generally known in the west of Scotland as *Axinus carbonarius*, Portlock, now described as *Protoschizodus axiniformis*, var. *depressus*, Portlock, var. The latter species is not so regularly triangular or so nearly equilateral, and has a well-marked oblique ridge and dorsal slope, which characters may be relied upon for the differential diagnosis of the two species. One of the specimens of *P. Cantrainianus*, de Ryckholt, sp., in the Museum of Natural History, Brussels, somewhat resembles this species, but the figured specimen is totally unlike; it is more oblique, and has the dorsal slope more developed.

PROTOSCHIZODUS NUCULOIDES, *M'Coy*, sp., 1844. Plate XIX, figs. 10—16.

AXINUS NUCULOIDES, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 63, pl. xi, fig. 9.
ANATINA DELTOIDEA, *M'Coy*, 1844. Ibid., p. 51, pl. viii, fig. 7.
AXINUS? NUCULOIDES, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 189.
ANATINA? DELTOIDEA, *Morris*, 1854. Ibid., p. 183.
SCHIZODUS NUCULOIDES, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 290.
ANATINA DELTOIDEA, *Etheridge*, 1888. Ibid., p. 277.

Specific Characters.—Shell small, ovate, transverse, moderately convex, bluntly pointed behind. The anterior end comprises about one third of the valve, and is comparatively deep in a dorso-ventral direction; its border is gradually curved, and not well defined either above or below. The inferior border is extended, only very gently convex for the greater part, but more so posteriorly, where it joins the posterior border, making an elliptical curve. The posterior border is long, oblique, almost straight, descending backwards and downwards. The hinge-line is fairly extensive and gently arcuate, passing behind into the posterior border without a break. The umbones are small, pointed, forming the largest portion of the valve in front; the anterior umbonal slope is not well defined, but proceeding downwards and backwards towards the postero-inferior angle is a well-marked angular ridge, above which the shell is compressed, forming a flattened dorsal slope. The valve is gently convex, and much narrowed posteriorly from above downwards.

Interior.—The pallial line is entire. The hinge of the right valve consists of a single fairly large tooth, situated in front of the umbones, inclined forwards. The posterior part of the hinge-plate is somewhat flattened, but there is no sign of a posterior lateral tooth. Muscle-scars are normal in position. Pallial line simple.

Exterior.—The surface is almost smooth, but here and there the microscope reveals fine concentric lines of growth. Shell very thin.

Dimensions.—Fig. 10, Pl. XIX, measures—

Antero-posteriorly	13 mm.
Dorso-ventrally	9 mm.
Elevation of valve	4 mm.

Localities.—Scotland: Encrinite-bed, Broom Hill, St. Andrews; Calciferous Sandstone series. Ireland: Carboniferous shales of Dromard, Draperstown, co. Londonderry.

Observations.—This little species was described and figured by M'Coy in 1844. The Woodwardian Museum, Cambridge, possesses a slab from the same locality as that where the type specimen was collected, which is full of specimens of this shell. I have been able to isolate the hinge of the right valve, which I have described above, and which is typical of the genus in its characters. The Geological Survey of Scotland possesses a block from the Encrinite-bed, St. Andrews, in which are two specimens, both casts. One, a right valve, shows as a hollow the place which the cardinal tooth occupied; the other, a left valve, gives details of the muscle-scars and pallial line.

This species is much more comparatively transverse than any other, and can be easily distinguished by this character.

The *Anatina deltoidea*, M'Coy, is, I think, without doubt, a synonym of this species. The following is the description given of it:—"Subtrigonal, gibbous; anterior side large, rounded; front margin very convex; posterior side compressed, broad, obliquely truncated, separated from the body of the shell by an obtuse ridge," &c. The interior is shown in the original figure with an entire pallial line; but it is stated that the "pallial impression (is) sinuous." An attempt is made in the figure to make the pallial sinus in an impossible place, *i. e.* posterior, and just below the posterior adductor muscle. This specimen is refigured, Pl. XIX, fig. 11. Although the name *Anatina deltoidea* is found on p. 51, and that of *Axinus nuculoides* on p. 63, the former specific appellation cannot be adopted on account of its previous use (though only as a synonym) for another species of this genus.

The specimen of an interior figured Pl. XIX, fig. 12, shows that the pallial line was entire.

PROTOSCHIZODUS MAGNUS, *de Koninck*, 1885. Plate XIX, figs. 22, 22 *a*, 23.

PROTOSCHIZODUS MAGNUS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 126, pl. xiii, figs. 1—3.

Specific Characters.—Shell of medium size, moderately compressed, triangularly suborbicular, subequilateral, subalate at the postero-superior angle. The anterior end forming rather less than half the shell, is produced forwards, and regularly and gradually compressed into the margins. The anterior border, immediately continuous with the hinge-line above, is only gently curved, passes forwards and downwards, and then being bluntly curved backwards becomes the inferior border, which is very convex, especially in front and behind. The posterior border is truncate and nearly straight above, making a well-marked obtuse angle; below it becomes curved, and so joins the inferior border. The hinge-line is short in front and curved; posteriorly it is straight, depressed, and produced. The umbones are small, not marked off at all in front from the rest of the valve; pointed, contiguous, almost central, and not much raised above the hinge-line. Posterior to a line passing from the umbo to the postero-inferior angle the valve is rapidly compressed and expanded, so that the dorsal slope is concave. Elsewhere the valves are regularly but slightly convex, and there is no indication of an oblique ridge. The ligament is small and external, situated in a very narrow groove posterior to the umbones.

Interior.—This has not been well observed, but there are indications that the muscle-scars are normal in position. Pallial line entire.

Exterior.—The surface is ornamented with very numerous, regular, fine, concentric lines of growth, more apparent near the anterior edge.

Dimensions.—Fig. 22, Pl. XIX, measures—

Antero-posteriorly	53 mm.
Dorso-ventrally	47 mm.
Laterally	23 mm.

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

Observations.—I have met with only two specimens of this species, both of which occurred in Irish beds; one, a very fine testiferous example, is in the collection of the Geological Survey of Ireland, and the other is in the cabinet of Mr. Joseph Wright, F.G.S., of Belfast. These two shells are distinguished from other species of the genus by their peculiar shape. The produced anterior end, depressed and extended hinge-line, and the small inconspicuous umbones, which have no sign of an anterior fold, are characteristic. This condition of the umbo at once separates *P. magnus* from *P. æquilateralis*, in which the anterior fold is very well marked.

Mr. J. Wright's specimen, fig. 23, Pl. XIX, is a cast from Little Island, co. Cork, but unfortunately details are not well shown, and it is imperfect at the posterior end; and this is also, to a smaller extent, the case with the other specimen, fig. 22, Pl. XIX; but the general contour can be well made out from the two examples, for the latter specimen is only imperfect below, while the former is so above. The absence of any oblique ridge is also very marked—a feature present in most of the species of this genus. In the absence of this character *P. magnus* agrees with *P. impressus*, but the umbones of the latter species are much better marked off from the shell and raised above the hinge-line, and not median. The external ligament is well preserved in the Survey specimen, and is very small and short.

De Koninck gives three figures of a single specimen of this species, which, he states, is very rare, and occurs in the Lower Carboniferous of Tournai. His specimen shows the hinge, which is normal. The specimen is less perfect even than those I figure, and this fact accounts for the slight difference in his description of the contour of the valve and mine. He remarks on the feebleness of the diagonal ridge, so common to other species of the genus.

PROTOSCHIZODUS ÆQUILATERALIS, *M'Coy*, sp., 1844. Pl. XX, figs. 5, 7, 10—12.

LEPTODOMUS FRAGILIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 67, pl. x, fig. 11.
DOLABRA ÆQUILATERALIS, *M'Coy*, 1844. Ibid., p. 65, pl. xi, fig. 14.
— — *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 202.
LEPTODOMUS FRAGILIS, *Morris*, 1854. Ibid., p. 206.
— — (pars.), *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 101, pl. iv, figs. 6, 7.
PROTOSCHIZODUS INSIGNIS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 128, pl. xxii, fig. 10.
DOLABRA ÆQUILATERALIS, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 283.

Specific Characters.—Shell of moderate size, subquadrate, oblique, regularly gibbose, except at the postero-superior angle, which is compressed, produced, and subalate. The anterior end is much shorter than the posterior, regularly convex, and has its border semicircularly curved, which passes into the ventral border without a break. The latter is convex, the arc of a larger circle than that of the anterior border. The posterior border is almost straight, truncate, and slightly oblique from above downwards and backwards. The postero-inferior angle is almost a right angle, but the postero-superior angle is obtuse. The hinge-line is arcuate in front, but produced and straight posteriorly, and somewhat depressed downwards.

The umbones are of moderate size, marked off both in front and behind by a distinct fold, and twisted forwards, pointed, incurved, contiguous, raised above the hinge-line, and situated in the anterior third of the valve.

Proceeding downwards and backwards from the posterior border of the umbo to the postero-inferior angle is a more or less acute ridge, posterior to which the shell is rapidly compressed and somewhat expanded. There is a second ridge close to the hinge-line, formed by the bending of the valve on itself to form the hinge-plate, which is fairly constant, and gives rise to a *pseudo*-escutcheon.

Interior.—The anterior adductor muscle-scar is subcircular; its position is high up, and just within the anterior edge of the valve. The posterior is placed high up on the dorsal slope, and very inconspicuous. The pallial line is entire, and remote from the margin. The hinge has not yet been exposed.

Exterior.—The surface is almost smooth, but under the microscope fine concentric lines, parallel to the margins, are to be seen, and these become a little coarser or subimbricating as they pass over the posterior slope to end in the hinge-line, and are fairly well marked at the lower margin. Shell thin.

Dimensions.—Fig. 5, Pl. XX, from Magazine Limeworks, Pathhead, measures—

	Antero-posteriorly.	Dorso-ventrally.	Elevation of valve.
	48 mm.	41 mm.	10 mm.
The type of M'Coy's *Dolabra æquilateralis* .	35 mm. + (not perfect)	37 mm.	—

Localities.—Ireland: the Carboniferous Limestone; Clonmel; Monaster; Doorin, Co. Donegal; Limerick. Scotland: Magazine Ironworks, Pathhead; Burn Anne; Calderwood Cement-stone, East Kilbride.

The type-specimen of *Dolabra æquilateralis,* M'Coy, is very poor and incomplete, it has lost a good deal of the posterior end, and the umbo is badly preserved. On this account it is a very unsatisfactory specimen on which to found a species, and the drawing given by M'Coy is largely ideal. In its incomplete condition this type does not appear to be so oblique as the shells which I have ventured to think belong to M'Coy's species; and the original shell, now preserved in the Griffith Collection in the Science and Art Museum, Dublin, is here refigured. Mr. R. Etheridge, jun., described and figured a certain specimen from the Calderwood cement-stone as *Leptodomus fragilis* (op. cit.), which, from its obliquity and the angular nature of the oblique ridge, cannot belong to that species; but which I have no doubt is the same species as the shell here figured, Pl. XX, fig. 5, from Pathhead. A comparison of this specimen with the type of *Leptodomus fragilis*, Pl. XX, fig. 6, will at once show that this reference of the Calderwood shell was erroneous.

De Koninck considered the *Dolabra æquilateralis* of M'Coy to be a synonym of *Amphidesma subtruncata* of the same author, but I think this is incorrect, and give the reasons for this view under my remarks on this species, p. 249. He described, however, as a new species, founded on a single specimen, *P. insignis*, a shell which is identical with Mr. Joseph Wright's specimen, represented in Pl. XX, fig. 10. These both have the shell well preserved, and it is not altogether to be wondered at that de Koninck did not recognise that his specimen was the exterior shell of the cast figured by M'Coy.

De Koninck states, "Le *Protoschizodus cuneatus*, F. B. Meek ('Pal. Ohio,' p. 336, pl. xx, fig. 7), est le seul qui ait quelques ressemblance avec celui que je viens de décrire." But on reference to the original figure and description of the shell in question, it is not easy to understand why it was thought necessary to compare two such dissimilar shells, and from the shape of the American specimen I should doubt, in the absence of any evidence of the hinge, the propriety of removing that shell from the genus *Schizodus*. This shell may be briefly described as ovate, subtrigonal, posterior side long, cuneate, somewhat narrowed.

P. æquilateralis more nearly approaches *P. subtruncatus* than any other species of the genus, but is easily recognised by the strong oblique ridge, more truncate posterior end, and more elevated and conspicuous umbones.

PROTOSCHIZODUS SUBTRUNCATUS, *M'Coy*, sp., 1844. Plate XX, figs. 1—4.

AMPHIDESMA SUBTRUNCATA, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 53, pl. x, fig. 10.
SCHIZODUS SUBTRUNCATUS, *King*, 1849. Monogr. Permian Fossils, p. 185 (footnote).
ANODONTOPSIS SUBTRUNCATUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 184.
DOLABRA SUBTRUNCATA, *de Ryckholt*, 1853. Mélanges paléontol., pt. 2, p. 78.
ANODONTOPSIS SUBTRUNCATUS, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 297.
PROTOSCHIZODUS SUBTRUNCATUS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. xi, p. 131, pl. xxii, fig. 2.
ANODONTOPSIS SUBTRUNCATUS, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 278.

Specific Characters.—Shell of medium size, transverse diameter only slightly longer than the dorso-ventral, ovately subquadrate, moderately and very regularly gibbose. The anterior portion comprises about one-third of the valve, is deep, and has its border semicircularly curved. The inferior border is regularly curved in front, continuously with the anterior edge; but behind, where it joins the posterior border, the curvature is much more rapid, and there is no approach to angulation. The posterior border is subtruncate, but more or less convex; and it joins the superior border with an obscure, almost obsolete, obtuse angle. The hinge-line is gently curved. The umbones are small, triangularly pointed, not much raised above the hinge-line, contiguous, anterior, and slightly twisted forwards. The valve is rapidly compressed posterior to a line passing obliquely downwards and backwards from the posterior edge of the umbo, so that the dorsal slope is concave; but there is no ridge or approach to angulation.

Interior.—The muscle-scars are normal in position. Hinge not yet exposed.

Exterior.—The surface is almost smooth, but under the microscope very faint concentric lines of growth are visible. Shell very thin.

Dimensions.—Fig. 4, Pl. XX, the type of *Amphidesma subtruncata*, M'Coy, measures—

Antero-posteriorly	33 mm.
Dorso-ventrally	30 mm.
Elevation of valve	11 mm.

Localities.—England: the Carboniferous Limestone of Park Hill, Derbyshire. Ireland: the Carboniferous Limestone of Millicent, Clane, co. Cork; and Firogh, co. Limerick.

Observations.—The figure given by M'Coy of his *Amphidesma subtruncata* is very different from the original shell. As is the case with all M'Coy's figures, the original, a right valve, is depicted as a left; and the shell is more oblique, and not so quadrate as represented in the figure. That the specimen which I reproduce, Pl. XX, fig. 4, now preserved in the Griffith Collection in the Museum of Science and Art, Dublin, is the orginal, there can be no doubt, the contour of the line which shows where the shell is absent being identical with that shown in the original drawing. The type is a little imperfect in front, but otherwise is a very good specimen. Unfortunately I have not been able to obtain any other examples but the three fragmentary specimens here figured, Pl. XX, figs. 1—3, which are from the Limestone of Park Hill, Derbyshire. De Koninck figures a single example of this species from Pauquys, near Dinant, and states that it is not so very rare in one locality, but that he has only seen a single complete specimen. This author confounds this species with the *Dolabra æquilateralis*, M'Coy (now re-described as *P. æquilateralis*), placing the latter as a synonym of *P. subtruncatus*. For some time I thought that this view was correct, but *P. æquilateralis* has a much more truncate posterior end, its umbones more anterior, and marked off both in front and behind by distinct umbonal ridges, and there is a well-marked oblique ridge posteriorly—a series of characters which, taken together, are sufficient, in my opinion, to retain both species.

PROTOSCHIZODUS FRAGILIS, *M'Coy*, sp., 1844. Plate XX, figs. 6, 8, 9.

	LEPTODOMUS	FRAGILIS,	*M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 67, pl. x, fig. 11.
	—	—	*Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 202.
Non	—	—	*R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 101, pl. iv, figs. 5—7.
	—	—	*R. Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 284.

Specific Characters.—Shell subquadrately oval; gibbose, inequilateral. The anterior end is well developed, and has a regularly curved border which passes gradually into the inferior margin, which is very gently rounded and produced transversely. The posterior border is narrowed from above downwards, somewhat obliquely truncate and almost straight, meeting the upper and lower margins at well-marked obtuse angles. The hinge-line is arched in front, straight, extended and depressed posteriorly. The umbones are obtusely rounded, gibbose, pointed, contiguous, elevated above the hinge-line, and situated at the junction of anterior and middle thirds of the upper border. The umbonal swelling rises gradually from the general convexity of the valve, and its borders have an approach to sharpness only in the upper part. The dorsal slope of the valve is much compressed and expanded, becoming slightly concave in section, and the oblique swelling, which marks the passage of the compressed dorsal slope into the general convexity of the valve, is gradually rounded.

Interior.—I have not been able to observe the hinge or muscle-scars, but the pallial sinus is entire.

Exterior.—The surface is ornamented with regular very fine concentric striæ and lines of growth. Shell very thin.

Dimensions.—Fig. 6, Pl. XX, the type of M'Coy's *Leptodomus fragilis*, measures—

Antero-posteriorly	53 mm.
Dorso-ventrally	44 mm.
Elevation of valve	16 mm.

Localities.—England: the Redesdale Ironstone, Redesdale, Northumberland. Ireland: the type specimen is said to have come from the Lower Limestone, but no locality is given, probably Limerick.

Observations.—I refigure the type specimen of M'Coy's *Leptodomus fragilis*, Pl. XX, fig. 6, which is a fairly complete specimen of a left valve; but it has lost its antero-superior angle. This species is more regularly oval and less obliquely triangular than most of the others included in the genus, and it may be distinguished from *P. æquilateralis* by the absence of an oblique angular keel, also by its comparatively larger anterior end, and the absence of any general obliquity.

R. Etheridge, jun., described certain shells under this species, but these I now place with *P. æquilateralis* for reasons given above. In his observations on the more perfect of these specimens Mr. Etheridge admits that "the obtuse diagonal ridge is more pronounced, the posterior portion of the ventral margin straighter." It is not to be wondered at, considerable uncertainty having existed as to M'Coy's species, because the specimens were so poor and the descriptive accounts very meagre, but a study of the type makes it impossible to associate with it forms which have an acute oblique ridge, anterior prosogyrous umbones, and a more generally flattened shell, such as is characteristic of *P. æquilateralis*.

P. subtruncatus appears to me to be more closely allied to *P. fragilis*; but it is flatter, and has not the squared subalate posterior angle; it is quite possible, however, that the one may only represent the adult form of the other. Owing to the paucity of examples it is impossible to pronounce definitely.

Family UNIONIDÆ.

Genus CARBONICOLA, *M'Coy*, 1855.

(See 'Monograph on Carbonicola, Anthracomya, and Naiadites,' Pal. Soc., 1894, p. 38.)

Generic Characters.—Equivalve, inequilateral, transversely ovate, gibbose; scar of accessory pedal muscle above that of anterior adductor. Hinge-plate triangular, with or without cardinal teeth; no anterior and posterior lateral teeth. Pallial line non-sinuate. Periostracum thick, wrinkled; ligament external; umbones often eroded.

Species.

CARBONICOLA ROBUSTA, *Sowerby*, sp., 1840. Monogr., 1894, pp. 45, 174, pl. i, figs. 1—6; pl. ii, figs. 1—6, 9—11; pl. xxi, figs. 11, 11 *a*, and 12.

— RUGOSA, *Brown*, sp., 1843. Ibid., p. 49, pl. ii, figs. 7, 8, 8 *a*.

— ACUTA, *Sow.*, sp., 1829. Ibid., pp. 150, 175, pl. iii, figs. 1—12; pl. iv, figs. 8—17; pl. v, figs. 1, 3—37, 39; pl. vi, figs. 1—43; pl. xxi, fig. 1.

CARBONICOLA ACUTA, var. RHOMBOIDALIS, *Hind*, 1894. Monograph, p. 55, pl. iii, figs. 13—21; pl. iv, figs. 1—7.
— OVALIS, *Martin*, sp., 1809. Ibid., p. 56, pl. iv, figs. 18—22; pl. v, fig. 38.
— POLMONTENSIS, *Rhind*, sp., 1838. Ibid., p. 58, pl. vii, figs. 1—4.
— SUBCONSTRICTA, *Sow.*, sp., 1812. Ibid., p. 59, pl. vi, fig. 44; pl. vii, figs. 5—12.
— OBTUSA, *Hind*, 1894. Ibid., p. 61, pl. vii, figs. 16—23; pl. xi, figs. 1, 2.
— NUCULARIS, *Hind*, 1894. Ibid., pp. 63, 174, pl. vii, figs. 24—42; pl. ix, fig. 11; pl. xi, figs. 14—16; pl. xxi, fig. 8.
— GIBBOSA, *Hind*, 1894. Ibid., p. 65, pl. viii, figs. 1, 1 *a*, 1 *b*, 2.
— SUBROTUNDA, *Brown*, sp., 1843. Ibid., p. 65, pl. viii, figs. 3—7.
— TURGIDA, *Brown*, sp., 1843. Ibid., p. 66, pl. viii, figs. 8—25.
— AQUILINA, *Sow.*, sp., 1840. Ibid., p. 69, pl. v, fig. 2; pl. ix, figs. 1—10, 12—37; pl. x, figs. 1—42; pl. xi, figs. 31—33.
— ANGULATA, *de Ryckholt*, sp., 1850. Ibid., p. 75, pl. xi, figs. 3—5.
— SIMILIS, *Brown*, sp., 1843. Ibid., p. 76, pl. xi, figs. 6—13, 15, 17—23, 25—27.
— CUNEIFORMIS, *Hind*, 1894. Ibid., p. 78, pl. xi, figs. 24, 24 *a*.
— ANTIQUA, *Hind*, 1894. Ibid., p. 79, pl. xi, figs. 28—30.
— ELEGANS, *Kirkby*, sp., 1880. Ibid., p. 81, pl. xx, figs. 12—15 *a*.

Genus ANTHRACOMYA, *Salter*, 1862.

(See 'Monograph on Carbonicola, Anthracomya, and Naiadites,' Pal. Soc., 1894, p. 83.)

Generic Characters.—Shell very slightly inequivalve, inequilateral, posterior end compressed, expanded, and truncate; umbones small, from which a rounded oblique ridge passes towards the postero-inferior angle.

Interior.—Muscle-scars shallow, as in *Carbonicola*. Hinge-plate small, with a cardinal and one long posterior lateral tooth. Pallial line non-sinuate.

Exterior.—Surface concentrically striate, with thickened wrinkled periostracum.

Species.

ANTHRACOMYA ADAMSII, *Salter*, 1861. Monograph, 1895, p. 89, pl. xii, figs. 1—19.
— — var. EXPANSA, *Hind*, 1894. Ibid., p. 91, pl. xiii, figs. 1—3.
— DOLOBRATA, *Sowerby*, sp., 1840. Ibid., pp. 93, 176, pl. xiii, figs. 4—9, 11; pl. xxi, figs. 13 and 15.

ANTHRACOMYA MODIOLARIS, *Sowerby*, sp., 1840. Monograph, p. 95, pl. xiii, figs. 10, 12 ; pl. xiv, figs. 1—11, 32 ; pl. xvi, figs. 49—53.

— WILLIAMSONI, *Brown*, sp., 1849. Ibid., p. 99, pl. xiv, figs. 12—31 ; pl. xv, fig. 10.

— — var. OBTUSA, *Ludwig*, sp., 1859. Ibid., p. 103, pl. xv, figs. 5—9.

— LANCEOLATA, *Hind*, 1893. Ibid., p. 104, pl. xv, figs. 11, 11 *a*.

— WARDI, *Etheridge* (after *Salter*), 1890. Ibid., p. 105, pl. xiii, figs. 13, 15, 16 ; pl. xv, figs. 1—4, 12—20 ; pl. xxi, figs. 9—10 *a*, p. 175.

— PUMILA, *Salter*, 1861. Ibid., p. 108, pl. xvi, figs. 2, 3, and 40.

— SUBCENTRALIS, *Salter*, 1861. Ibid., p. 109, pl. xvi, figs. 1, 4—9 ; pl. xvii, figs. 3—5 ; pl. xix, figs. 21, 21 *a*.

— OBOVATA, *Hind*, 1893. Ibid., p. 110, pl. xvi, fig. 41.

— SENEX, *Salter*, 1861. Ibid., pp. 111, 175, pl. xv, figs. 21—28 ; pl. xxi, fig. 14.

— VALENCIENSIS, *Hind* (after *R. Etheridge, jun.*, MS.), 1895. Ibid., p. 113, pl. xvi, figs. 44—48.

— PULCHRA, *Hind*, 1895. Ibid., p. 114, pl. xv, figs. 29—49.

— MINIMA, *Ludwig*, 1859-60. Ibid., p. 116, pl. xvi, figs. 21, 22, 24—34.

— — var. CARINATA, *Hind*, 1895. Ibid., p. 119, pl. xvi, figs. 35—39.

— PHILLIPSII, *Williamson*, sp., 1836. Ibid., pp. 120, 176, pl. xvi, figs. 10—16 ; pl. xxi, fig. 7.

— LÆVIS, *Dawson*, var. SCOTICA, *Etheridge*, 1877. Ibid., p. 123, pl. xvi, figs. 17—20, 42, 43.

— SUBPARALLELA, *Portlock*, sp., 1843. Ibid., p. 176, pl. xvii, figs. 1, 2 ; pl. xxi, figs. 2—6.

Family EDMONDIDÆ, *King*, 1849.

EDMONDIDÆ, *King*, 1849. Monogr. Permian Foss., p. 162.

ANATININÆ (pars), *Stoliczka*, 1871. Pal. Indica, vol. iii, p. 162.

CARDIOMORPHIDÆ, *Hall*, 1883. Pal. New York, vol. v, pt. ii, headings of pls. lxii —lxiv.

— *Miller*, 1889. Geol. and Pal. N. America, p. 458.

Family Characters.—Equivalve ; umbones more or less prosogyrous ; no lunule; hinge edentulous, or with a single blunt cardinal tooth (in *Scaldia*). Ligament external, small. Pallial line entire.

Observations.—The genera *Cardiomorpha* and *Edmondia*, de Koninck ; *Sedgwickia*, M'Coy ; *Scaldia*, de Ryckholt, form a well-defined group, which cannot satisfactorily be placed in any of the accepted families of the Lamellibranchs. These genera have been referred by various authors to various families, including the *Mytilidæ* and the *Anatinidæ*. I have felt it imperative, therefore, to form a new family, and have adopted for it the name proposed by King, *Edmondidæ*, which I would place after the *Unionidæ*. King states of this family, "This is a provisional group, supposed to be related to *Mytilidæ*, concluding from the internal cartilage-fulcra, edentulous hinge, and entire pallial line of its type." The type of the genus *Edmondia* is stated to be *Isocardia unioniformis*, Phillips. I think that the term "cartilage-fulcra" is misleading, and that de Koninck and de Verneuil were describing something different from that which King called by this name. De Koninck, it seems, was describing a vertical plate, the hinge-plate, but King assumed that he referred to a horizontal ossicle, a character which he (King) figures most accurately in a shell from the Redesdale Ironstone, which, however, differs in every essential character from the type of the genus *Edmondia*, and which must therefore be referred to a new genus.

When de Koninck proposed the name *Edmondia* for his new genus he stated that it belonged to the *Mactridæ*, and at the same time placed *Cardiomorpha* in the family *Cardiadæ*, notwithstanding the fact that neither of these genera possessed hinge-teeth. He thought that these genera might bear some such relation to the types of those families as *Anodon* does to *Unio;* but the *Mactridæ* are sinuopallial, and *Edmondia* integropallial.

King thought that *Edmondia* showed more affinities to the *Mytilidæ*, but still retained *Cardiomorpha* in the *Carditidæ*. De Ryckholt referred his new genus *Scaldia* to the *Mactridæ;* and de Koninck states that he included in it species of *Edmondia* and *Cardiomorpha*.

M'Coy included *Edmondia* in the family *Mytilidæ*, and *Cardiomorpha* in a new family, *Cœlonotidæ,* which he placed immediately after the *Mytilidæ*. *Edmondia,* however, is equivalve, not byssiferous, and has no mytiliform characters whatever.

Stoliczka placed *Edmondia* and *Cardiomorpha* together in a new subfamily, *Anatininæ*, of the *Anatinidæ*, in spite of the absence both of an internal cartilage-pit and the presence of a deeply sinuate pallial line.

Meek and Hayden place *Cardiomorpha* and *Sedgwickia* in the *Anatinidæ*.

Fischer refers *Edmondia* to *Lyonsiidæ*, and *Cardiomorpha* and *Sedgwickia*, with a number of very different genera, provisionally to the *Grammysiidæ;* while *Pachydomus* is placed in a new family, *Pachydomidæ*, which is located after the *Cyprinidæ; Scaldia* and *Pseudedmondia* are referred to the *Unicardidæ*.

De Koninck, in his final work on the Carboniferous Lamellibranchs, placed *Cardiomorpha*, *Edmondia*, *Pachydomus*, and *Scaldia*, with several other very dissimilar groups, in the *Anatinidæ*.

I do not think it permissible to place any group of shells in the *Anatinidæ* which do not possess a sinuate pallial line and a central cavity in the hinge for the internal cartilage.

The hinge-apparatus of the genera composing the *Edmondidæ* has been misunderstood, and the small external ligament overlooked. Fischer pointed out that many of de Koninck's species of *Edmondia* have a very well marked groove for the external ligament, and in consequence erected the genus *Pseudedmondia;* but de Koninck states this fact as a generic character, and the latter "genus" is therefore unnecessary.

De Koninck is evidently at one with me on the close connection between *Cardiomorpha* and *Edmondia*, for he says, "Il est presque impossible de distinguer les coquilles de ce genre [Edmondia] de celles qui appartientient à certain groupe du genre *Cardiomorpha* lorsque la charnière fait défaut" ('Ann. Mus. Roy. d'Hist. Nat. Belgique,' vol. xi, p. 28). I am unable to see any real difference in the hinge-plates of the two genera except that due to the peculiar shape and size of the shells.

I find myself unable to retain the genera *Isoculia* and *Pachydomus* which were placed in a group with *Cardiomorpha* and *Edmondia* by de Koninck. The former is separated from *Cardiomorpha* on the supposed presence of a lunule, and its more circular shape and concentric sulcations. The lunule, however, is absent, and I give my reasons at length, under my remarks on *Cardiomorpha*, for this view. *Pachydomus* of Morris is stated to have one or two (?) large teeth in each hinge, and deeply excavated muscle-scars, characters which are absent in the shells de Koninck has referred to this genus.

The genus *Scaldia*, de Ryckholt, differs from all others in this group in the possession of a single blunt cardinal tooth in each valve, with a corresponding socket, the valves also being orbicular rather than transverse. Externally they closely resemble *Edmondia*, as de Koninck says, "Les coquilles de ce genre ont le facies des *Edmondia* et des *Cardiomorpha* à crochets, non contournés."

Woodward regarded *Scaldia* as a sub-genus of *Edmondia*, and Zittel ('Man. Paleont.,' p. 512) considers the two names synonymous. On examination the fine series of *E. Kicksiana* in the Museum of Natural History at Brussels shows the tendency of this species to develop the rudiments of a single cardinal tooth, and points to the close connection of *Edmondia* and *Scaldia*, the latter species probably being descended from the former, and there is no evidence of an ancestral form with a toothed hinge from which *Edmondia* could have been evolved.

The term *Cardiomorphidæ* has been used by Hall ('Pal. New York,' vol. v, pt. 2) and Miller ('North Amer. Geol. and Palæontol.,' p. 458) as a family including *Cardiomorpha*, *Edmondia*, *Euthydesma*, and *Protomya*, but I am unable to trace the authority for this family.

Stoliczka, in spite of the non-sinuate pallial line of *Edmondia*, *Cardiomorpha*, and others, referred a very large number of dissimilar genera, *Edmondia*, *Allorisma*, *Cardiomorpha*, *Ceromya*, *Myacites*, *Cercomya*, *Anthracomya*, and *Chænomya*, to *Anatininæ*, a sub-family of the *Anatinidæ*, but this classification obviously cannot now stand.

Genus—Cardiomorpha, *de Koninck*, 1842.

Isocardia, *Sowerby*, 1825. Min. Conch., vol. v, p. 148.
— *Fleming*, 1828. Hist. Brit. Anim., p. 420.
— *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209.
Cardiomorpha (pars), *de Koninck*, 1842. Anim. Foss. Terr. Carb. Belgique, p. 101.
— *Morris*, 1843. Cat. Brit. Foss., p. 81.
— (pars), *M'Coy*, 1844. Carb. Limest. Foss. Ireland, p. 56.
Isocardia, *de Verneuil*, 1845. Géol. de la Russie, vol. ii, Pal., p. 302.
Non Cardiomorpha, *de Verneuil*, 1845. Ibid., p. 303.
— *Brown*, 1849. Illus. Foss. Conch., p. 197.
— *d'Orbigny*, 1850. Prodrome de paléont., p. 132.
— *M'Coy*, 1854. Brit. Pal. Foss., p. 509.
— *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 190.
— *Eichwald*, 1856. Bull. Soc. Nat. Moscou, vol. xxix, pt. 2, p. 137.
— *Shumard and Swallow*, 1858. Trans. Acad. Sci. St. Louis, vol. i, p. 207.
— *Eichwald*, 1860. Lethæa Rossica, p. 1019.
— *Shumard*, 1860. Trans. Acad. Sci. St. Louis, p. 635.
Non — *Meek and Worthen*, 1860. Proc. Acad. Nat. Sci. Philadelphia, p. 458.
— *Wardle*, 1862. Sleight's Hist. Leek, p. 286.
Axinus, *Wardle*, 1862. Ibid., pl. iii, fig. 8.
Cardiomorpha, *Winchell*, 1862. Proc. Acad. Nat. Sci. Philadelphia, p. 416.
— — 1863. Ibid., p. 15.
— *Dawson*, 1868. Acadian Geol., p. 304.
— *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Appendix, p. 50.
— *Stoliczka*, 1871. Pal. Indica, vol. iii, p. 66.
— *Baily*, 1875. Figures Charact. Brit. Foss., p. 115.
— ? *Meek*, 1875. Geol. Surv. Ohio, Pal., vol. ii, p. 304.
— *Römer*, 1876. Lethæa Palæozoica, pt. 1, pl. xliv, fig. 5.
— *Bigsby*, 1878. Thesaurus Devonico-carboniferus, p. 301.
— *Waagen*, 1881. Mem. Geol. Surv. India, Salt Range Fossils, p. 191.
— ? *Barrois*, 1882. Terr. Anc. des Asturias et de la Galice, p. 346.
— *Hall*, 1883. Pal. New York, vol. v, pt. 1, pls. lxii—lxiv.
— *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, p. 9.
Isoculia, *de Koninck*, 1885. Ibid., p. 17.
Pachydomus, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, p. 23.
Cardiomorpha, *Young*, 1887. Trans. Geol. Soc. Glasgow, vol. viii, p. 295.
— *Etheridge*, 1888. Brit. Foss., vol. i, Palæozoic, p. 280.

CARDIOMORPHA, *Miller*, 1889. N. Amer. Geol. and Palæont., p. 469.
— ? *Worthen*, 1890. Geol. Surv. Illinois, vol. viii, p. 126.
— *Keyes*, 1894. Missouri Geol. Surv., vol. v, pt. 2, Pal., p. 131.
Non — *Beushausen*, 1895. Abhand. Kön. Preus. Geol. Landes., Heft 17, Die Lamell. des Rheinsch. Devon, p. 276.
EDMONDIA, *Beushausen*, 1895. Ibid., p. 287.

Generic Characters.—Equivalve, inequilateral, gibbose, of obliquely rounded or subquadrilateral shape. The umbones are swollen and elevated, with the beaks markedly prosogyrous. Lunule absent. The hinge-plate is edentulous; the ligament small and external. The muscle-scars are shallow, and the pallial line entire. Shell thin, either ornamented with fine regular concentric lines, or smooth.

Observations.—This genus was erected by de Koninck in 1842 for certain shells which till that time had been confounded with *Isocardia*, but he included in it shells which, in his subsequent works, he recognised as belonging to totally different species. Out of thirteen species described he retained only one in the genus in his latest work; and, curiously enough, the type of the genus *C. elongata*, a species founded on a single valve, is not mentioned in this latter work. As this specimen, cannot be found, *C. oblonga* becomes the type in its place; in fact, de Koninck states that he regards this species as the type of the genus. This species was figured and described by Sowerby (*op. cit.*) under the name of *Isocardia*. M'Coy, unaware of the erection of *Cardiomorpha* by de Koninck, proposed the generic name *Isoculia* for these shells, but immediately substituted de Koninck's name for it in the text of his book, though in some copies *Isoculia* appears at the foot of the plates. He described four species, only two of which, *C. corrugata* and *C. ventricosa*, were new; but he included erroneously *Schizodus axiniformis*, Phillips, sp.

Lately Dr. Beushausen has criticised de Koninck's diagnosis of *Cardiomorpha*. He demurs to the statement that a groove exists for the internal ligament, and in this stricture I am in agreement with him; but he further objects to the separation of *Isoculia* from *Cardiomorpha*, stating that the absence of a lunule and the deep concentric grooving, on which de Koninck relied as generic characters, are found in certain Devonian shells which he describes. I do not think that these characters supply sufficient grounds for separating *Isoculia* from *Cardiomorpha*, and am of opinion that no lunule exists in M'Coy's species. Indeed, I am of opinion that most if not all the shells referred to *Cardiomorpha* by Beushausen do not belong to this genus, which was enlarged by that author to receive them; nor can I understand on what grounds he bases his statement that a lunule is present in *C. oblonga*, or in any of the species included in the genus by de Koninck in his later work.

Many of Beushausen's Devonian species are transverse, and possess acute oblique ridges, *e. g. Cardiomorpha alata* and *C. Humbolti*, and I question the advisability of expanding the genus in order to receive them. I have never been able to observe a lunule in the typical species of *Cardiomorpha*, and, as defined by de Koninck, this genus does not contain transverse shells with an ornament consisting of concentric sulci.

The figures of *Edmondia gigas* from the upper part of the Middle Devonian of West Germany given by Beushausen (*op. cit.*) seem to me to be characteristic of the genus *Cardiomorpha* rather than that to which it is referred, and much more in accordance with it than any of those shells placed in the genus by that author.

De Koninck described eighteen species, seventeen of which were said to be new; many of them are probably synonymous, and due to slight variations in shape, and to the fact that several specimens are in different stages of growth. The distribution of these species is as follows:

Étage III.—Viséan	5
,, II.—Waulsortian	12
,, I.—Tournaisian	1
	18

—the idea being that each species is confined to its own horizon. Curiously enough, the common forms, *C. communis* and *C. oblonga*, which are said to be confined to étage II in Belgium, are in Great Britain found in the limestones characterised by the presence of *Productus giganteus,* which is considered as typical of étage I, the Viséan in Belgium. Fifteen out of the eighteen species are stated to be more or less rare. The description of fourteen species is from the pen of Prof. Jules Fraipont.

I am able to recognise only at most half a dozen of the species, as many of the shells described as new species are simply different stages of growth of the common forms, or differ merely in some slight details of comparative measurement. Although in the possession of markedly prosogyrous umbones, *Cardiomorpha* has a close resemblance to *Isocardia;* its edentulous hinge-plate at once separates the two genera.

De Koninck separated the *Cardiomorpha corrugata*, M'Coy, from *Cardiomorpha* on the ground that the former possessed a lunule, concentric folds, and umbones less enrolled. I cannot agree with him on these points; and, as I point out under my observations on *C. corrugata,* the species has no more trace of a lunule than any of the other species of the genus. I would also add that, few though they be, *C. ventricosa* possesses well-marked concentric grooves. The hinge-characters, judging from casts and internal anatomy, are identical in *C. corrugata* and the other species, and I can see no real grounds for retaining the genus *Isoculia.*

I am unable to agree with de Koninck that shells with edentulous hinges should be placed under *Pachydomus* of Morris; and retain the species described under this generic name as *Cardiomorpha*, although they have not the markedly enrolled umbones of the type of this genus, and at the same time are more orbicular, and have a thicker shell and more marked concentric striations. These characters, however, are not absolutely peculiar to the shells included under *Pachydomus* by de Koninck, for *C. corrugata* and *C. orbicularis* have an orbicular outline.

Hall has erected a genus *Euthydesma* on a single species ('Pal. New York,' vol. v, pt. 2, p. 32) which he places near *Cardiomorpha*, and which has somewhat the appearance of these shells, but at present I prefer including them in the genus *Cardiomorpha*.

Cardiomorpha oblonga, *Sowerby*, sp., 1825. Plate XXI, figs. 1—6.

Isocardia oblonga, *J. de C. Sowerby*, 1825. Min. Conch., vol. v, p. 148, pl. ccccxci, fig. 2.
— — *Fleming*, 1828. Hist. Brit. Anim., p. 420.
— — *Woodward*, 1830. Synops. Table Brit. Org. Rem., p. 13.
— — *Deshayes*, 1835. Hist. Nat. Anim. sans Vert., 2nd edit., t. vi, p. 450.
— — *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 9.
Non Cardiomorpha oblonga, *de Koninck*, 1842. Desc. des anim. foss. de la Belgique, p. 105, pl. ii, fig. 7.
— — *Morris*, 1843. Cat. Brit. Foss., p. 81.
— — *M'Coy*, 1844. Syn. Carb. Limest. Foss. Ireland, p. 56.
— — *Bronn*, 1848. Nomencl. palæont., p. 223.
— — *Brown*, 1849. Illus. Foss. Conch., p. 197, pl. lxxix, figs. 30, 31; pl. lxxxi, fig. 8.
— — *d'Orbigny*, 1852. Prodrome de Pal., p. 132.
— — *de Ryckholt*, 1852. Mélange pal., p. 102.
— ? — *S. P. Woodward*, 1854. Man. Mollusca, p. 323.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 191.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 510.
Non — — *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Appendix, p. 50.
— — *Baily*, 1871. Figures Char. Brit. Foss., vol. i, p. 115, pl. xxxix, fig. 10.
— — *Young and Armstrong*, 1876. Catal. Foss. W. Scot., p. 53.
— — *Römer*, 1876. Lethæa Pal., pl. xliv, fig. 5.
— — *Bigsby*, 1878. Thesaurus Devonico-carb., p. 301.
— — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 11, pl. ii, figs. 3, 4; pl. iii, figs. 10, 11.
— quadrata, *de Koninck*, 1885. Ibid., p. 13, pl. iii, figs.

CARDIOMORPHA ETHERIDGEI, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 14, pl. iii, figs. 16, 17.
— ELEGANS, *de Koninck*, 1885. Ibid., figs. 8, 9.
— LATA, *de Koninck*, 1885. Ibid., p. 13, pl. ii, figs. 11, 12.
? PACHYDOMUS LONGUS, *de Koninck*, 1885. Ibid., p. 26, pl. iii, fig. 15.
— OBLONGUS, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 280.

Specific Characters.—Shell oblique, somewhat transverse, subquadrilateral, gibbose, very inequilateral, expanded posteriorly. The anterior end is very short and low, compressed, especially above, where it is actually concave laterally, between the base of the umbonal swelling and the edge of the valve. The anterior border is semicircularly curved. The curvature hardly becomes altered in degree at the anterior inferior angle, where it passes almost imperceptibly into the lower edge of the valve. The inferior border is very gently curved and somewhat produced, becoming more convex posteriorly, and passing without a break into the posterior border, which is bluntly rounded, the degree of curvature being greater at the junction with the upper and lower borders. The hinge-line is arcuate, the anterior portion being at a much lower level than the posterior, which is long and almost straight. The umbones are prominent, gibbose, raised above the hinge-line, twisted forwards at first, and then become spirally coiled on themselves, so that the pointed apices are twisted down and outwards, and partly upwards. There is no lunule. The umbonal swelling is well marked off from the anterior part of the shell, and rises suddenly; posteriorly, however, it passes gradually into the general convexity of the valve. The umbonal gibbosity is produced somewhat obliquely backwards and downwards, but becomes lost about midway across the surface of the valve. The posterior and larger portion of the valve is evenly swollen, but compressed rapidly near the borders. The greatest convexity of the valves is through the umbo at about the level of the hinge-line.

Interior.—The anterior adductor muscle-scar is shallow and rounded, and situated immediately within the antero-superior angle. The posterior scar is large, obovate, almost obsolete, and situated on the dorsal slope, remote from the margins. The pallial line is entire and almost obsolete.

The hinge-plate is edentulous. The anterior third of the posterior part is formed by a bending of the valve on itself at right angles, so as to develop a flat plate, which comes in contact with that of the opposite valve; but posteriorly this plate gradually becomes obsolete. Above this plate, and between it and the umbo, is a narrow groove, which widens as it passes backwards, forming an elongate area or escutcheon, marked off from the rest of the valve by a longitudinal ridge. The ligament is not preserved in any of the specimens I have yet examined, but it was probably lodged in a narrow groove above the hinge-plate, which is seen between the umbones.

Exterior.—The surface of the shell is covered in front with numerous very fine striæ and lines of growth, arranged concentrically; but over the greater portion of the shell posteriorly the surface is smooth. Shell very thin.

Dimensions.—Fig. 2, Pl. XXI, the largest example I have met with, measures—

Antero-posteriorly	76 mm.
Dorso-ventrally	58 mm.
From side to side	47 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud and Castleton, Derbyshire; Clifton, near Bristol. The Isle of Man. Scotland: the Lower Limestone series of Gameshill, Stewarton. Ireland: the Carboniferous Limestone of St. Dooghlas and Blackrock, near Dublin; Millicent, co. Cork; Kildare; Rathkeale and Limerick.

Observations.—The original type of Sowerby's *Isocardia oblonga* appears to have been lost, but that of Phillips is in the Gilbertson Collection of the British Museum (Nat. Hist.), South Kensington, and I am able to reproduce it by the kindness of the authorities. Sowerby's specimen is stated to have been obtained from Blackrock, co. Dublin; and I am able to figure a fine specimen from this locality, from the collection of Mr. Joseph Wright of Belfast, Pl. XXI, fig. 1. De Koninck thought that the specimen figured by Phillips, Pl. XXI, fig. 5, did not belong to the same species as that of Sowerby, and gave it a new name, *C. Woodwardi*. The distinctive character of this species is that the dorso-ventral diameter is equal to the transverse; or, judging from the figures in the 'Descript. des Anim. foss.,' pl. ii, figs. 7 *a*, *b*, *c*, apparently even greater. Woodward pointed out that de Koninck's specimen was wrongly referred to Sowerby's species ('Manual Mollusca,' p. 323); but I think de Koninck was in error in placing Phillips's shell in the same species, and consider that the original determination was the correct one.

In de Koninck's last work Fraipont has described a number of species of *Cardiomorpha*, which I can but regard as synonymous with *C. oblonga*. The examination of a fair number of specimens from British localities shows that this species varies somewhat in the comparative dimensions in almost each individual case, and it is easy to find in a series from one locality specimens which possess the characters given by Fraipont as distinctive of the numerous species he describes. The characters are, without exception, mere differences in comparative measurement, which cannot be accepted as possessing specific value. I therefore regard *C. quadrata*, *C. Etheridgei*, *C. elegans*, and *C. lata* as synonyms of *C. oblonga*; and possibly *C. ovata* should be added to these.

I have also placed with a ? *Pachydomus longus*, de Koninck, as a synonym of *C. oblonga*. This species differs from the others referred to the genus in possessing anterior umbones, which are markedly prosogyrous. The figure appears to me to be an adult specimen of the species under discussion, somewhat flattened relatively to its other dimensions. There is a great tendency for the valves of this fossil to slip on each other, and in consequence the extreme edges are often wanting, and this gives an erroneous idea of the real dimensions and shape.

This species is easily distinguished from *C. ventricosa* by its regularly quadrate form, and the absence of the broad deep sulcations which pass concentrically across the shell of the latter. It is not so compressed or transversely produced, nor so oblique as its variety, *C. communis*.

CARDIOMORPHA COMMUNIS, *de Koninck*, 1885. Plate XXII, fig. 2.

CARDIOMORPHA COMMUNIS, *de Koninck*, 1885. Ann. Mus. Roy. d'Hist. Nat. Belgique, vol. xi, p. 10, pl. ii, figs. 1, 2.
— SPECIOSA, *de Koninck*, 1885. Ibid., p. 12, pl. ii, figs. 5, 6.
— PARALLELA, *de Koninck*, 1885. Ibid., pl. ii, figs. 7, 8.

Specific Characters.—The general characteristics are as in *C. oblonga*, and the only difference is one of shape. Shell transversely elongated, subovate, obliquely swollen; narrow in front and expanded behind. The anterior end is very narrow and very little produced; its border bluntly rounded. The inferior border is nearly straight, and is directed downwards and backwards. The posterior border is obliquely truncate, the postero-superior and inferior angles being well rounded. The shell is moderately gibbose, and the gibbosity of small extent and oblique, posterior to which the valve is rapidly compressed. The umbones are not very large; prosogyrous and almost terminal. The posterior part of the hinge-line is long and almost straight. The greatest thickness is about the centre of the valve from above downwards.

Dimensions.—Fig. 2, Pl. XXII, a somewhat imperfect specimen, measures—

Antero-posteriorly	62 mm.
Dorso-ventrally	55 mm.
Laterally	43 mm.

Locality.—The Carboniferous Limestone of St. Dooghlas, Dublin.

Observations.—Longer, less globose, more oblique than *C. oblonga;* its short anterior and long posterior end give a very characteristic shape to this variety. Fraipont in de Koninck's work says it is closely allied to *C. speciosa*, with which species and also with *C. parallela* I believe it to be synonymous. I have only come across a single example in Great Britain, and at present cannot speak with any certainty on the value of this "species," which may turn out to be only a variety of *C. oblonga.*

CARDIOMORPHA OBLIQUA, *Hind*, sp. nov. Plate XXIV, figs. 3—5, 5 *a*, 5 *b*.

Specific Characters.—Shell ovate, inequilateral, obliquely gibbose. The anterior end is short and narrow, but projects forwards in front of the umbones, forming a rapidly compressed lobe with an elliptically rounded erect border, passing gradually into the ventral margin, which is markedly convex and extended, being much longer than the upper border. The posterior border is bluntly but regularly curved, and about twice as extensive as the anterior, the postero-inferior and postero-superior angles being gradually rounded. The hinge-line is arched and somewhat extended, and depressed posteriorly. The umbones are, in the anterior part of the shell, gibbose, large, not elongated, elevated, twisted forwards and inwards, the apices being rolled on themselves. The valves are obliquely swollen, the line of greatest convexity passing from the centre of the umbones downwards to the middle of the inferior border. Both in front of and behind this line the valves are rapidly compressed, especially posteriorly and upwards. The upper part of the anterior part of the valve is so much excavated and compressed below the prosogyrous umbones as to be concave. No lunule, but a well-marked escutcheon, which becomes broader and shallower as it passes backwards.

Interior.—The posterior adductor scar is large and round, situated near the dorsal border in the hollow of the posterior slope, but remote from the posterior end; pallial line faint but entire. Hinge not exposed.

Exterior.—The surface is almost smooth, but is seen to be covered with faint concentric lines, collected into bands by very shallow grooves. Shell thin.

Dimensions.—Pl. XXIV, fig. 3, from Ardlaman, co. Limerick, in the collection of the Geological Survey of Ireland, measures antero-posteriorly 50 mm., dorso-ventrally 40 mm., from side to side 36 mm.

Localities.—The Carboniferous Limestone of the Isle of Man. Ireland: the Carboniferous Limestone of Ardlaman, co. Limerick.

Observations.—This species is more regularly ovate than any other; more transverse than *C. orbicularis*, and not oblong-quadrangular like *C. oblonga*. It differs from both these species in possessing a prominent anterior end. The peculiar oblique gibbosity and more erect elevated umbones also serve to immediately distinguish it from the latter species. In adult specimens the posterior end becomes more and more contracted by the approach of the upper and lower borders. This is well shown in Pl. XXIV, fig. 4.

C. obliqua appears to be very rare. I have only met with the species in the two localities mentioned above.

CARDIOMORPHA ORBICULARIS, *M'Coy*, 1853. Plate XXII, figs. 1, 3—7.

CARDIOMORPHA ORBICULARIS, *M'Coy*, 1853. Ann. and Mag. Nat. Hist., ser. 2, vol. xii, p. 189.
— — — 1855. Brit. Pal. Foss., p. 510, pl. 3 I, figs. 41, 41 *a*.
— — *Bigsby*, 1878. Thesaurus Devonico-carbonif., p. 301.
— GLOBATA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 15, pl. iv, figs. 3, 4.
— SOWERBYI, *de Koninck*, 1885. Ibid., p. 15, pl. iv, figs. 5, 6; pl. xii, figs. 21, 22.
Cf. — TRAPEZOIDALIS, *de Koninck*, 1885. Ibid., p. 15, pl. iv, figs. 9, 10.
— SUBQUADRATA, *de Koninck*, 1885. Ibid., p. 16, pl. viii, figs. 1 and 2.
— ORBICULARIS, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 281.

Specific Characters.—Shell large, suborbicular, gibbose, almost equilateral. The anterior end is comparatively large, compressed, especially at the antero-superior angle, where it is concave; its border is semicircularly curved. The ventral border is also regularly curved in front, and behind it passes into the posterior border without a break. The posterior margin is short and convex, the segment of a smaller circle than that which forms the anterior, the posterior side being smaller than the anterior and gradually compressed. The hinge-line anterior to the umbo is straight, but the posterior portion is regularly arched and rapidly depressed, the whole extending across the shell, of which it forms the longest transverse diameter. The umbones are very large, tumid, elevated above the hinge-line, markedly twisted inwards and forwards, contiguous; the apices are depressed, everted, and curved spirally on themselves. They are almost median in position, and somewhat oblique. There is no lunule. The valves are regularly convex, but become gradually compressed towards the margins. The valves attain the greatest degree of convexity at a point on a level with the hinge-line.

Interior.—The anterior and posterior adductor muscle-scars are very shallow and inconspicuous. The former is large, orbicular, and situated just within the antero-superior angle; the posterior, almost obsolete, is just below the posterior extremity of the hinge-line. The pallial line is simple and remote from the margin. The hinge is thin and linear in front of the umbo; a hinge-plate is developed behind at right angles to the shell, corresponding to a deep groove in casts. This at first is bevelled at the expense of its lower border, the upper border being prominent, but in the posterior third the plate again becomes flatter. There are no signs of hinge-teeth. Above the extreme edge of the valve is a narrow elongate groove, which follows the curvature of the shell, and forms a narrow elongate escutcheon. The external ligament occupied the anterior part of this groove.

Exterior.—The surface is almost smooth, but under the microscope fine regular lines of growth are to be distinguished.

Dimensions.—The type specimen, Pl. XXII, fig. 6, measures—

	Antero-posteriorly.	Dorso-ventrally.	From side to side.
	90 mm.	80 mm.	—
Pl. XXII, fig. 5	68 mm.	62 mm.	46 mm.

Localities.—England : the upper beds of the Carboniferous Limestone, Castleton and Park Hill, Derbyshire; Settle, Yorkshire; Worston, near Clitheroe, Lancashire. Scotland: the Upper Limestone series of Newfield, High Blantyre, Blathgate. The Lower Limestone series of Gameshill, Stewarton. Ireland: the Carboniferous Limestone of Tuogh, Ardlaman, co. Limerick.

Observations.—This species was described by M'Coy in 1853, and subsequently the description was republished with a figure, but the species does not seem to have been widely recognised, as apparently it is not mentioned in any of the lists of fossils of Great Britain. As M'Coy points out, "this is only likely to be confounded with the *C. oblonga*, Sow. sp., but is distinguished by its large anterior and small posterior sides, extremely large beaks, and flattened orbicular valves."

I have placed four species described by de Koninck as synonyms of this species. Of *C. subquadrata* it is remarked that "cette espèce ressemble beaucoup à *Cardiomorpha orbicularis,* F. M'Coy, mais elle est moins arrondie, plus haute, et sa surface n'est pas aussi lisse que celle de l'espèce qui vient d'être citée." Our specimens show that M'Coy's species does vary in the degree of curvature of its lower border, and in the proportions of the transverse and dorso-ventral diameters.

Cardiomorpha globata is stated to have its anterior extremity larger than the posterior. This is the case in the younger examples of *C. orbicularis*, for with growth the posterior end enlarges more rapidly than the anterior. The relation of the posterior to the anterior part of the shell depends largely on the angle of view at which the shell is placed. The more the posterior part of the hinge-line is elevated, the smaller in consequence is the anterior extremity, and *vice versâ*, for the division between anterior and posterior is arbitrary, and is generally defined by a perpendicular line falling from the umbones, and in shells with arcuate hinge-lines there is no special horizontal line that can be taken as fixed.

Cardiomorpha Sowerbyi is founded on a fragmentary valve, and it is stated "cette espèce est plus allongée que le *Cardiomorpha globata*,"—not a very definite specific characteristic when a large portion of the anterior part of the shell is wanting. There is a fine series of specimens of *C. orbicularis* from the Limestone of Ardlaman, co. Limerick, in the collection of the Geological Survey of Ireland, showing the shell in all stages of growth.

I figure a well-preserved example of the hinge of this species, which was presented to me by Professor G. De Walque of Liége, fig. 4, Pl. XXII, from the Carboniferous Limestone of Belgium.

CARDIOMORPHA VENTRICOSA, *M'Coy*, 1844. Plate XXIII, figs. 1—4.

CARDIOMORPHA VENTRICOSA, *M'Coy*, 1844. Syn. Carb. Foss. Ireland, p. 56, pl. xiii, fig. 3.
— OBLONGA (pars), *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 191.
— — *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
— — (pars), *de Koninck*, 1885. Ann. Mus. Hist. Nat. Belg., vol. xi, p. 11.
— — *Etheridge*, 1888. Brit. Foss., vol. i, Palæozoic, p. 281.

Specific Characters.—Shell of only moderate size, very obliquely ventricose, produced downwards, so that the antero-posterior diameter is shorter than the others in all except very large examples; shape very irregular. The anterior end is very short, deeply excavated above, just below the twisted umbones, but elsewhere regularly swollen. The anterior border is curved and very short. The inferior border descends downwards and somewhat backwards, passing at its posterior and lowest portion into the posterior border with a blunt curve. The latter border is extended and very bluntly curved, joining the hinge-line above without any marked break. The hinge-line is arched, the posterior part produced. The umbones are large, gibbose, somewhat compressed laterally, much raised above the hinge-line, twisted forwards, with their apices markedly prosogyrous, being curved on themselves, and very anterior in position. The umbonal swelling is prolonged obliquely across the shell to the postero-inferior angle, becoming somewhat flattened in its progress across the shell. Above this swelling, which occupies a very large portion of the valve, the shell is compressed so as to form a gradually flattened slope towards the hinge-line, which lies in the centre of an elongate groove between the two expanded valves. Below the oblique swelling the valve is somewhat flattened and compressed into the inferior border.

Interior.—The muscle-scars and pallial line are normal. The hinge has not yet been exposed.

Exterior.—The surface is ornamented by numerous almost microscopic lines of growth, which are divided at irregular intervals, more frequent towards the lower margin, by deep concentric grooves, the upper one of which is fairly broad from above downwards; but they diminish as they approach the margin. The finer concentric lines are continued in the grooves as in other parts of the valve. Shell thin.

Dimensions.—Fig. 1, Pl. XXIII, a fairly perfect specimen in the collection of Mr. J. Wright of Belfast, from the Limestone of Cork, measures—

	Antero-posteriorly.	Dorso-ventrally.	From side to side.
	33 mm.	38 mm.	37 mm.
A more transverse example, Pl. XXIII, fig. 3 . .	53 mm.	46 mm.	48 mm.

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

Observations.—This very distinct species was, M'Coy says (*op. cit.*), regarded by him as a "monstrous variety of *C. oblonga*," but he erected the species on becoming aware that examples were fairly common in the Limestone of Cork. *C. ventricosa* differs very markedly from *C. oblonga* in its degree of gibbosity and obliquity, and in its dorso-ventral diameter being longer than the antero-posterior, whereas the opposite measurements obtain in *C. oblonga*. I have been able to find the same characters in several young shells, which show the characteristic linear sulci passing transversely across the shell, so typical of the species. One of these, from Little Island, co. Cork, I figure, Pl. XXIII, fig. 2. There is another young specimen in the collection of the Geological Survey of Ireland. M'Coy's original specimen is represented in the Griffith Collection in the Museum of Science and Art, Dublin, by a plaster cast, but I am quite sure that the shell from Mr. J. Wright's Collection, which I figure, Pl. XXIII, fig. 1, was the type, for it was originally part of the collection of the late Dr. Haines, of Cork, who possessed some of the types figured in M'Coy's work. This specimen has a peculiar imperfection in the front part of the inferior border of the left valve, which is present also in the plaster cast, which removes all doubt of the identity of this specimen being the type.

This species seems to have had a very limited horizontal distribution, for it has been found only at Little Island, Cork, and even here it seems to be rare, although M'Coy says, "I am assured that they are not uncommon in the Cork limestone."

De Koninck with strange inconsistency, though apparently always willing to make new species, thought *C. ventricosa* was only a deformed variety of *C. oblonga*. Morris and Etheridge also seem to have confounded these two species in their respective catalogues. They cannot have been correct; for it would be unlikely that very young examples should possess the same characteristics which are shown in the adult, if the peculiar shape and marking of *C. ventricosa* were due to deformity.

There seems to be a fair amount of variation amongst the specimens collected. Pl. XXIII, fig. 3, is relatively much more transverse than the type, but it is a much larger shell, and this may account for it. The depth, number, and position of concentric grooves also vary. In young specimens one appears much closer to the umbo than is seen on the adult examples, showing that these grooves probably became filled up or altered during the process of growth.

In *C. corrugata*, M'Coy, the tendency to deep, occasional, concentric grooves becomes a regular character, but the shapes of the valve in the two species have nothing in common.

Cardiomorpha limosa, *Fleming*, sp. Plate XXI, figs. 7—11.

> Corbula limosa, *Fleming*, 1828. Hist. Brit. Animals, p. 246.
> Cardiomorpha oblonga, *Young and Armstrong*, 1871. Carb. Foss. W. Scotland, p. 50.

Specific Characters.—Shell small, transversely ovate, gibbose, somewhat inequilateral. The anterior end is well developed; somewhat narrower from above downwards than the posterior; gradually compressed into the margins, but above, beneath the umbones, it is concave, so that the anterior part of the hinge-line forms a central elevation. The border is elliptically curved, and passes without a break into the ventral border, which is slightly curved, but becomes more convex at each end. The posterior end is short, obliquely truncate above and rounded below, and forms an obtuse angle with the hinge-line. This is arcuate, but produced posteriorly, and this portion is nearly straight and somewhat depressed. The umbones are gibbose, slightly prosogyrous, contiguous, and elevated above the hinge-line. They are situated a little in front of the middle of the shell, and the anterior border is much more apparent than the posterior. The umbonal swelling becomes rapidly gibbose, but is not of large extent, the valves being rapidly compressed into the borders. The greatest gibbosity is at the junction of the upper and middle thirds of the shell. In adult specimens there is an oblique groove, which passes from the umbo backwards and very slightly downwards to the posterior border at a small distance below the upper border.

Interior.—The muscle-scars have not yet been exposed. The hinge is edentulous, with a narrow groove above, between it and the umbones, for the ligament, which becomes slightly broader and shallower posteriorly, and forms a false escutcheon. Pallial line not exposed.

Exterior.—The surface is ornamented with fine microscopic concentric lines of growth, parallel to the margins. Shell very thin.

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

Antero-posteriorly	19 mm.
Dorso-ventrally	14 mm.
Laterally	12 mm.

Localities.—Scotland: Upper Limestone series, excavation for Inland Revenue Buildings at St. George Square and Railway cutting, Garngad Road, Glasgow; Thornliebank; Orchard; Gare; Limekilnburn. Middle Ironstone and Coal series, Robroystone; Bishopbriggs; and Calder. Lower Limestone series, Beith; Craigenglen.

Observations.—Mr. James Neilson has fortunately unearthed a tablet of shells, in the Museum of Science and Art, Edinburgh, which formed part of the Fleming Collection, bearing a label: "Described in Fleming's British Animals—*Corbula limosa.*" Unfortunately all the figures were drawn before this discovery was made. Fleming did not figure any specimens in his work; but his description is as follows: "Transversely subtriangular and longitudinally heart-shaped, beaks gibbose, surface slightly striated by layers of growth, shell thin. From shale clay connected with Carboniferous Limestone." It appears that hitherto these shells have been considered as dwarf forms of *Cardiomorpha oblonga*, with which species they have really nothing in common. The characters distinguishing *C. limosa* from *C. oblonga* are the more regularly ovate form, the umbones being not so spirally coiled, the shell never attaining to one-fifth the size of the latter, and the comparatively greater development of the anterior end.

It is more difficult, however, to distinguish this species from the genus *Schizodus*, to which it has, from its peculiar shape, a very close resemblance. The hinge and the groove for the external ligament just below the umbo are, however, characteristic of the genus. The dorsal slope is not so hollow, nor is the posterior end so truncate.

As far as I can ascertain at present this species has not been found in England or Ireland. From the associated fauna—*Nucula*, *Nuculana*, and a number of small Gasteropoda—it would appear that the beds in which these species occur were laid down in comparatively shallow water, which probably in a large measure accounts for the small size of the individuals of this species; for with the exception of *C. parva*, to be next described, all the representatives of the genus attain a large size. Mr. Neilson says that this species is rare, but moderately common in one bed in the Middle Ironstone and Coal series; but as this bed is only rarely exposed, during sinking to reach the Lower Fossil Ironstones, few specimens can be obtained. The Middle Coal and Ironstone series consists almost exclusively of fresh-water beds, there being only one thin bed containing marine fossils, and these even are confined to those species which could stand a large mixture of fresh water.

CARDIOMORPHIA PARVA, *Hind*, sp. nov. Plate XIX, figs. 17—21.

Specific Characters.—Shell small, globosely triangular, the transverse and dorso-ventral diameters almost equal, inequivalve.

The anterior end is short, its upper border, descending rapidly downwards, makes it very short from above downwards in the extreme front; its upper portion being excavated below, the overhanging umbo is concave. The border is almost elliptically curved, and passes into the ventral edge without a break. The latter border is very slightly convex, and forms the greatest transverse diameter of the shell. The posterior border is subtruncate, making an obscure obtuse angle with the hinge-line; but below it is gradually rounded off into the inferior border.

The hinge-line is arcuate, the umbones comparatively large, much raised, prosogyrous, and contiguous, though the points are far apart.

The valves are convexly swollen from above downwards, and from before backwards, the greatest degree of convexity being about the middle point of the valve. There is a very slight amount of compression at the postero-superior angle.

Interior.—The muscle-scars, pallial line, and hinge have not yet been exposed.

Exterior.—The surface is ornamented with very fine concentric striæ, visible only with the microscope; but over the umbones these lines become obsolete.

Dimensions.—Fig. 21, Pl. XIX, measures—

Antero-posteriorly	11 mm.
Dorso-ventrally	10 mm.
Elevation of valve	5 mm.

Localities.—England: the Redesdale Ironstone, Redesdale, Northumberland. Scotland: Upper Limestone series of Orchard and Clonbeith, Kilwinning; Lower Limestone series of Waterland, near Dunlop; Shale between the Lower Limestones, Gateside, Beith.

Observations.—I have erected this species on a fairly numerous suite of specimens from the Redesdale Ironstone, collected by Mr. John Dunn, of Redesdale, and myself. I have referred the shell to the genus *Cardiomorpha* on external characters only, as at present I have not been able to discover any specimens showing the hinge-plate or the interior. The shape and markedly prosogyrous umbones are, however, very typical of the genus. This species never appears to attain to any considerable size, fig. 21, Pl. XIX, being the largest specimen I have yet obtained. Fig. 17, Pl. XXI, is the only specimen with both valves in contact which I have yet seen. I figure also a series showing the shell in all stages of growth from a very small size to the full-grown adult.

De Koninck, in his 'Description des animaux fossiles,' &c., p. 100, described a species, apparently of *Cardiomorpha*, under the name of *Isocardia pumila*, which agrees with *C. parva* in its small size, but has its dorso-ventral diameter greater than the transverse. This species has been lost sight of, and is not redescribed in de Koninck's later work, so that it has been impossible for me to examine the specimen. The species was founded on two specimens from the Limestone of Visé.

From the only other small species of this genus (*Cardiomorpha limosa*), *C. parva* can at once be distinguished by its less transverse and more globose shape.

I do not think it probable that we have to do here with a dwarfed form of one of the larger species of *Cardiomorpha*, though in shape it very closely resembles *C. orbicularis*, M'Coy. Other dwarfed forms of species associated with the latter shell are not found in the Redesdale fauna, which, especially with regard to the bivalves, is very different from that which is found in the Carboniferous Limestone. Both species, however, occur at horizons which have beds containing *Productus giganteus* both above and below them.

CARDIOMORPHA CORRUGATA, *M'Coy*, 1844. Plate XXIII, figs. 5—7.

CARDIOMORPHA CORRUGATA, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 56, pl. viii, fig. 15.
— — *d'Orbigny*, 1850. Prod. Pal. Strat., vol. i, p. 133.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 190.
— — *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
ISOCULIA CORRUGATA, *M'Coy*, 1862. Synops. Carb. Foss. Ireland, 2nd edit., pl. viii, fig. 15.
CARDIOMORPHA CORRUGATA, *Bigsby*, 1878. Thesaurus Devonico-Carbonif., p. 301.
ISOCULIA CORRUGATA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 18, pl. viii, fig. 5; pl. ix, figs. 5—9.
? — UNDATA, *de Koninck*, 1885. Ibid., p. 18, pl. x, figs. 3, 27, 28.
CARDIOMORPHA CORRUGATA, *Etheridge*, 1888. Brit. Foss., vol. i, Palæoz., p. 280.

Specific Characters.—Shell large, gibbose, slightly transverse, obliquely suborbicular. The anterior end is shorter and compressed, especially at the postero-superior angle, where it is concave. This compression is continued along and below the anterior portion of the hinge-line, forming a well-marked excavation below the prosogyrous umbo, and takes the place of a lunule, which is really absent. The antero-superior angle is well marked, and is a rounded right angle, from which point the border descends in a regular, almost semicircular curve, sweeping round and continuous with the curvature of the lower border (which, however, is the segment of a larger circle than that forming the anterior edge), and passes into the posterior border without a break. The latter is regularly curved, larger than the anterior border; and it passes gradually into the hinge-line above, so that the antero-inferior border forms one general curve of varying intensity. The hinge-line is long, elevated, and almost straight in front, slightly arched and produced posteriorly.

The umbones are large, gibbose, produced and twisted forwards, with their apices curled on themselves, pointing downwards, outwards, and forwards; much raised above the hinge-line and contiguous.

The umbonal swelling expands rapidly, and forms the general convexity of the valve, which is somewhat oblique in direction, the shell becoming gradually less convex towards the borders. Parallel with the hinge-line is a narrow elongate groove for the external ligament; it becomes shallower and broader posteriorly.

Interior.—The position of the anterior adductor muscle has not yet been exposed, but the posterior is large and fairly deep, situated on the dorsal slope, well within the margin. Pallial line simple. Casts show the usual elongated groove for the posterior portion of the edentulous hinge-plate, and they show a series of deep concentric regular grooves,—deeper, in fact, than are indicated on the preserved exterior of the shell.

Exterior.—The surface is covered with very numerous, fine, concentric lines of growth, and on the anterior and posterior portions of the shell these are thrown into a series of regular folds and sulci, which are almost obsolete over the median portion of the valve and at the antero-superior angle. These folds are narrow and close at the umbo, but become more widely separated and larger as they approach the lower border. Shell thin.

Dimensions.—Pl. XXIII, fig. 5, the type specimen, measures—

Antero-posteriorly	103 mm.
Dorso-ventrally	100 mm.
From side to side, single valve . . .	35 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud and Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Malahide, St. Dooghlas, co. Dublin; also obtained in co. Limerick, but the locality was not given.

Observations.—M'Coy's species, *C. corrugata*, is very distinct, being separated at once from all other species of the genus by its general shape and ornament. It seems to attain a much larger size than any other, but with advanced growth becomes more transversely oval and less orbicular. De Koninck separated this species from *Cardiomorpha*, placing it in the genus *Isoculia*, which name, it seems, M'Coy had proposed for the shell on which de Koninck founded *Cardiomorpha*, being unaware of this fact. This name, however, only appeared by mistake in the explanation of a plate, and was never really brought into use by M'Coy. De Koninck bases his reason for separating *C. corrugata* from *Cardiomorpha* on the strength of it possessing a lunule—an observation which I believe to be erroneous. There is really no lunule marked out by definite lines; but, in common with all species of *Cardiomorpha*, *C. corrugata* has its anterior and upper part compressed and hollowed without there being a definite lunule. The hinge-line of the species under discussion is very much compressed and raised in front, so as to stand erect (see figs. 5 and 6, Pl. XXIII); and, though the sulci and ridges are absent lower down, there is no definite lunule marked off by a distinct margin from the rest of the upper surface of the valve. If *C. corrugata* has a lunule, all other species of the genus have exactly the same character quite as well developed. De Koninck has mistaken the absence of ridges and sulci at the extreme antero-superior angle, and taken the resulting smoothness as evidence of a lunule. He says (*op. cit.*, p. 17), "Isoculia . . . se distingue non seulement par les fortes rides concentriques, mais encore par la lunule qu'elle posède au-dessous de ses crochets. . . . C'est principalement ce dernier caractère qui sert à séparer le genre *Isoculia* du genre *Cardiomorpha*, dont les espèces sont complétement depourvues. J'ajouterai encore que les crochets de ces dernières espèces sont beaucoup moins enroulés et moins profondément situés que ceux des espèces appartenant au genre voisin." The umbones are, perhaps, somewhat less enrolled than those of *C. oblonga*, but are more so than in *C. parva*. *C. ventricosa* possesses well-marked concentric grooves; and I therefore see no ground for retaining de Koninck's genus *Isoculia*, under which he described only two forms. "*Isoculia undata*," he says, "a les plus grands rapports avec *l'Isocula corrugata*, F. M'Coy, et je l'eusse considérée comme ne formant que le jeune âge de celle-ci, si le paléontologiste Irlandais n'avait fait remarquer, et si moi-même je n'avais pu constater qu'en cet état sa forme était généralement subcirculaire, tandis que celle de *l'Isoculia undata* est ovale. C'est principalement dans cette différence de forme que réside son caractère distinctif." Both these species occur together at the same horizon in Belgium, and I think it is probable that a large suite of specimens would show that this form is merely a variety of M'Coy's species.

De Koninck says that *C. corrugata* is limited to the middle or Waulsortian division of the Belgian Carboniferous series, and claims that it is characteristic of this division in Ireland; but, unfortunately for this view, it occurs with a fauna of Visean facies at St. Dooghlas, and I have collected a specimen (fig. 7, Pl. XXIII) from the uppermost beds of the Carboniferous Limestone of Derbyshire.

CARDIOMORPHA EGERTONI, *M'Coy*, sp., 1844. Plate XXIV, figs. 1 and 2; Plate XXV, figs. 1—4.

CYPRINA EGERTONI, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 55, pl. x, fig. 9.
CARDIUM ORBICULARE, *M'Coy*, 1844. Ibid., p. 56, pl. xii, fig. 7.
MACTRA INCRASSATA, *M'Coy*, 1844. Ibid., p. 52, pl. xix, fig. 8.
CYPRINA EGERTONI, *d'Orbigny*, 1850. Prodrome de paléontol., p. 133.
— — *Morris*, 1854. Catal. Brit. Foss., p. 199.
MACTRA INCRASSATA, *Morris*, 1854. Ibid., p. 209.
CARDIUM ORBICULARE, vel EDMONDIA, *Morris*, 1854. Ibid., p. 193.
EDMONDIA EGERTONI, *M'Coy*, 1855. Brit. Pal. Foss., p. 500.
CYPRINA EGERTONI, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
Non EDMONDIA EGERTONI, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasg., vol. iii, Supplement, p. 51.
— — — — 1876. Cat. West-Scott. Foss., p. 53.
CARDIOMORPHA EGERTONI, *Bigsby*, 1878. Thesaurus Devonico-carbonif., p. 301.
— — *Etheridge*, 1885. Brit. Foss., vol. i, Palæozoic, p. 280.
MACTRA INCRASSATA, *Etheridge*, 1885. Ibid., p. 285.
CARDIUM ORBICULARE, *Etheridge*, 1885. Ibid., p. 281.
PACHYDOMUS EGERTONI, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat., vol. xi, p. 25, pl. v, fig. 4; pl. vi, figs. 3, 4, 15, 16.
— DEPRESSUS, *de Koninck*, 1885. Ibid., p. 25, pl. iv, figs. 1, 2.
— MACCOYI, *de Koninck*, 1885. Ibid., p. 26, pl. v, figs. 11, 12.
EDMONDIA ORBICULATA, *de Koninck*, 1885. Ibid., p. 40, pl. iii, fig. 12; pl. vii, figs. 1, 2, 15, 16.

Specific Characters.—Shell large, triangular orbicular, only slightly inequivalve, regularly but only moderately convex. The anterior end is large, compressed, and narrowed in the dorso-ventral diameter. Its border is more or less semicircularly rounded, and passes with a regular sweep into the hinge-line above and the ventral border below. The latter is rounded, the segment of a larger circle than that of the anterior edge. The posterior border is also rounded; but above there is an approach towards truncation, the postero-superior angle being obscurely obtuse. The hinge-line is gently arched and extended; the posterior portion being almost straight and elevated. The umbones are obtuse, tumid, twisted inwards and forwards, and only slightly curved on themselves, slightly elevated above the hinge-line, contiguous, and subcentral. There is no lunule, but a narrow elongate escutcheon exists, in the front part of which is lodged the external ligament.

The shell is regularly curved, and is gradually compressed into its margins. Owing to the direction of the umbones, and the depressed anterior end, the general gibbosity appears to be somewhat oblique, and there is an approach to compression at the postero-superior angle.

Interior.—The anterior adductor muscle-scar is large, ovate, and very inconspicuous, remote from the margin, in the anterior umbonal hollow. The posterior scars almost obsolete, situated on the dorsal slope. The hinge consists of a thickened plate at right angles to the valve, which leaves a groove in casts; edentulous. Pallial line entire, almost obsolete. The surface of casts is marked by obscure, fine, radiating striæ.

Exterior.—The surface is ornamented with numerous well-marked but fine concentric lines of growth, with an occasional deeper one at irregular intervals. Shell thick.

Dimensions.—Fig. 4, Pl. XXV, the type of M'Coy's "*Cyprina Egertoni*," measures—

Antero-posteriorly	97 mm.
Dorso-ventrally	87 mm.
Elevation of valve	33 mm.

Localities.—England: the Carboniferous Limestone of Narrowdale, Staffordshire; Castleton, Derbyshire; Lowick, Northumberland; Scotland: the Carboniferous Limestone series of Longniddry, Haddingtonshire. Ireland: the Carboniferous Limestone of Millicent, co. Cork; Nanteenan, co. Limerick; and St. Dooghlas, co. Dublin.

Observations.—This species is easily recognised by its orbicular shape, thick shell, and the small degree of inrolment of the umbones. De Koninck placed this species in the genus *Pachydomus* of Morris, established in 1845 for some large bivalves from New South Wales. I am at a loss to understand on what grounds he thought it right to place a shell with an edentulous hinge-plate in a genus whose hinge is described as follows by Morris in Strzelecki's 'New South Wales and Van Diemen's Land,' p. 271:—"Hinge-line sunk, with an antiquated area, and one or two (?) large teeth in each valve." In this genus the muscle-scars are very well marked.

De Koninck says of the genus, "Dents nulles, remplacées par un étroit bourrelet lisse." The hinge is, in fact, so very similar to that of *Cardiomorpha*, described by the same author, that I have retained the shell in this family. If in the future it should be thought that the absence of inrolled umbones and the orbicular form are sufficient to separate it from this genus, it is possible that it may have some affinity to *Paracyclas* of Hall. *C. corrugata* and *C. orbicularis* seem, however, to form well-defined intermediate stages between *C. oblonga* and the species under description. M'Coy soon changed his view as to the generic character of this species, for he relegated it to *Edmondia*, with which it has certain resemblances; and it seems, indeed, to be a link between that genus and *Cardiomorpha*.

De Koninck figures several shells (*op. cit.*) under the names *Pachydomus Egertoni*, *P. depressus*, and *P. MacCoyi*, which I am disposed to regard as the same species. Curiously enough, the shells which he refers to M'Coy's species are less like the type than either of the others, being less orbicular and more transverse; but such a variety occurs in Ireland, an example of which I figure, Pl. XXIV, fig. 1. The first and third of these are stated to occur in étage II, Pauquys, the second in étage I, Visé; which to some extent accounts for the number of species. Both M'Coy and de Koninck describe this species as possessing a lunette, but this is a mistake. In M'Coy's type specimen the shell is absent at the antero-superior part, and the groove for the hinge-plate in the cast has been perhaps mistaken for a lunule; but an examination of Figs. 1 and 3 *a*, Pl. XXV, shows that, in common with all other species of the family, *P. Egertoni* has no lunule. I have no hesitation in referring the *Cardium orbiculare* and *Mactra incrassata* of M'Coy to this species, the type specimens of which I figured, Pl. XXV, fig. 2. The latter shows a series of equidistant, deep, concentric grooves in the cast, which has been mistaken by M'Coy for the external surface, although a portion of the shell is preserved lower down. This character is also present in Fig. 1, Pl. XXV, a specimen from Nanteenan, co. Limerick, in the collection of the Geological Survey of Ireland, which fortunately has the shell preserved on the other valve. This character is an approach towards the concentric markings of *C. ventricosa* and *C. corrugata*, and is another character showing the affinity of the species to the genus *Cardiomorpha* rather than to *Edmondia*.

The original type of *Cardium orbiculare* is extant in the Griffith Collection of the Museum of Science and Art, Dublin, and it is figured in Fig. 2, Pl. XXIV. Both valves are preserved with a portion of the shell, but they have slipped somewhat one on another. This is a younger example than the type of *C. Egertoni*, and consequently the shell is not so thick.

C. Egertoni is quoted by Messrs. Young and Armstrong in their List of Carboniferous Lamellibranchs from the West of Scotland under the generic name "*Edmondia*." The shells which I find with this name attached in Scottish collections are *Edmondia senilis*, Phillips, sp., and I have not yet come across this species in the Carboniferous series of the West of Scotland. They also mention *Mactra? incrassata* as occurring at Craigenglen, but I have not seen any shell that I can identify as the species.

PLATE XVI.

Fig. 1.—*Schizodus Harii.* A left valve from the Upper Coal-measures, Kansas, U.S.A. My Collection. (Page 214.)

Fig. 1 *a.*—*Schizodus Harii.* The hinge of the same specimen, figured to give an idea of the typical hinge of the genus as developed in a large example. *x*, anterior tooth; *y*, bifid cardinal tooth; *z*, elongate posterior lateral tooth. (Page 214.)

Fig. 2.—*Schizodus Pentlandicus.* The interior of a right valve, with the hinge-teeth and muscle-scars. From the Calciferous-sandstone series, Woodhall, Water of Leith. In the York Museum. (Page 217.)

Fig. 3.—*Schizodus Pentlandicus.* The hinge of fig. 7; a left valve with, *a*, the anterior tooth; *b*, the cardinal tooth; *c*, the posterior lateral tooth. Same locality and Collection. (Page 217.)

Fig. 4.—*Schizodus Pentlandicus.* The hinge-plate of a right valve; *a*, anterior tooth; *b*, cardinal tooth; *c*, posterior lateral tooth. From the Calciferous-sandstone series of Randerstone, Fife. My Collection. (Page 217.)

Fig. 5.—*Schizodus Pentlandicus.* A right valve. Same locality. My Collection. (Page 217.)

Figs. 6 and 7.—*Schizodus Pentlandicus.* A right and left valve. From Woodhall, Water of Leith. In the York Museum. (Page 217.)

Fig. 8.—*Schizodus Pentlandicus.* A left valve from Randerstone, Fife. My Collection. (Page 217.)

Fig. 9.—*Schizodus Pentlandicus.* A right valve from the roof of the Coopers-eye Coal, Scremerston, Northumberland. In the Collection of the Woodwardian Museum, Cambridge. (Page 217.)

Fig. 10.—*Schizodus axiniformis.* A cast, the type specimen of Sowerby's *Donax (?) sulcata.* From the Pennystone Ironstone, Coalbrookdale. In the British Museum (Nat. Hist.), Geol. Department. (Page 219.)

Fig. 10 *a.*—*Schizodus axiniformis.* The type specimen viewed from above. (Page 219.)

Fig. 11.—*Schizodus axiniformis.* A very large and fine example, semi-decorticated. From the Redesdale Ironstone. My Collection. (Page 219.)

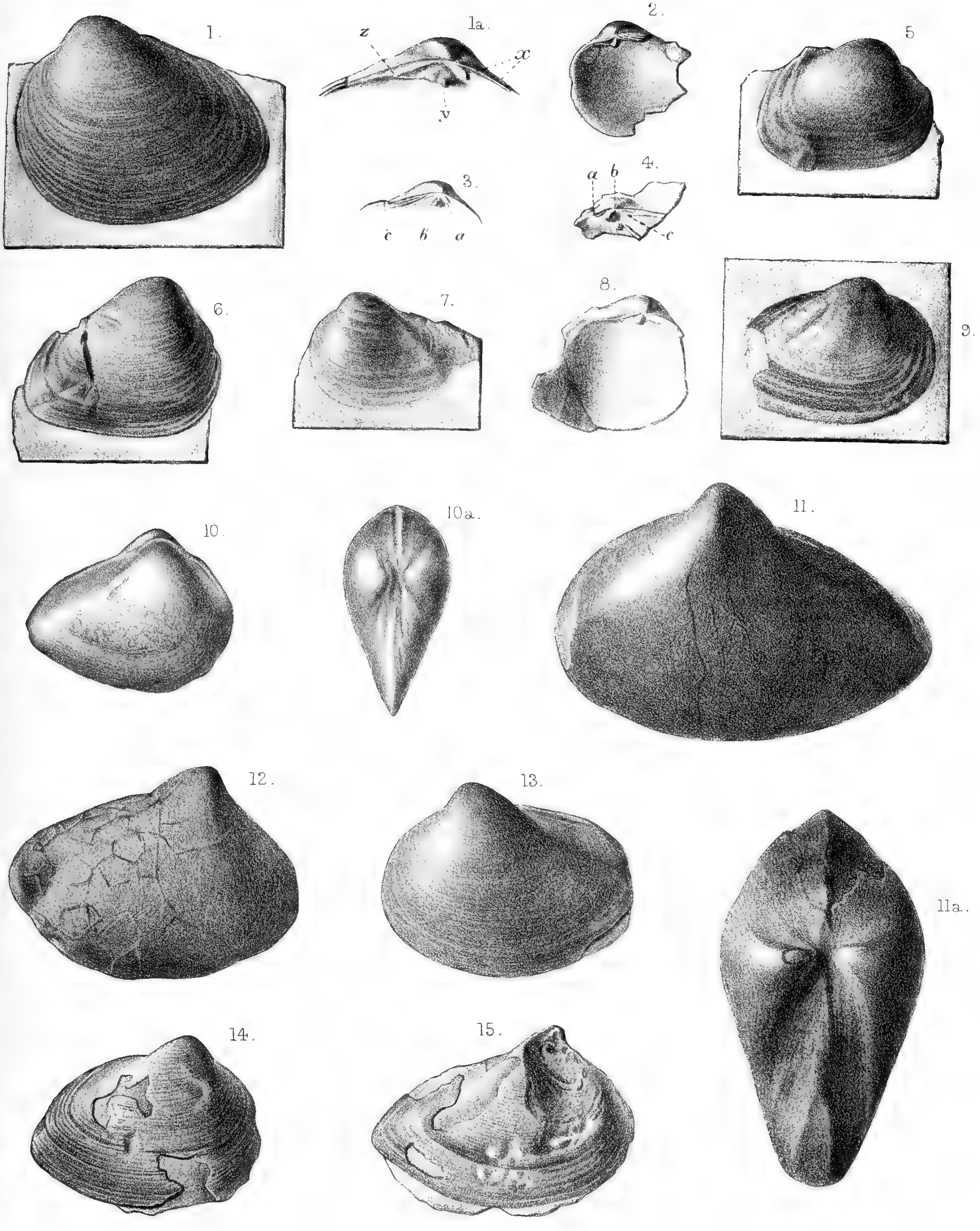
Fig. 11 *a.*—*Schizodus axiniformis.* The same specimen viewed from above. (Page 219.)

Figs. 12 and 13.—*Schizodus axiniformis.* Two other specimens exhibiting slight differences in the contour of the posterior extremity. Same locality. My Collection. (Page 219.)

Fig. 14.—*Schizodus axiniformis.* A right testiferous valve. Same locality. My Collection. (Page 219.)

Fig. 15.—*Schizodus axiniformis.* A right testiferous valve. Same locality. My Collection. (Page 219.)

PLATE XVI.



H. Searle del et lith

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PLATE XVII.

Fig. 1.—*Schizodus axiniformis.* A cast from the Redesdale Ironstone. My Collection. (Page 219.)

Fig. 2.—*Schizodus axiniformis.* The cast of an adult example from the Pennystone Ironstone, Coalbrookdale. My Collection. (Page 219.)

Fig. 3.—*Schizodus axiniformis.* A cast from the Redesdale Ironstone. My Collection. (Page 219.)

Fig. 4.—*Schizodus axiniformis.* A young example. Same locality. My Collection. (Page 219.)

Fig. 5.—*Schizodus axiniformis.* Showing portion of the hinge in the right valve. Same locality. My Collection. (Page 219.)

Fig. 6.—*Schizodus axiniformis.* Showing the hinge of a left valve. Same locality. My Collection. (Page 219.)

Fig. 7.—*Schizodus carbonarius.* The type specimen of Sowerby's *Venus carbonaria.* From the Pennystone Ironstone, Coalbrookdale. In the British Museum (Natural Hist.), Geological Department. (Page 222.)

Fig. 7 *a.*—*Schizodus carbonarius.* The same specimen viewed from above. (Page 222.)

Fig. 8.—*Schizodus carbonarius.* A fairly perfect specimen. From the same locality. My Collection. (Page 222.)

Fig. 8 *a.*—*Schizodus carbonarius.* The anterior aspect of the same specimen. (Page 222.)

Fig. 9.—*Schizodus carbonarius.* A very large and perfect example from the same horizon. In the Woodwardian Museum, Cambridge. (Page 222.)

Fig. 10.—*Protoschizodus axiniformis.* The type of *Amphidesma axiniformis*, Portlock. In the Museum of the Geological Survey, Jermyn Street. (Page 228.)

Fig. 11.—*Protoschizodus axiniformis*, var. *depressus.* The type of *Amphidesma carbonaria*, Portlock. In the same Collection. (Page 232.)

Fig. 12.—*Protoschizodus axiniformis*, var. *depressus.* The type of *Amphidesma carbonaria*, var. *depressa.* In the same Collection. (Page 232.)

Fig. 13.—*Protoschizodus axiniformis.* The type of *Amphidesma deltoidea*, Portlock. In the same Collection. (Page 228.)

Fig. 14.—*Protoschizodus axiniformis.* The cast of both valves, showing muscle-scars and pallial line. From one of the Lowick Limestones. In the Woodwardian Museum, Cambridge. (Page 228.)

Fig. 15.—*Protoschizodus impressus.* A specimen from Tournay, Belgium.

Fig. 15 *a.* Showing the hinge-teeth of the left valve. (Page 234.)

Fig. 16.—*Protoschizodus axiniformis.* A left testiferous valve. From the Redesdale Ironstone. My Collection. (Page 228.)

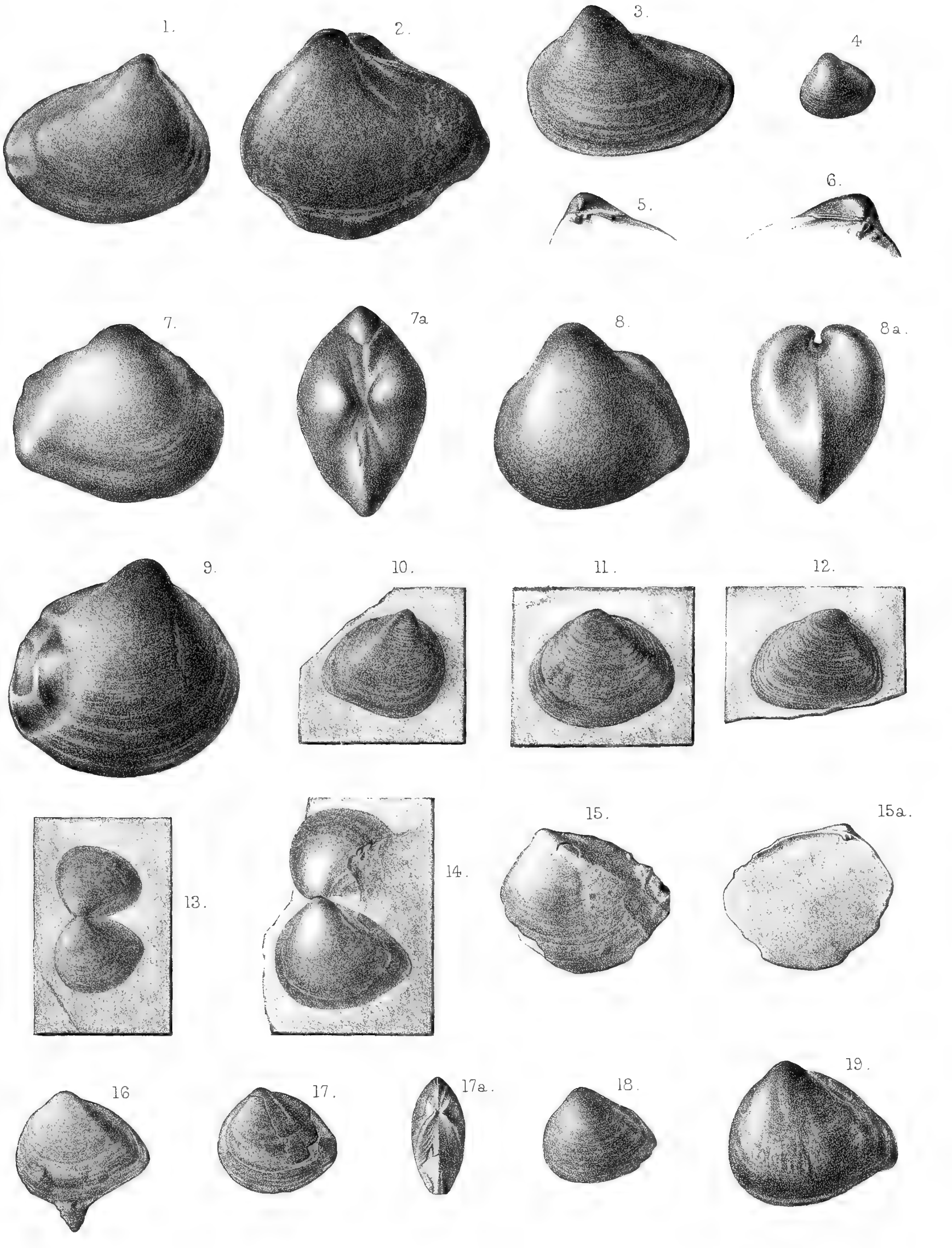
Fig. 17.—*Protoschizodus axiniformis.* A perfect example. From the Redesdale Ironstone, Bellingham. My Collection. (Page 228.)

Fig. 17 *a.*—*Protoschizodus axiniformis.* The same specimen viewed from above. (Page 228.)

Fig. 18.—*Protoschizodus axiniformis.* A perfect example. From the Upper Limestone series, Garngad Road, Glasgow. In the Collection of Mr. James Neilson. (Page 228.)

Fig. 19.—*Protoschizodus axiniformis.* The cast of a full-sized shell. From the Upper Limestone series of Newfield, Scotland. (Page 228.)

PLATE XVII.



A.H.Searle del. et lith.

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PLATE XVIII.

Fig. 1.—*Ctenodonta sinuosa*. A cast of the right valve, showing muscle-scars, hinge-teeth, and pallial line, from a marine band below the Third Millstone-grit, Congleton Edge, Cheshire. My Collection. (Page 210.)

Fig. 1 *a*.—*Ctenodonta sinuosa*. The hinge-plate of the same specimen enlarged.

Fig. 2.—*Ctenodonta sinuosa*. A perfect cast, showing hinge-plate. Same locality and collection. (Page 210.)

Fig. 3.—*Ctenodonta sinuosa*. A testiferous example. Same locality and collection. (Page 210.)

Fig. 4.—*Ctenodonta sinuosa*. A younger example, with 4 *a*, the upper surface showing the narrow escutcheon. Same locality and collection. (Page 210.)

Figs. 5, 6.—*Ctenodonta sinuosa*. Two young specimens to show the truncate, obtuse posterior end in this stage of existence. Same locality and collection. (Page 210.)

Fig. 7.—*Protoschizodus impressus*. A testiferous left valve from the Upper Limestone series of Orchard, near Glasgow. In the Collection of Mr. J. Neilson. (Page 233.)

Fig. 8.—*Protoschizodus impressus*. A perfect cast from one of the Lowick Limestones, showing muscle-scars and pallial line. In the Woodwardian Museum, Cambridge. With fig. 8 *a*, a view from above. (Page 233.)

Fig. 9.—*Protoschizodus impressus*. A smaller cast. Same locality and collection. (Page 233.)

Fig. 10.—*Protoschizodus obliquus*. A decorticated specimen from the Lower Limestone of Beith. 10 *a*.—View from above. My Collection. (Page 235.)

Fig. 11.—*Protoschizodus triangularis*. A fairly perfect cast from the Lower Limestone series of Beith. My Collection. (Page 242.)

Figs. 12, 13.—*Protoschizodus triangularis*. Two casts from the same locality. My Collection. (Page 242.)

Fig. 14.—*Protoschizodus trigonalis*. An almost perfect specimen from the upper beds of the Carboniferous Limestone, Castleton, Derbyshire. With 14 *a*, a view from above. My Collection. (Page 238.)

Fig. 15.—*Protoschizodus subæqualis*. A right valve from the upper beds of the Carboniferous Limestone, Hill Bolton, Yorks. My Collection. (Page 239.)

Figs. 16—19.—*Protoschizodus subæqualis*. A series of specimens from the Carboniferous Limestone of Thorpe Cloud, Derbyshire. These appear much too flat in the drawing. They are very gibbose, with a much compressed and depressed posterior superior wing. My Collection. (Page 239.)

Fig. 20.—*Protoschizodus rectangularis*. From the Carboniferous Limestone of Settle. Burrow Collection of the Woodwardian Museum, Cambridge. This specimen is much too flat in the drawing. (Page 237.)

Fig. 21.—*Protoschizodus orbicularis*.—A full-sized example of a left valve from the marine band below the Third Grit, Congleton Edge. My Collection. (Page 241.)

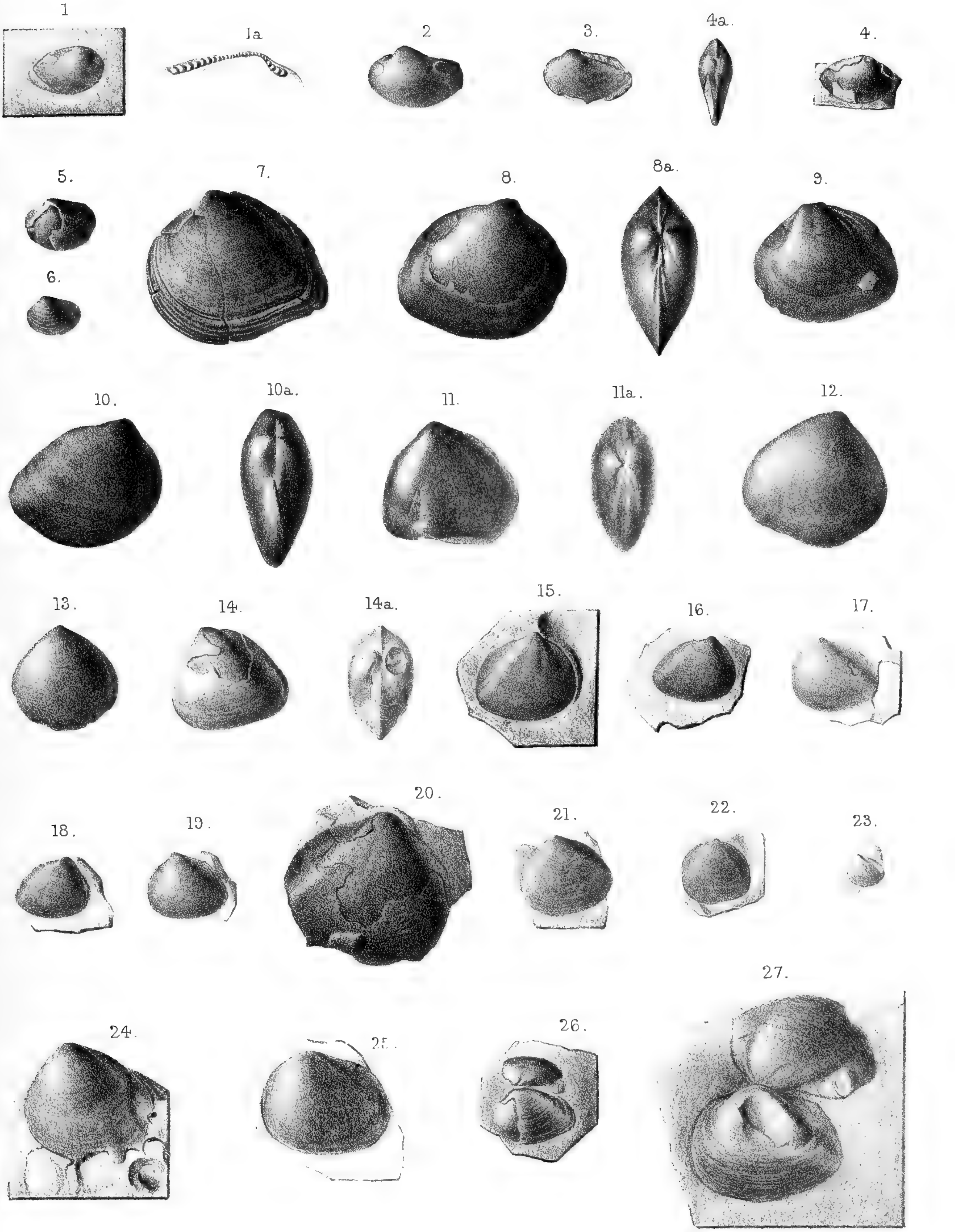
Fig. 22.—*Protoschizodus orbicularis*. The cast of a left valve, showing muscle-scars, pallial line, and the impression of the hinge-teeth. Same locality. My Collection. (Page 241.)

Fig. 23.—*Protoschizodus orbicularis*. A small specimen of the left valve. Same locality and collection. (Page 241.)

Figs. 24, 25.—*Schizodus antiquus*. Two imperfect casts of the left valve, showing the pallial line and muscle-scars from bed of a calcareous sandstone below the Millstone grits, Pule Hill, Marsden. My Collection. (Page 225.)

Fig. 26.—*Schizodus antiquus*. A small testiferous example from the roof of the Bay Coal, Longton. Collection of Mr. J. Ward. (Page 224.)

Fig. 27.—*Schizodus antiquus*. A fine specimen of both valves from the shales below the grits of Pule Hill, Marsden. Collection of Mr. W. F. Holroyd. (Page 224.)



A.H.Searle del et lith.

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PLATE XIX.

Fig. 1.—*Protoschizodus impressus.* The original of the shell figured by the Rev. David Ure in his 'History of Rutherglen and East Kilbride,' pl. xv, fig. 2. From the latter locality. In the Ure Collection of the Royal Soc. of Edinburgh. (Page 233.)

Fig. 2.—*Protoschizodus rectangularis.* A right valve from Ballyhomock, co. Limerick. Geological Survey of Ireland Collection. [The actual shape is more compressed on the dorsal slope than shown in the figure.] (Page 237.)

Fig. 3.—*Protoschizodus rectangularis,* the type specimen of M'Coy's *Dolabra rectangularis* from Bundoran. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 237.)

Fig. 4.—*Schizodus antiquus.* A right valve from the shales below the Millstone-grit, Vale of Todmorden. In the Geological Collection of the Manchester Museum, Owens College. (Page 225.)

Fig. 5.—*Schizodus antiquus.* A right valve from the Millstone-grit series at Holt Head, near Slaithwaite, Yorkshire. In the Collection of Mr. J. Barnes, of Manchester. (Page 224.)

Fig. 6.—*Schizodus antiquus (?),* Young (?). The shell figured as Anthracosia by Mr. Wild, 'Trans. Manch. Geol. Soc.,' vol. xxi, pl. ii, fig. 7. From the roof of the Bullion Mine, Carre Heys, Colne. In the Manchester Museum, Owens College. (Page 225.)

Fig. 7.—*Protoschizodus obliquus.* The cast of the interior of a large right valve from Easter Bucklyvie, Donibristle. In the Collection of the Geological Survey of Scotland. (Page 235.)

Fig. 8.—*Protoschizodus obliquus.* A testiferous example of the right valve. Same locality and collection. (Page 235.)

Fig. 9.—*Protoschizodus obliquus.* The type specimen of M'Coy's *Axinus obliquus* from Mullaghtenny, Clogher, co. Tyrone. In the Griffith Collection of the Science and Art Museum, Dublin. (Page 235.)

Fig. 10.—*Protoschizodus nuculoides.* A testiferous example of the left valve from the encrinite bed, Broom Hill, St. Andrews. In the Collection of the Geological Survey of Scotland. (Page 243.)

Fig. 11.—*Protoschizodus nuculoides.* The type specimen of M'Coy's *Anatina deltoidea* from Townplots, Killala. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 243.)

Fig. 12.—*Protoschizodus nuculoides.* The cast of a left valve. Same locality and collection as Fig. 10. (Page 243.)

Figs. 13—16.—*Protoschizodus nuculoides.* A series of small examples from Dromard, Draperstown, co. Londonderry. In the Collection of the Woodwardian Museum, Cambridge. Fig. 14 shows the hinge of the right valve. (Page 243.)

Fig. 17.—*Cardiomorpha parva.* A perfect example from the Upper Limestone series of Clonbeith, Kilwinning. In the Collection of Mr. J. Smith, of Kilwinning. (Page 270.)

Fig. 17 *a.*—*Cardiomorpha parva.* The same specimen viewed from above. (Page 270.)

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Fig. 20.—*Cardiomorpha parva.* A right valve, same locality and collection. (Page 270.)

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Fig. 20 *b.*—*Cardiomorpha parva.* The same specimen viewed from in front. (Page 270.)

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Fig. 22.—*Protoschizodus magnus.* A bivalve testiferous example from the Carboniferous Limestone of Ballyhomock, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 245.)

Fig. 22 *a.*—*Protoschizodus magnus.* The same specimen viewed from above.

Fig. 23.—*Protoschizodus magnus.* A cast from the Carboniferous Limestone of Little Island, co. Cork. In the Collection of Mr. J. Wright, of Belfast. (Page 245.)

PLATE XIX.

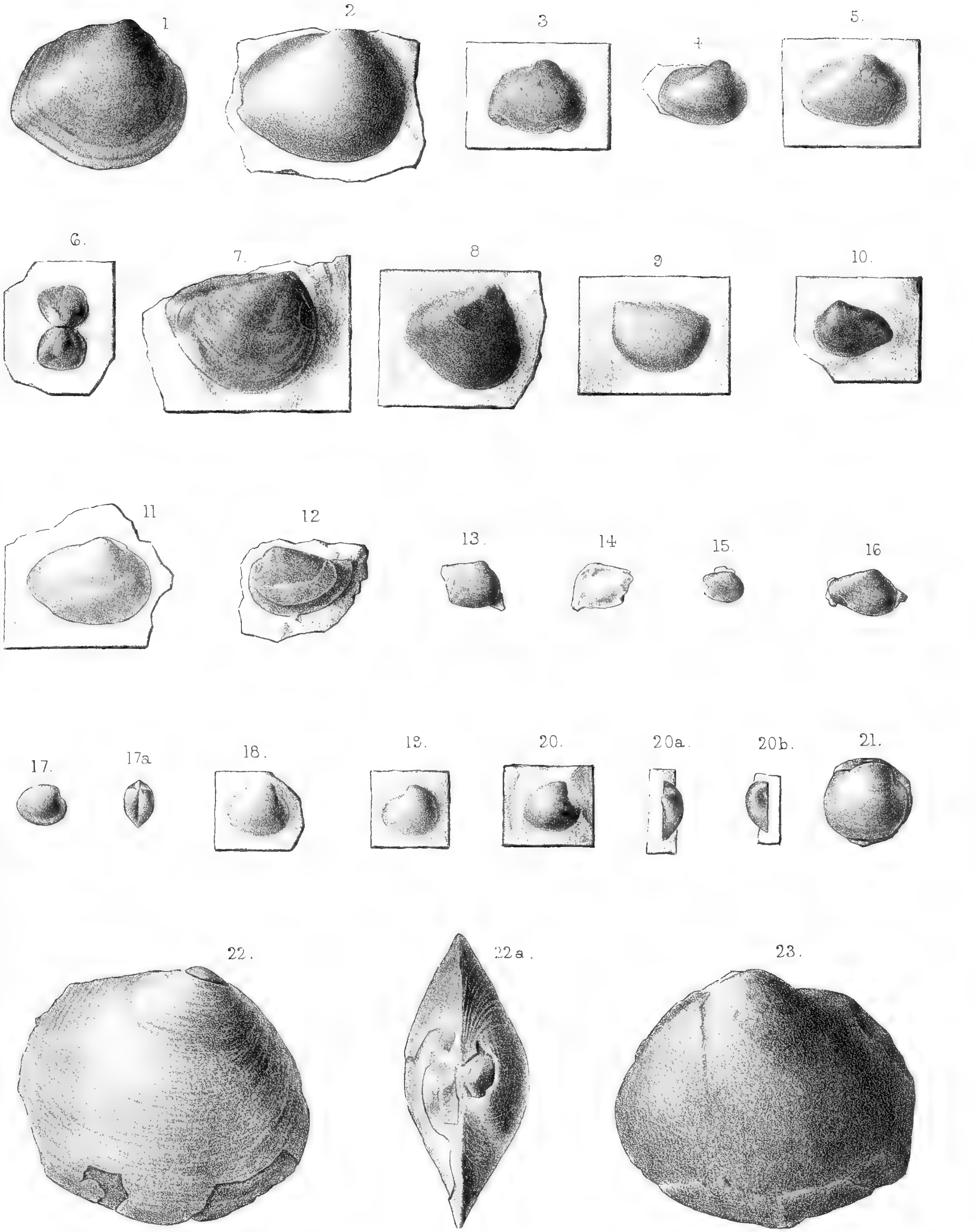

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PLATE XX.

Figs. 1—3.—*Protoschizodus subtruncatus.* Three very imperfect examples from the upper beds of the Carboniferous Limestone, Park Hill, Derbyshire. My Collection. (Page 248.)

Fig. 4.—*Protoschizodus subtruncatus.* The type specimen of M'Coy's *Amphidesma subtruncata*, from Millicent, co. Cork. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 248.)

Fig. 5.—*Protoschizodus æquilateralis.* A fine testiferous specimen from the Magazine Limeworks, Pathhead. In the Collection of the Geological Survey of Scotland. (Page 246.)

Fig. 6.—*Protoschizodus fragilis.* The type specimen of *Leptodomus fragilis*, M'Coy. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 250.)

Fig. 7.—*Protoschizodus æquilateralis.* The type specimen, very imperfect, of *Dolabra æquilateralis*, M'Coy, from the Carboniferous shale of Doorin, co. Donegal. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 246.)

Fig. 8.—*Protoschizodus fragilis.* A right valve from the Redesdale Ironstone beds, Redesdale. My Collection. (Page 250.)

Fig. 9.—*Protoschizodus fragilis.* A young example with the shell partially preserved, from the Carboniferous Limestone of Limerick. In the Collection of the Geological Survey of Ireland. (Page 250.)

Fig. 10.—*Protoschizodus æquilateralis.* A somewhat imperfect bivalve example from the Carboniferous Limestone of Clonmel. In the Collection of Mr. J. Wright. (Page 246.)

Fig. 11.—*Protoschizodus æquilateralis.* A cast of the right valve from the Limestone of Monaster. Same Collection. (Page 246.)

Fig. 12.—*Protoschizodus æquilateralis.* A bivalve example from Burn Anne, Scotland. In the Collection of the Geological Survey of Scotland. (Page 246.)

PLATE XX.

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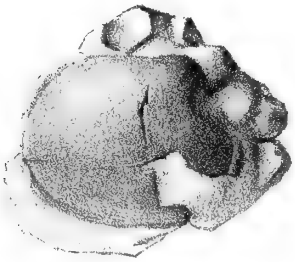

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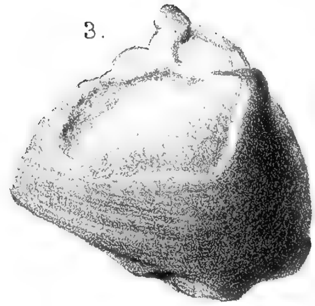

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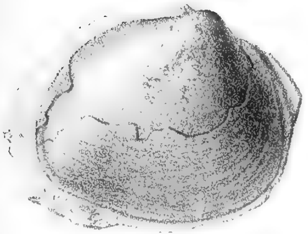

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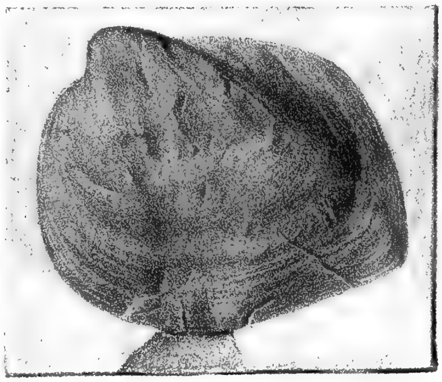

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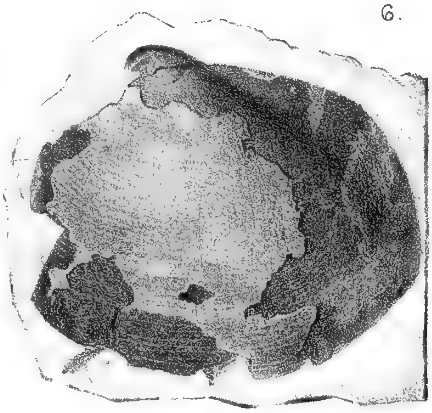

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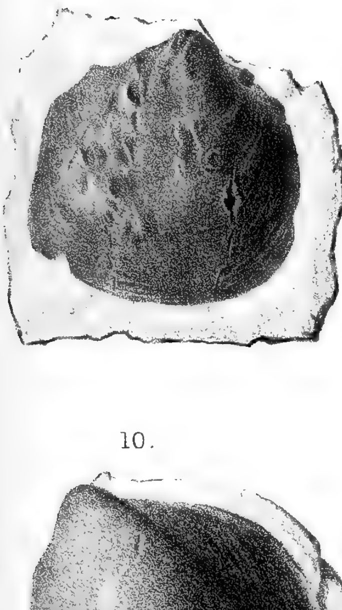

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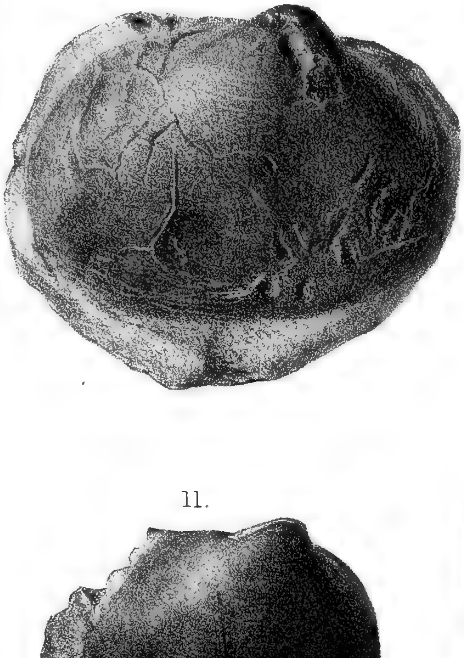

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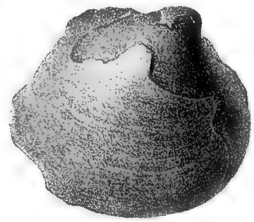

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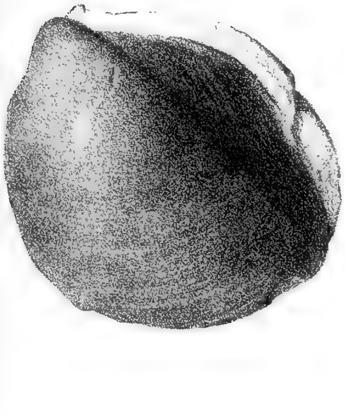

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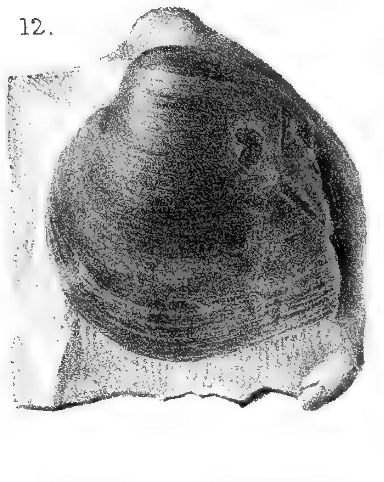

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PLATE XXI.

Fig. 1.—*Cardiomorpha oblonga.* A fine example from the Carboniferous Limestone of Millicent, co. Cork. In the Collection of Mr. J. Wright of Belfast. (Page 259.)

Fig. 1 *a.*—*Cardiomorpha oblonga.* The same specimen viewed from in front.

Fig. 1 *b.*—*Cardiomorpha oblonga.* The same specimen viewed from above.

Fig. 2.—*Cardiomorpha oblonga.* A full-grown example from the Carboniferous Limestone. In the Woodwardian Museum, Cambridge. (Page 259.)

Fig. 3.—*Cardiomorpha oblonga.* A cast from the Carboniferous Limestone of the Isle of Man. Same Collection. (Page 259.)

Fig. 4.—*Cardiomorpha oblonga.* A specimen in the Sowerby Collection of the British Museum (Natural History), South Kensington. From the Carboniferous Limestone. Locality not known. (Page 259.)

Fig. 5.—*Cardiomorpha oblonga.* The type specimen of Phillips's *Isocardia oblonga.* From Bolland. In the Gilbertson Collection of the British Museum (Nat. Hist.), South Kensington. (Page 259.)

Fig. 6.—*Cardiomorpha oblonga.* A left valve with portions of the test preserved. Locality unknown. British Museum (Nat. Hist.), South Kensington. (Page 259.)

Fig. 7.—*Cardiomorpha limosa.* A full-grown example from Thornliebank. In the Collection of Mr. J. Neilson of Glasgow. (Page 268.)

Fig. 7 *a.*—*Cardiomorpha limosa.* The same specimen viewed from above. (Page 268.)

Fig. 8.—*Cardiomorpha limosa.* A specimen showing the hinge-plate and cartilage-groove of a left valve. From the Upper Limestone series, Garngad Road, Glasgow. Same Collection. (Page 268.)

Fig. 9.—*Cardiomorpha limosa.* A perfect specimen from the Upper Limestone series under George Square. In the Collection of Mr. J. Neilson. (Page 268.)

Fig. 10.—*Cardiomorpha limosa.* A testiferous example. From Bishopbriggs. In the Collection of Mr. J. Neilson. (Page 268.)

Fig. 10 *a.*—*Cardiomorpha limosa.* The same shell viewed from the front, showing the prosogyrous umbones. (Page 268.)

Fig. 10 *b.*—*Cardiomorpha limosa.* The same specimen viewed from above to show the upper surface. (Page 268.)

Fig. 11.—*Cardiomorpha limosa.* A slightly crushed example. From the Upper Limestone series of Dernshaw, Stewarton. In the Collection of Mr. J. Smith. (Page 268.)

PLATE XXI

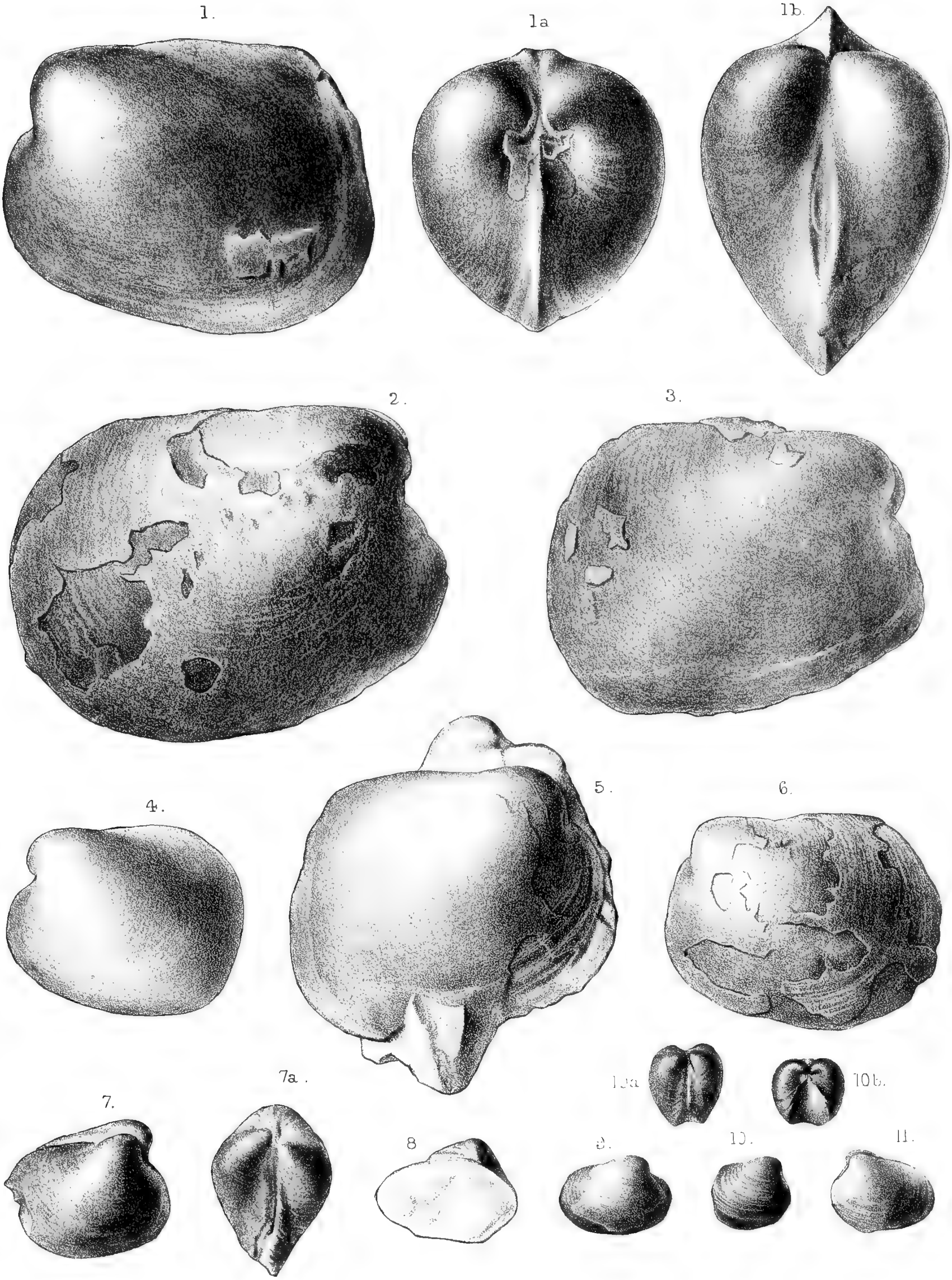

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PLATE XXII.

Fig. 1.—*Cardiomorpha orbicularis.* A full-grown example from the Carboniferous Limestone of Belgium. In the Collection of the British Museum (Natural History), South Kensington. (Page 264.)

Fig. 2.—*Cardiomorpha communis.* A specimen from the Carboniferous Limestone of St. Dooghlas, co. Dublin. My Collection. (Page 262.)

Fig. 3.—*Cardiomorpha orbicularis*, showing part of the hinge-plate of a left valve from the Carboniferous Limestone of Belgium. In the Collection of the British Museum (Natural History), South Kensington. (Page 264.)

Fig. 4.—*Cardiomorpha orbicularis.* A left valve showing the hinge-plate, presented to me by Prof. G. DeWalque from the Carboniferous Limestone of Belgium. (Page 264.)

Fig. 4 *a*.—*Cardiomorpha orbicularis.* The same specimen showing the exterior of the valve. (Page 264.)

Fig. 5.—*Cardiomorpha orbicularis.* A complete cast from the topmost bed of the Carboniferous Limestone, Castleton, Derbyshire. My Collection. (Page 264.)

Fig. 5 *a*.—*Cardiomorpha orbicularis.* The same specimen viewed from above, showing the grooves left by the impressions of the hinge-plates.

Fig. 6.—*Cardiomorpha orbicularis.* The type specimen figured by M'Coy from the Carboniferous Limestone of Derbyshire. In the Woodwardian Museum, Cambridge. (Page 264.)

Fig. 7.—*Cardiomorpha orbicularis.* To show the anterior portion of the shell. Viewed from the front. From the Carboniferous Limestone of Settle, Yorkshire. In the Woodwardian Museum, Cambridge. (Page 264.)

PLATE XXII.

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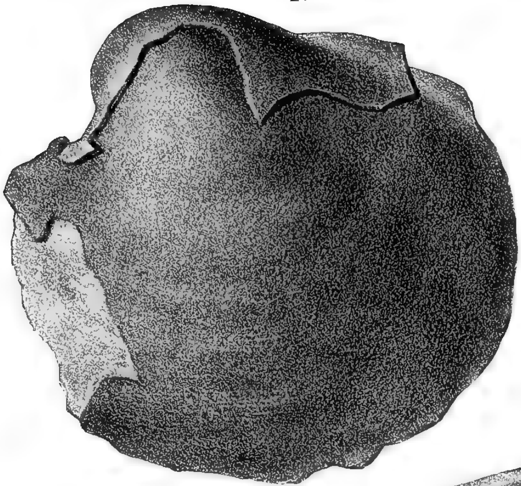

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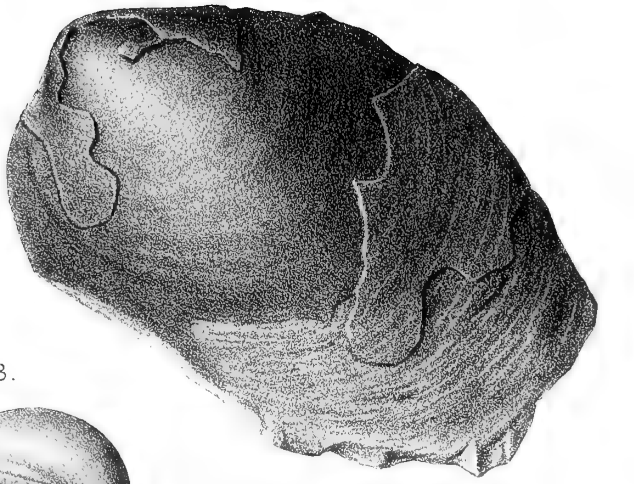

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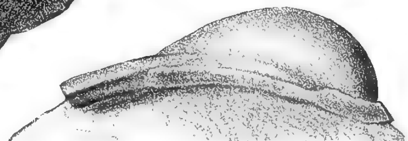

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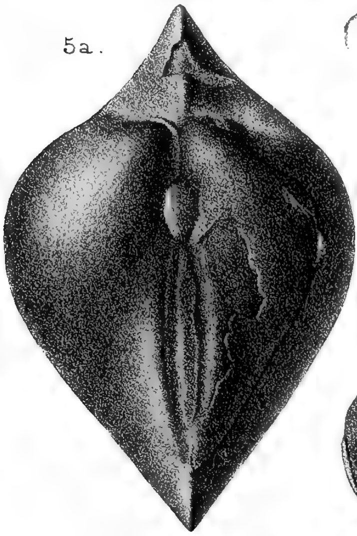

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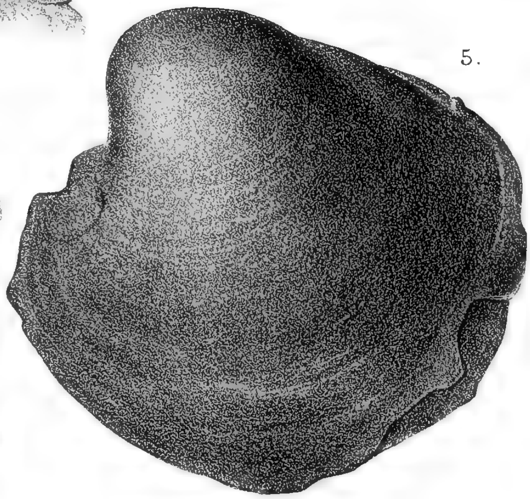

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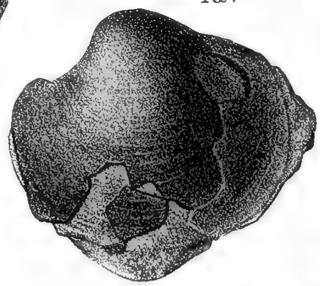

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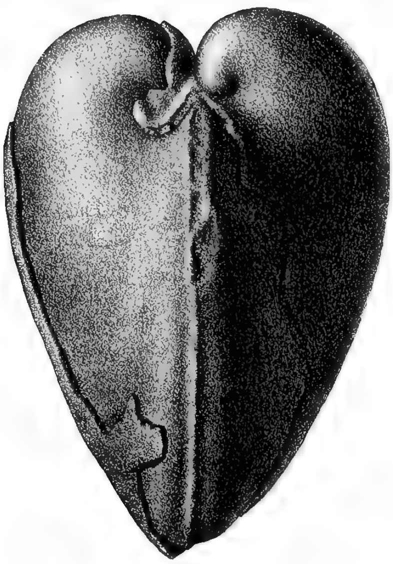

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PLATE XXIII.

Fig. 1.—*Cardiomorpha ventricosa.* The type specimen figured by M'Coy, now in the Collection of Mr. Joseph Wright, of Belfast, who obtained it from the Collection of Dr. Haines, of Cork. From the Carboniferous Limestone, co. Cork. (Page 266.)

Fig. 1 *a.*—*Cardiomorpha ventricosa.* The same specimen viewed from in front.

Fig. 1 *b.*—*Cardiomorpha ventricosa.* The same specimen viewed from above.

Fig. 2.—*Cardiomorpha ventricosa.* A very young specimen from the Carboniferous Limestone of Little Island, co. Cork. Same Collection. (Page 266.)

Fig. 3.—*Cardiomorpha ventricosa.* A large example from the Carboniferous Limestone, co. Cork. Same Collection. (Page 266.)

Fig. 4.—*Cardiomorpha ventricosa.* A specimen from the Carboniferous Limestone of the South of Ireland, which possesses less well-marked concentric grooves than generally obtain. In the Collection of Mr. James Neilson, of Glasgow. (Page 266.)

Fig. 5.—*Cardiomorpha corrugata.* The type specimen figured by M'Coy. From the Carboniferous Limestone of Millicent, Clane, co. Cork. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 271.)

Fig. 6.—*Cardiomorpha corrugata.* A full-sized example from the Carboniferous Limestone of co. Dublin. In the Collection of the Geological Survey, Jermyn Street. (Page 271.)

Fig. 7.—*Cardiomorpha corrugata.* A small example from the Carboniferous Limestone of Thorpe Cloud, Derbyshire; showing 7 *a*, a view from above, and 7 *b*, a view from in front. My Collection. (Page 271.)

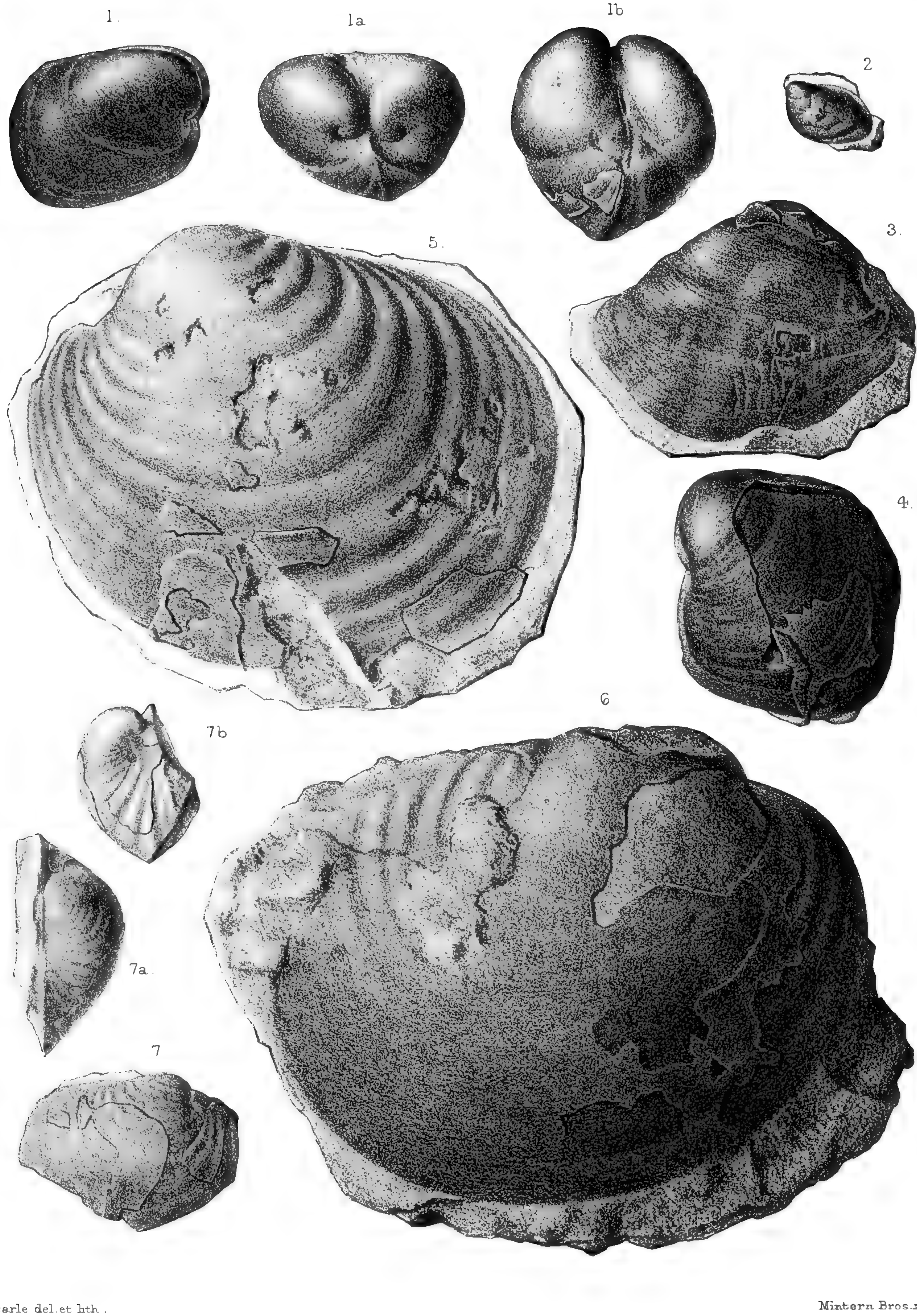

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PLATE XXIV.

Fig. 1.—*Cardiomorpha Egertoni.* A very transverse example from the Carboniferous Limestone of Ireland. In the Collection of the Geological Survey of Ireland. (Page 274.)

Fig. 2.—*Cardiomorpha Egertoni.* The left valve of the type specimen of M'Coy's *Mactra incrassata* from the Carboniferous Limestone of Kilmallock. The artist has unfortunately depicted the opposite valve to that which is shown by M'Coy, although, from M'Coy's custom of not reversing his figures on the stone, it would appear that the left valve is figured in each case. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 274.)

Fig. 3.—*Cardiomorpha obliqua.* A very finely preserved example from the Carboniferous Limestone of Ardlamon, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 263.)

Fig. 4.—*Cardiomorpha obliqua.* A very large example of the right valve, showing the comparative elongation of the anterior end in advanced growth. Same locality and Collection. (Page 263.)

Fig. 5.—*Cardiomorpha obliqua.* A fine specimen from the Carboniferous Limestone of the Isle of Man. In the Collection of the Woodwardian Museum, Cambridge. (Page 263.)

Fig. 5 *a.*—*Cardiomorpha obliqua.* The same specimen viewed from above.

Fig. 5 *b.*—*Cardiomorpha obliqua.* The same specimen viewed from in front.

PLATE XXIV

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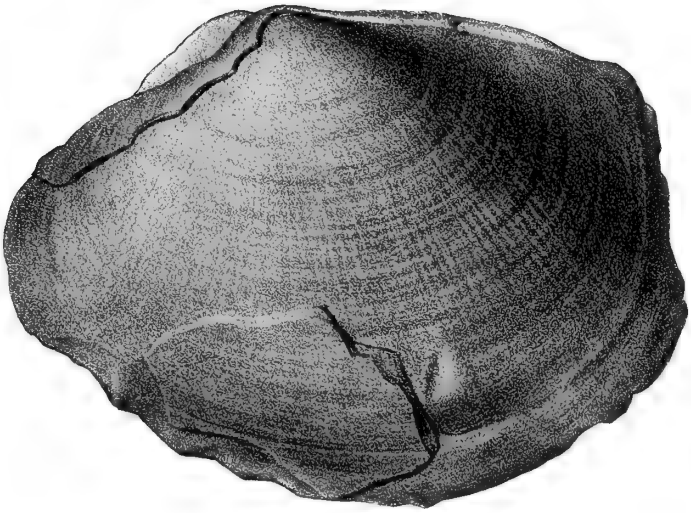

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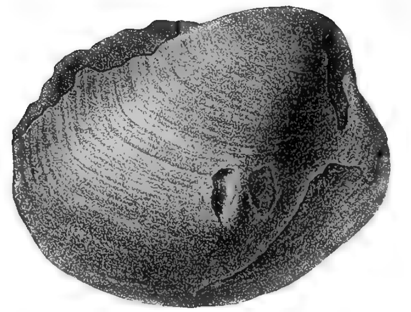

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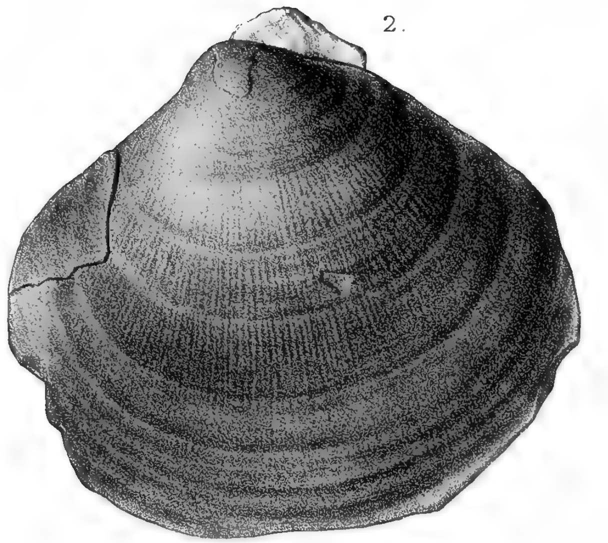

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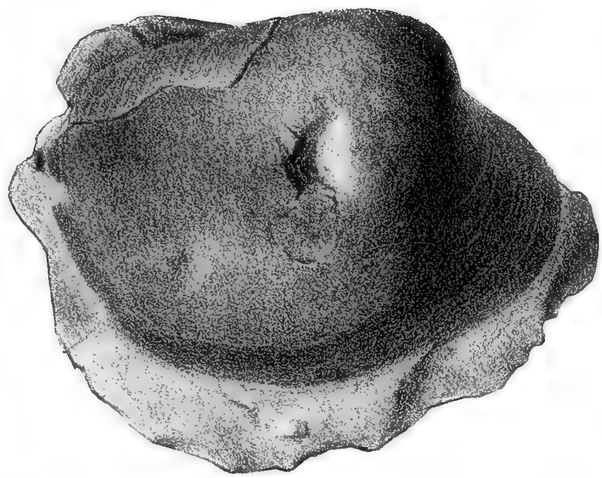

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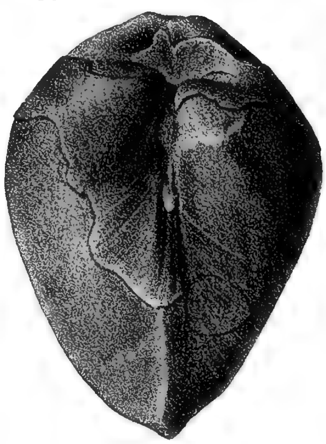

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PLATE XXV.

Fig. 1.—*Cardiomorpha Egertoni.* The right valve of a specimen with only the upper part of the shell left, showing the concentric lines seen on casts of the interior, from Nanteenan, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 274.)

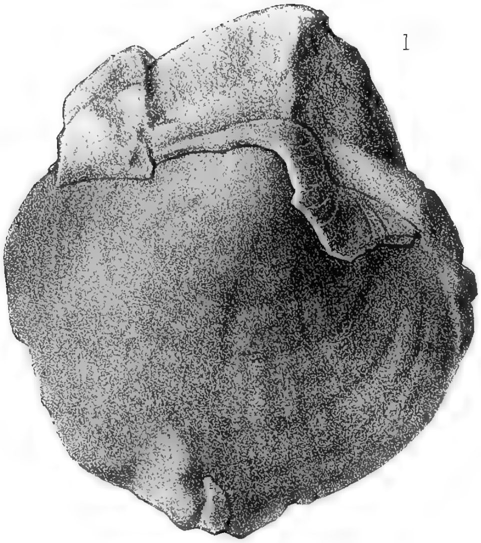
Fig. 1 *a*.—*Cardiomorpha Egertoni.* The left valve of the same specimen with the shell preserved, showing the surface markings.

Fig. 2.—*Cardiomorpha Egertoni.* The type specimen of M'Coy's *Cardium orbiculare*, from the Carboniferous Limestone of Little Island, co. Cork. In the Griffith Collection of the Museum of Science and Art, Dublin. (Page 274.)

Fig. 3.—*Cardiomorpha Egertoni.* The cast of a complete specimen, showing the adductor muscle-scars. From Nanteenan, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 274.)

Fig. 3 *a*.—*Cardiomorpha Egertoni.* The same specimen viewed from above.

Fig. 4.—*Cardiomorpha Egertoni.* The type specimen of M'Coy's *Cyprina Egertoni.* From Millicent, Clare. In the Griffith Collection in the Museum of Science and Art, Dublin. (Page 274.)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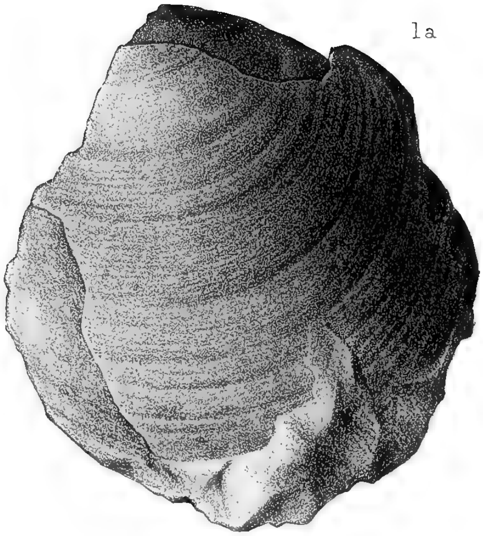
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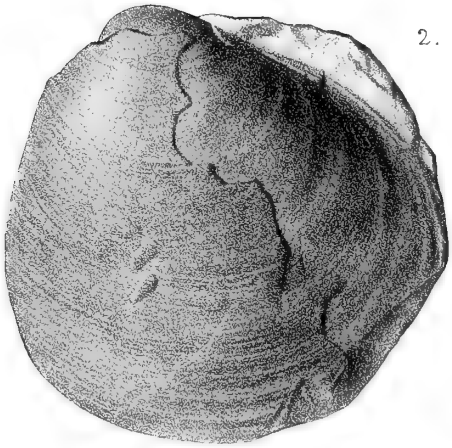
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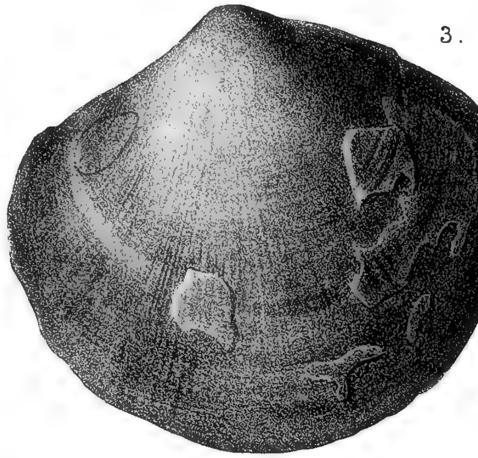
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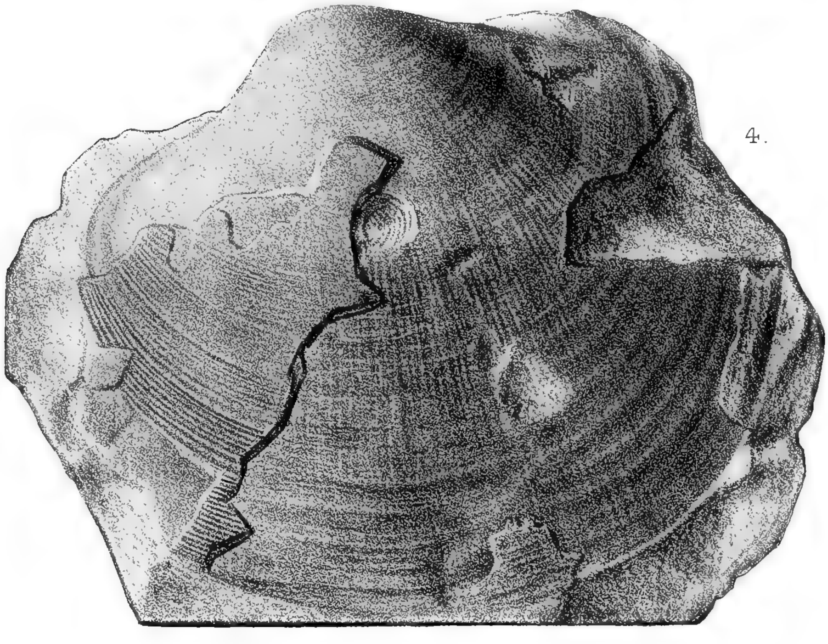
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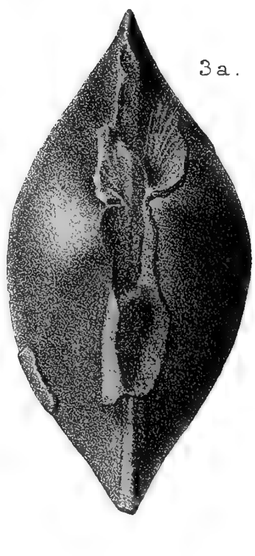
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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1898.

LONDON:

MDCCCXCVIII.

A MONOGRAPH

ON THE

INFERIOR OOLITE AMMONITES

OF

THE BRITISH ISLANDS.

BY

S. S. BUCKMAN, F.G.S.,

HONORARY MEMBER OF THE YORKSHIRE PHILOSOPHICAL SOCIETY; HONORARY SECRETARY OF THE COTTESWOLD NATURALISTS' FIELD CLUB, ETC.

PART X.

SUPPLEMENT:

I.—REVISION OF, AND ADDITION TO, THE HILDOCERATIDÆ.

PAGES i—xxxii; PLATES I—IV.

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INFERIOR OOLITE AMMONITES:

SUPPLEMENT:

I. REVISION OF, AND ADDITION TO, THE HILDOCERATIDÆ.

A THOROUGH revision of the genera and species belonging to the family Hildoceratidæ is imperative, for two reasons:—(1) because of the large accumulation of material, with so many new forms; (2) because the knowledge concerning the affinities of different species has necessarily become more complete. This revision will form the main object of the present Supplement.

The great difficulty in connection with the Hildoceratidæ is the occurrence of many series of specimens with a remarkable similarity of shape. So long as such a feature was regarded as of supreme importance, and due consideration was not given to other characters, because their significance was misunderstood, so long was the classification of the Hildoceratidæ incorrect and unsatisfactory.

Outward form is of merely subordinate value in classification. It is obvious that species most dissimilar in mere shape can produce, by modification, specimens which are very similar. Hence some other criteria of affinity must be sought for; and they are to be found in the characters of the ornamentation and suture-lines of the species. In comparison with the mere shape both these features are constant. They are modifiable and they are modified; but they change so much more gradually than does the mere shape of the conch that they may, for practical purposes, be regarded as fairly stable. At any rate, they change so slowly that their identity is preserved.

In regard to the suture-line and the character of the ornamentation as criteria of affinity, it must be acknowledged that the former undoubtedly holds premier position. But there are many practical reasons why it cannot always be used as efficiently as it deserves. And when, as in the Hildoceratidæ, the ornamentation is found to give a criterion with so much diversity of character, it may well, until knowledge of the family be more complete, be utilised, with the suture-line, as a basis for a classification.

By the term ornament it is not intended to imply merely the production of costæ and tubercles. They practically indicate stages of phyletic development, and no more. It is not the kind, but the manner of ornament which has to be considered, namely, the disposition of the growth-lines, for in these cases the ornament is parallel therewith. The disposition of the ornament, then, is found to have very remarkable variation in the Hildoceratidæ; and, as this disposition is the same as the growth-lines, which were the results of the two processes of deposition and absorption on the part of the mantle during the growth of the specimen, it must indicate certain anatomical differences on the part of the various species.

Therefore in the Hildoceratidæ the disposition of the ornament, or, what is the same thing, of the growth-lines, is considered to be of particular importance. At any rate, it is regarded as a test of generic affinity. This disposition of the ornament is used in illustration, and referred to as the radial line or curve.[1]

Such are the reasons for, and the methods of the revision. No one regrets more than the author of this work that the revision will mean the alteration of many names, involving the disturbance of what appeared to be settled. But it cannot be helped. It may be said with Cicero, *Errorem creat similitudo;* and what may be called the deceptions of homœomorphy are only being gradually learnt. I confess that they have misled me. It is no excuse if I have been deceived in good company. But I recognise some of the incorrectness of my own work. I would attempt to alter this, and to place the whole on a surer basis, hopeful that I am wiser to-day than I was yesterday.

In order to carry out the revision with conciseness, and to deal with an immense mass of detail, it becomes very necessary to introduce certain definite technical terms. Some of them have been already employed in earlier portions of this work; but the following notes are intended to save the labour of reference in regard to the old, and to explain the meanings of the new terms.

Shape of Whorls.—Concise terms to express the differences of whorl-shape are required. Some of the following terms are already used in connection with Gastropoda, and so I have extended them to make a congruous series.

An Ammonite may reach a given diameter by making several narrow, or a few broad whorls. In the first case, in reference to the number of whorls, it would be *polygyral;* in the second, *oligogyral;* while in reference to the breadth of the whorls—from inner margin to periphery—it would be *stenogyral*, narrow-

[1] The radial curve and the suture-line both demand consideration. In certain cases there is an identical form of radial curve, but a marked difference in suture-line. There are some striking cases of this deceptive homœomorphy.

whorled, or *platygyral*, broad-whorled. Then there is the other dimension of the whorl to be considered—from side to side. If the Ammonite has thick whorls it is *pachygyral;* if thin compressed whorls it is *leptogyral.*

Radius.—This is the comprehensive term for the ornament which is parallel with the growth-lines. It gives no qualification as to its direction, size, shape, &c.

Direction of Radius.—This has to be considered under two headings:

1. The radius is straight or curved on the lateral area. In the first place it is a *rectiradius*, and the specimen is *rectiradiate;* in the second, a *flexiradius.*

2. The *recti-* or *flexiradius* has a general direction across the whorl in regard to a straight line drawn from the centre of the Ammonite through the inner end of the radius: (*a*) it either falls behind that line on its way to the periphery,—it is then a *rursiradius*, and the specimen is *rursiradiate;* (*b*) it has, in its general direction, the same course as the line,—it is then a *versiradius;* (*c*) it tends forwards of the line,—it is then a *prorsiradius*, and the specimen is *prorsiradiate.*[1] When the radius is so disposed as to be a combination of *prorsi-* and *rursiradius*, forming a >, the apex pointing towards the aperture of the conch, it may be called an *anguliradius*, and the specimen would be *anguliradiate.*

It is convenient to have similar terms in connection with the manner in which the radius crosses the periphery. As the radial curve is drawn in comparison with a straight line from the centre to the position attained by the radius on the medial line of the periphery, it makes much difference whether the specimen be peripherally *anguliradiate* or *rectiradiate.*

Stria.—This describes the radius when it is like any slightly raised line.

Costa.—This signifies a coarser ornamentation in the form of a ridge. According to the size of its costæ a specimen may be *parvicostate* or *crassicostate;* according to the number, *paucicostate* or *densicostate.*

When the radius is part costa and part stria the terms may be *strii-costa* or *costi-stria*, commencing from the inner margin.

Tuberculation.—A raising of the test, more restricted than a costa, forms a *tubercle*—as a general term. A conical elevation is a *spina;* an obtuse elevation, more or less laterally compressed, a *bulla;*[2] a round knob, a *nodus;* a small pimple-like elevation, a *papilla.*

In certain cases the tubercle is partitioned off by a layer of test at the base.[3] In other cases it is not, and the interior must have been occupied by the

[1] *Rursum*, backwards; *versum*, turned in the direction of; *prorsum*, forwards.

[2] In the cases under consideration the long axis of the bulla is across the whorl parallel with the radius. To meet other cases further nomenclature will be required. It is obvious that these terms are not sufficient.

[3] In *Deroceras* (*Am. armatus* group): when the test is lost there are no tubercles on the core, but only plate-like areas.

mantle.[1] In the former case the specimen is *septituberculate;* in the latter *non-septituberculate*, or, more simply, *tuberculate.*

Ornamentation.—The greater or less elaboration of the ornament (costæ and tubercles) upon the conch may be stated in the following terms: *crassornate, ornate, subornate;* when there is no ornament, *lævigate.*

Regulari- and Irregulari-ornate.—The ornament is irregular if it varies considerably in size, or is not uniform in its development. When the irregularity consists merely of occasional variation in size, a more particular term may be *inæqui-ornate.* Similar qualifying terms may be used in connection with the particular details of the ornament.

Periphery.—In order to describe all the different aspects of the periphery an elaborate scheme of nomenclature would be required. That would be out of place here, but the following terms are necessary.

The periphery may be *planate*, *convex*, or *concave;* when the concavity is rather restricted the periphery is *sulcate;* if furnished with a carina it may be *carinati-convex* or *carinati-sulcate;*[2] when somewhat like the roof of a house sloping into a more or less definite edge, it is *fastigate.* Its sloping sides may be slightly convex, flat (truly fastigate), or slightly concave, when the following modificatory definitions are necessary: *convexi-*, *plani-*, and *concavi-fastigate.* A narrow flat periphery is *tabulate;* divided by a carina it is *carinati-tabulate*, which is perhaps better than *bitabulate.*

Carina.—The different developments of the peripheral carina may be distinguished as *alticarina*, *carina*, *parvicarina.* The carina is sometimes partitioned off by a septum, when it has been called a hollow carina (*vide* p. 81); when not so parted it has been designated a solid carina. The terms are not exact, and may be replaced by *septicarina* and *non-septicarina.* In most cases an *alticarina* is a *septicarina*, but not always,—for instance, *Hyperlioceras.*

The *umbilicus* requires many technical terms, but the following may suffice for the present.

Gradumbilicate.—A portion of each inner whorl is exposed, making the umbilicus in the form of steps, or like an amphitheatre.

Concavumbilicate.—A small bowl-shaped umbilicus, so noticeable in the *Ammonites concavus*, Sow. The lower edge of the inner margin of the overlapping whorl is superposed on the upper edge of its predecessor, and as the inner margin has more or less of a slope, the result is in some cases a regularly concave umbilicus like a small bowl. When the superposition is not quite exact,

[1] In *Sonninia*, in *Stepheoceras* (= *Stephanoceras*, i.e. *Humphriesianum* group), &c.: when the test is lost the core is still tuberculate.

[2] Formerly *carinate-bisulcate*, but it is really one furrow divided by a carina.

but a small portion of the side of the whorl is shown, it may be called *sub-concavumbilicate;* when more of the preceding whorl is exhibited, the conch would be *gradumbilicate.*

Craterumbilicate, having a deep basin-shaped umbilicus like that of *Ammonites Blagdeni.*

Latumbilicate, with a wide umbilicus.

Angustumbilicate, with a narrow umbilicus.

Concentrumbilicate, having an umbilicus in which the whorls coil regularly around the central axis at a gradually increasing distance.

Excentrumbilicate, having an umbilicus in which the whorls do not coil regularly around a central axis. The umbilicus shows a more or less sudden expansion after a certain period.

Particular attention should be given to whether a species is *excentri-* or *concentri-latumbilicate.* Frequently a species may be *angustumbilicate* in youth, but may become *excentrilatumbilicate* in the adult state.

The Septa.—The following terms in connection therewith are required for the sake of brevity in definition.

Densiseptate, a specimen with septa close together.

Pauciseptate, when the septa are distant.

Ornatilobate, when the septum is considerably branched, so as to form a complex suture-line.

Inornatilobate, when the septum is not much branched.

By the use of these technical terms the descriptions will be rendered much more concise, and the comparison of species will be facilitated.

Chronology.—One other matter yet remains, and that is how to indicate the sequential occurrence of the different species. In this Supplement the chronological system will be adopted; and each species will be dated, as regards the time of its existence, by means of the chronological unit, the term *hemera.*[1]

For the purposes of this Monograph the term "Inferior Oolite" has been considered to embrace the deposits from the base of the Cotteswold Sands of Frocester Hill to the top of the limestone beds of Broad Windsor, inclusive. The time which it took to deposit these and all their intervening strata is now divided into twenty-three hemeræ, whereby it is possible to express the date and sequence of species with considerable and very necessary exactitude. The list of these hemeræ, named after their principal Ammonites, is as follows:

[1] "The Bajocian of the Sherborne District," 'Quart. Journ. Geol. Soc.,' vol. xlix, p. 481.

HEMERÆ:	*Witchelliæ* sp.	*Aalensis.*
Fuscæ.	*Sonniniæ* sp.	*Moorei.*
Zigzag.[1]	*Discitæ.*	*Dumortieriæ* sp.
Truellii.[1]	*Concavi.*	*Dispansi.*
Garantianæ.	*Bradfordensis.*	*Struckmanni.*
Niortensis.	*Murchisonæ.*	*Striatuli.*
Blagdeni.	*Scissi.*	*Variabilis.*
Sauzei.	*Opaliniformis.*	*Lilli.*

Of these Hemeræ so many form an Age, but that portion of the subject does not require consideration here.[1]

Family—HILDOCERATIDÆ.

The *Lillia-Haugia* series.

At present a considerable series of species, to which certain titles have been somewhat indiscriminately applied, are arranged under the two genera *Lillia* and *Haugia*. The method of such generic distribution and its consequent nomenclature is more influenced by shape than by questions of exact genetic affinity. It is somewhat as follows:

Haugia, platyleptogyral, somewhat angustumbilicate, more or less alticarinate species.

Lillia, stenogyral, latumbilicate, peripherally carinati-sulcate species.

However, such characters belong to stages of phylogenetic development,—that is to say, the biologically later *Lilliæ* would possess characters ascribed to "*Haugia;*" the biologically earlier *Haugiæ* the characters given to "*Lillia.*" Such characters, therefore, can only be taken relatively to other features, as to what degree they are developed in proportion to the development of those other features.

The following is a list of the principal species which belong to the *Lillia-Haugia* series, or are sufficiently similar to require consideration:

ANDIUM, HARPOCERAS, *Gottsche*, Pl. i, fig. 8.
BAYANI, AMMONITES, *Dumortier*, Pl. xvi, figs. 7—9.

[1] Buckman and Wilson, "Dundry Hill," 'Quart. Journ. Geol. Soc.,' vol. lii, p. 669; and Table IV, &c., 1896. Also Buckman, 'Jurassic Time,' ibid., vol. liv, p. 442.

COMENSIS, AMMONITES, *von Buch*, Pl. ii, figs. 1—3.
— — *Dumortier*, Pl. xx, figs. 1, 2.
— — *Hauer*, Pl. xi, figs. 1—8.
— — *Meneghini*, Pl. v; Pl. vi, figs. 1—3; Pl. vii, figs. 1—5; Pl. viii, figs. 5—7; Pl. xii, fig. 1.
ERBAENSIS, AMMONITES, *Dumortier*, Pl. xxiii.
— — *Hauer*, Pl. xi, figs. 10—14.
— — *Reynès*, Aveyron., Pl. v, fig. 5.
— — — Monogr., Pl. vi, figs. 1—11.
ESCHERI, AMMONITES, *Dumortier*, Pl. xix, fig. 7.
— — *Hauer*, Pl. x, figs. 1—3.
ESERI, AMMONITES, *Oppel*, Pal. Mitth., pl. xliv, fig. 3.
ILLUSTRIS, AMMONITES, *Denckmann*, Pl. v, fig. 2; Pl. vi, fig. 1.
JUGOSUS, AMMONITES, *Sowerby*, Pl. xcii, fig. 1.
LILLI, LILLIA, *Bayle*, Pl. lxxxii, fig. 1.
— AMMONITES, *Dumortier*, Pl. xxi.
— — *Hauer*, Pl. viii, figs. 1—3.
— — *Reynès*, Monogr., Pl. v, figs. 31, 32.
LYTHENSIS, AMMONITES, cf. *Quenstedt*, Amm. Schwäb. Jura, pl. liii, fig. 14.
MALAGMA, AMMONITES, *Dumortier*, Pl. xxii, figs. 1—4.
NAVIS, AMMONITES, *Denckmann*, Pl. vi, fig. 4.
— — *Dumortier*, Pl. xx, figs. 3—6.
OGERIENI, AMMONITES, *Denckmann*, Pl. v, fig. 1.
— — *Dumortier*, Pl. xix, figs. 3—5.
RADIANS COMPRESSUS, AMMONITES, *Quenstedt*, Ceph., pl. vii, fig. 9.
— — — — Jura, pl. xl, fig. 13.
— — — — Amm. Schwäb., pl. li, figs. 6—8.
— GIGAS, AMMONITES, *Quenstedt*, Ibid., pl. li, figs. 2, 3.
RHEUMATISANS, AMMONITES, *Dumortier*, Pl. xxv.
ROBUSTUS, AMMONITES, *Denckmann*, Pl. vii, fig. 1.
TIROLENSIS, AMMONITES, *Dumortier*, Pl. xxiv.
— — *Hauer*, Pl. vii, figs. 1—3.
VARIABILE, HARPOCERAS aff., *Gottsche*, Pl. i, fig. 9.
— — *Quenstedt*, Amm. Schwäb., pl. lii, figs. 11—13. A doubt may be expressed whether the specimens shown in figs. 12, 13 do belong to the *Lillia-Haugia* group at all.
— — *Wright*, Pl. lxvii, figs. 1, 2, 5, 6; Pl. lxviii.
VARIABILIS, AMMONITES, *Chapuis et Dewalque*, Pl. ix, fig. 2.
— — *Denckmann*, Pl. v, fig. 3.
— — *d'Orbigny*, Pl. cxiii.
WERTHI, AMMONITES, *Denckmann*, Pl. ii, fig. 1.

The following is a list of the works wherein they are figured:

BAYLE, Explic. Carte géol. de la France, vol. iv, pt. 1, 1878.
BUCH, Pétrif. remarq., 1831.
CHAPUIS ET DEWALQUE, Foss. Luxembourg, Mém. cour. et Mém. des Savants étrang., tom. xxv, 1853.

Denckmann, Fauna von Doernten; Geol. Specialkarte von Preussen und den Thüringischen Staaten, Bd. viii, Heft 2, 1887.

Dumortier, Études pal. Bassin du Rhône, vol. iv, 1874.

Gottsche, Jurass. Verstein.; Palæont., Suppl. 3, Lief ii, Heft 2, 1878.

Hauer, Ceph. N. O. Alpen; Denksch. math.-natur. Wissensch., Bd. xi, 1856.

Haug, Nouv. Amm.; Bull. Soc. Géol. France, 3e sér., 1884.

Meneghini, Lias supérieur; Pal. Lombarde, series 4, 1867.

Oppel, Jurass Ceph.; Pal. Mittheilungen, 1862.

Orbigny, Ceph. Terr. Jurass.; Pal. franç., 1844.

Quenstedt, Cephalopoden, 1846.

— Jura, 1858.

— Amm. Schwäb. Jura, 1885.

Reynès, Géol. et Pal. Aveyronnaises, 1868.

— Monogr. Amm., Lias sup., 1879.

Sowerby, Mineral Conchology, 1815.

Wright, Lias Ammonites, Pal. Soc., 1882.

These species of the *Lillia-Haugia* series may be arranged according to the different characters which they possess. Thus at least five different characters may be utilised for the purpose of a rough analysis. So a species is either—

Latumbilicate or Angustumbilicate[1]	Rectiradiate or Flexiradiate	Rursiradiate or Versiradiate or Prorsiradiate	Crassornate or ornate or parviornate	Regulari-ornate or irregulari-ornate

—and there are further characters of distinction.

A rough classification of the different species of the *Lillia-Haugia* series is now attempted. It is attended with very considerable difficulty. In the first place, it has not hitherto been considered necessary to figure the radial curve, and so a most important character is wanting. Then there is a mechanical difficulty: it is impossible to place side by side the figures of species contained in a number of large volumes; so that comparison is rendered extremely laborious, and at best it is unsatisfactory. It is only possible to carry out the arrangement of the species in a natural order by having figures of all specimens mounted on separate slips, in order that they can be brought together in series in a small compass. But this can only be accomplished either by re-drawing all the figures, or by cutting up the plates of costly volumes; and both these processes are out of the question at present. But one or the other will have to be adopted if an exact classification is to be obtained.

However, the result of the comparison which I have instituted between the various species, and the analysis of their characters, is now presented.

[1] These terms are used comparatively with regard to species nearly in the same developmental stage,—for instance, to express the distinction between the umbilication of *Lilli* and *Bayani*, both costate species with the carinati-sulcate periphery retained.

CLASSIFICATION OF THE SPECIES OF THE *LILLIA-HAUGIA* SERIES.

I. Latumbilicate[1] (pachygyral).

A. Rectiradiate.

A. Subornate—Lillia, Chartronia.

α. Subtuberculate—*Lillia.*

1. *Subpaucicostate.*

Am. Lilli, *Hauer*, = Lillia Lilli.

2. *Subdensicostate.*

Am. Lilli, *Dumortier*, = Lillia narbonensis.
Lillia Lilli, *Bayle.*

β. Bituberculate—*Chartronia,* g. n.

Chartronia binodata, sp. n.

B. Crassornate—Denckmannia, g. n.

α. Rursiradiate.

1. *Crassicostate, tuberculate.*

Am. erbaensis, *Dum.* (non *Hauer*), = D. iserensis (*Oppel*).
Am. erbaensis, *Reynés*, Aveyron, Pl. v, fig. 5.

2. *Subcrassicostate, paucituberculate.*

Am. erbaensis, *Hauer.*
Am. erbaensis, *Reynés*, Monogr., L. Sup., Pl. vi, figs. 7, 10.

β. Versiradiate.

D. tumefacta, sp. n.
Am. erbaensis, *Reynés*, Monogr., L. Sup., Pl. vi, fig. 5.
Am. navis, *Denckmann*, Pl. vi, fig. 4.
D. torquata, sp. n.

[1] In comparison to development.

γ. Rursi-subflexiradiate.

AM. ROBUSTUS, *Denckmann*.
AM. MALAGMA, *Dumortier*.
HARP. VARIABILE, *Wright*, Pl. lxviii, = D. ASPERA.
AM. cf. OGERIENI, *Denckmann*, Pl. v, fig. 1.
D. OBTECTA, sp. n.

C. *Inæquiornate* = "*Podagrosi*" (pars).

α. Tuberculation inconspicuous.

AM. RHEUMATISANS, *Dumortier*.

β. Tuberculation more conspicuous.

AM. COMENSIS, *Meneghini*, Pl. vi, fig. 3.

D. *Subcrassornate—Haugia*.

α. Subrursiradiate, subirregulari-ornate.

AMMONITES sp. ind., *Denckmann*, Pl. vi, fig. 6.
AM. NAVIS, *Dumortier*.

β. Subrursiradiate, regulari-ornate.

1. *Tuberculate stage long.*

AM. COMENSIS, *Meneghini*, Pl. vi, fig. 1.
HAMMATOCERAS OGERIENI, *Bayle*.
AM. VARIABILIS, *d'Orb*, Pl. cxiii, figs. 3, 4.
HAUGIA VARIABILIS, This Monogr., Pl. xxv, fig. 2, = HAUGIA aff. VARIABILIS.
HARPOCERAS VARIABILE, *Wright*, Pl. lxvii, figs. 1, 2, = HAUGIA sp.

2. *Tuberculate stage short.*

AM. TIROLENSIS, *Hauer*.

γ. Versiradiate.

1. *Umbilicate.*

AM. VARIABILIS, *d'Orb*, Pl. cxiii, figs. 1, 2. Type = HAUGIA VARIABILIS.
HARPOCERAS VARIABILE, *Wright*, Pl. lxvii, figs. 5, 6, = HAUGIA VARIABILIS?
AM. OGERIENI, *Dum.*, Pl. xix, fig. 5. Type = HAUGIA OGERIENI.
HAUGIA JUGOSA, This Monogr., Pl. xxiv, = HAUGIA GRANDIS.
HAUGIA PATELLIFORMIS, sp. n.

2. Less umbilicate.

AM. JUGOSUS, *Sowerby*.
AM. OGERIENI, *Dumortier*, Pl. xix, figs. 3, 4.
HAUGIA JUGOSA (VARIABILIS), This Monogr, Pl. xxiii, figs. 11—13.

The following species show a slight amount of flexure in the costation, and this character seems to distinguish them. They may be placed here for convenience, but it is possible that they are more connected with *Phymatoceras*.

AM. ILLUSTRIS, *Denckmann*, Pl. vi, fig. 1, (Type).
AM. ILLUSTRIS, *Denckmann*, Pl. v, fig. 2.
HAUGIA ? COMPRESSA, sp. n.

Some of the species of the *Eseri*-group show flexure too. They are perhaps descendants of different genetic series, possibly of *Lillia*, possibly of *Phymatoceras*. But that matter being uncertain they may be placed here to avoid change of name.

B. Flexiradiate—*Phymatoceras*, Hyatt.

A. Tuberculation irregular.

AM. TIROLENSIS, *Dumortier*, (Type of genus).
AM. COMENSIS, *Meneghini*, Pl. viii, fig. 6.

B. Tuberculation subregular.

AM. ESCHERI, *Hauer*.
AM. COMENSIS, *Meneghini*, Pl. viii, fig. 7.
HAUGIA DUMORTIERI, *S. Buckman*.

C. Tuberculation inconspicuous.

AM. COMENSIS, *Meneghini*, Pl. v.
AM. COMENSIS, *von Buch*.
AM. COMENSIS, *Dumortier*, Pl. xx, figs. 1, 2.
AM. WERTHI, *Denckmann*, Pl. ii, fig. 1.
PH. ? PAUPER, sp. n.

II. Angustumbilicate (pachygyral)—*Brodieia.*

A. Septicarinate? carinati-sulcate.

A. Rectiradiate.

AM. COMENSIS, *Hauer*, Pl. xi, figs. 1, 2.
AM. BAYANI, *Dumortier.*
AM. COMENSIS, *Meneghini*, Pl. vii, figs. 2, 3, two species.
AM. COMENSIS, *Meneghini*, Pl. xii, fig. 1.
BRODIEIA JUNCTA, sp. n.

B. Subflexiradiate.

AM. COMENSIS, *Meneghini*, Pl. vii, fig. 1.
AM. COMENSIS, *Hauer*, Pl. xi, figs. 4, 5.

B. Non-septicarinate (periphery not bisulcate).

A. Non-tuberculate, platygyral.

INCERTÆ SEDIS, This Monogr., Pl. xii, figs. 35, 36, = BRODIEIA CURVA.

B. Tuberculate, stenogyral.

AM. ESCHERI, *Dumortier.*
LUDWIGIA sp., This Monogr., Pl. xxiii, figs. 9, 10, = BRODIEIA (?) WITCHELLI.

From the foregoing grouping it will be seen that there are several distinct genetic series to be dealt with. But as the series is obviously very incomplete, the application of generic names must be for the present somewhat arbitrary.

Geological Position.—The bulk of the species of the *Lillia-Haugia* series mark a very definite portion of geological time. The following table will show this:

Hemeræ.	Palæontological phenomena.	Geological phenomena in the Cotteswolds.
Striatuli . .	*Grammoceras striatulum* dominant. Non-tuberculate species like *Eseri.*	Ironshot limestone, base of Cephalopod-bed.
Variabilis . .	Platygyral forms like *Haugia jugosa.*	Upper part of Cotteswold sands.
Lilli . . .	Stenogyral forms like *Lilli.* Leptogyral forms allied to *Hild. bifrons.*	Lower part of Cotteswold sands.
Bifrontis . .	*Hildoceras bifrons* in its prime.	So-called Upper Lias clay.

The species like *Lilli* are only sparingly found in this country; and in some cases the containing deposits are so thin that the faunal sequence is made out with difficulty. In the Cotteswolds, where there is some thickness of deposit, they do not occur; but contemporaneity is established by their companion, the leptogyral, subangust-umbilicate development of *Hildoceras bifrons*.[1]

The forms like *Lilli* seem to belong to the Mediterranean borders and the Rhone basin. It would be interesting to know if their position in those places corresponds to that set forth in the above table.

Family—HILDOCERATIDÆ.

I. *Genus*—Lillia, *Bayle.*

1889. Lillia. This Monograph, p. 108 (pars).

Definition.—Stenogyral, latumbilicate, nodate, subrursi-recticostate, septicarinate, subpauciseptate, inornatilobate.

Remarks.—The nodi when present are situated near the edge of the inner margin of the whorl. They are not strongly developed, and they disappear in the gerontic stage while the costæ are still present.

Correction.—The solid carina described at p. 108 was an error partly due to incorrect drawings in the works of certain authors, partly to a wrong identification of "*sulcata*" as a *Lillia*. The carina is evidently hollow, as may be seen in Supplement, Pl. I, fig. 2, where a portion of the preserved infilling is shown.

History.—The title *Lillia* was given by Bayle to an Ammonite which he called "*Lillia Lilli* (Hauer);"[2] but it is not Hauer's species. Subsequently it was used by Haug for the groups of *A. comensis*, von Buch, and *A. Mercati*, Hauer.[3] Later it was employed by myself as title for a genus, with *A. comensis* for the type.

More critical consideration of generic characters makes it doubtful if such an interpretation was justified. It seems probable that the *Mercati*-group has nothing to do with the *Lillia-Haugia* series; while the *comensis*-group, so far as may be judged from von Buch's not very satisfactory figure, appears to be easily separable from Bayle's *Lilli* by possessing the character of flexed ribs.

Therefore it appears desirable to take as the type-form of *Lillia* the species which Bayle figured as *Lillia Lilli*, though it is not Hauer's species, as it is more densicostate.

[1] Cf. this Monograph, Pl. xxii, figs. 30, 31.

[2] Op. cit., pl. lxxxii, fig. 1.

[3] 'Beitr. Monogr. Harp. Neues Jahrb. Mineral.,' Beil.-Bd. iii, p. 637.

Correction.—In the explanation of Pl. XXII, figs. 32, 33, and Pl. XXIII, fig. 1, erase the word *Lillia*. The species does not belong to the Hildoceratidæ, but to the Sonnininæ, a sub-family of the Amaltheidæ. Haug has more correctly called the species *Sonninia sulcata*;[1] but its removal from *Sonninia* will become necessary. Consequently make the necessary corrections in the text at p. 109.

1. LILLIA LILLI, *Hauer*. Suppl., Plate I, figs. 1—6.

1856. AMMONITES LILLI, *Hauer*, Pl. viii, figs. 1—3.

(Non *Am. Lilli*, Dumortier; non *Lillia Lilli*, Bayle.)

Description.—Stenogyral, latumbilicate, subornate, nodate, sparsi-subrursi-recticostate, septicarinate, subpauciseptate, inornatilobate.

Remarks.—The rursicostate character is shown in Hauer's figure with so much want of uniformity as to suggest a possible incorrectness on the part of the artist. If, however, the character does exist as delineated, then our specimen does not agree with Hauer's in this respect, for it is only subrursicostate, in which case it may be wrong to give it the name of *Lilli*.

Localities and Stratum.—Somerset: Shepton Beauchamp; and Trent, near Yeovil, "Upper Lias" (in close connection with *Hildoceras bifrons*).

Date of Existence.—*Lilli* hemera.

2. LILLIA NARBONENSIS, *S. Buckman*. Suppl., Plate II, figs. 3, 4.

1874. AMMONITES LILLI, *Dumortier* (non *Hauer*), Pt. 4, pl. xxi.

Description.—Stenogyral, latumbilicate, subornate, nodate, subdensi-subrursi-recticostate, septicarinate (?).

Remarks.—The description is drawn up from Dumortier's figure. It may be presumed by analogy with other species that this one is septicarinate, and that the representation of the carina in Dumortier's figure is incorrect, the remains of the infilling being drawn as a complete carina.

The name *narbonensis* is taken from the appellation of the Roman province in which Dumortier's specimens were obtained.

[1] "Études sur les Ammonites des étages moyens du système jurassique," 'Bull. Soc. Géol. France,' 3e sér., pl. xx, p. 290, 1893.

History.—The *A. Lilli* of Dumortier differs from the *A. Lilli*, Hauer, in being less umbilicate, more numerously costate, less tuberculate, and having more elliptical whorls. It therefore requires a new name.

A rough fragment found by Mr. B. Thompson, F.G.S., was sent to me a few years ago for identification. I pointed out that it agreed with the *A. Lilli*, Dumortier (non Hauer), and Mr. Thompson quoted it on my authority in his paper on "The *Jurensis*-zone in Northamptonshire" ('Journal Northants N. H. Soc.,' 1890). The fragment, however, is not good enough to found a species upon. Therefore Dumortier's figure is taken as the type of *Lillia narbonensis*; and this specimen is considered to agree with Dumortier's figure. His drawing represents the rursicostate character as more marked than in the present fragment; but the representation of this character is not uniform, and it has perhaps been exaggerated in places. Also difference in age may have something to do with it.

Distinction.—The more numerous costæ sufficiently separate this species from *Lillia Lilli.*

Locality and Stratum.—Northamptonshire: Moulton (Upper *Leda-ovum*-beds,[1] "Upper Lias"), Mr. B. Thompson, F.G.S.

Date of Existence.—*Lilli* hemera.

[1] Mr. Thompson claims "the Upper *Leda-ovum*-beds" as *Jurensis* zone, and "that [they were] laid down contemporaneously with the sands and *Jurensis* beds of Gloucestershire and other counties" * ('Northants N. H. Soc.,' 1890, p. 99); also that they were deposited later than the "*communis*-beds." The last point may be admitted without allowing that the strata belong to the *Jurense*-zone. The fault really lies with the zonal system of nomenclature. With the hemeral system of geological chronology it may be stated that the Upper *Leda-ovum*-beds were deposited during the hemera *Lilli*, and before the hemera *variabilis*, the strata of which are usually taken as the first portion of the *Jurense*-zone. So these beds are contemporaneous only with the lower part of the Cotteswold Sands, the portion deposited before *Haugia jugosa* appeared.

* One remark of Mr. Thompson it is necessary to note because it states a fallacy which has led more than anything else to confusion in the matter of palæontological horizons. "A considerable change in the character of the sediment took place in the west and south-west long before it did with us in Northamptonshire, and this was necessarily accompanied by a change in the fauna generally, and particularly in the Ammonites, which latter seemed less able or willing to accommodate themselves to new conditions than lower forms" (p. 99). It is a great mistake to suppose that Ammonites were influenced by the character of the deposit, though this error has been so widely taught that nearly every writer, myself included, has argued as if it were a fact. When Dorset, Somerset, and Gloucestershire are compared, it will be found that the same species lived when the deposit was argillaceous, arenaceous, or calcareous, and flourished equally well. Notably is this the case when the Middle Lias of Dorset and of Somerset are compared; or the Lias-Oolite deposits of Dorset, Somerset, and Gloucestershire, and these again with the Continent. Further, that the Ammonite

II. *Genus*—Chartronia,[1] *S. Buckman.*

(Type: *Chartronia binodata*, sp. n.)

Definition. — Stenogyral, latumbilicate, binodate, versi-rectiradiate, septi-carinate,[2] subornatilobate.

Note.—The binodation is a phase of development. There might be uninodate ancestors and descendants of the type-species, and yet they would belong to the same genus.

Remarks.—The nodi of the inner row are situated at some little distance from the edge of the inner margin, and there are costæ extending from them to the edge of that margin. The nodi of the outer row are rather inconspicuous; they are situated on the edge of the periphery, just beyond *L.* (superior lateral lobe).

Distinction.—The binodation distinguishes the genus from either *Lillia* or *Haugia.* The more ornate character of the suture-line separates it from *Lillia.* It may also be noted that the position of the inner row of nodi is different from anything found in *Lillia* or *Haugia.*

1. Chartronia binodata, *S. Buckman.* Suppl., Plate I, figs. 11—15.

Description.—Given in the definition of the genus.

Note.—The peculiar characters of the species are, first, a row of tubercles set rather away from the inner margin; secondly, another row of small tubercles on the edge of the periphery.

Locality and Stratum.—Frocester Hill, Gloucestershire. Certainly from the "Cephalopod-bed," and, judging by the matrix, from the strata containing *Dumortieriæ.*

Date of Existence.—Hemera *Dumortieriæ* presumably.

History of the Figured Specimen.—Purchased from the collection of the late Dr. Thos. Wright, F.R.S., &c.

fauna changes quite independently of lithic conditions is shown throughout the Lias, particularly in Dorset.

It must be remembered that the fauna of any given hemera was of more than European extension, but that particular lithic characters were often excessively local, and seldom contemporaneous.

[1] In honour of M. L. Chartron, Memb. Soc. Géol. de France.

[2] This may be known by the impressed periphery bearing the mark of the partition-band.

III. *Genus*—Denckmannia,[1] *S. Buckman.*

(Type: *Denckmannia tumefacta,* sp. n.)

Definition.—Stenopachygyral, sublatumbilicate, crassornate, tuberculate, septicarinate, pauciseptate.

Distinction.—So far as the type species of the genus is concerned it is distinguished from *Lillia* by less compression being coupled with smaller umbilication and more pronounced ornamentation. The species grouped with *Denckmannia? iserensis* are even more separated by the robustness of their ornamentation. They show in a marked degree a rursicostate character, and are really quite separable from the true *Denckmannia.* The only feature which they possess in common therewith is a robustness of ornament.

1. Denckmannia? iserensis (Oppel). Suppl., Plate II, figs. 1, 2.

1856. Ammonites iserensis, *Oppel,* Juraf., p. 249.
1874. — erbaensis, *Dumortier* (non *Hauer*), Études pal. Bassin du Rhône, iv, pl. xxiii.
1893. Lillia iserensis, *Bonarelli,* Osservazioni sul Toarciano, &c., Boll. della Società geol. italiana, vol. xii, fasc. 2, p. 12 (pars).

Description.—Stenopachygyral, latumbilicate, subirregulari-crassornate, nodate, rursi-recticostate, septicarinate (?).

Note.—The above description is drawn up from Dumortier's figure. In all probability the species is septicarinate, and there has been the usual mistake in the delineation of the carina. Dumortier's specimen is chosen for the type for the reasons given under the historical remarks. The specimen now figured is considered to be a fragment of a large adult.

History.—Under the name *Am. iserensis,* Oppel separated, as distinct from "*Am. comensis,*" a species which he said reached a foot in diameter, and was not uncommon in the ironstone of la Verpillière and St. Quentin; it was found frequently at Milhau, and occurred in Swabia. He described it as having a nearly quadrate "aperture," ribs coarse and thick on the outer whorls, a broad keel, and an appearance like *Amm. Conybearei* or *Bucklandi,* &c. Unaccompanied by any figures, or by any measurements, or by any description of the septa,

[1] In honour of Dr. August Denckmann, whose work has frequently been referred to in these pages.

such a notice cannot be held to give a name to a species, and is of no value in the matter of priority.

Meneghini[1] considered Oppel's *iserensis* to be the same as Hauer's *erbaensis.* He supposed that Oppel did not know, or pretended not to know, of Hauer's almost contemporary work; but considering that both works appeared in the same year, and that publication is often long after preparation, the idea of pretence is scarcely warranted. Meneghini placed *erbaensis* as a synonym of *comensis*, though he recognised it as a perfectly distinct form; in fact, he separated *comensis* into as many as nine distinct types.

Haug regarded *iserensis* as a synonym of *erbaensis.*

Bonarelli, however, has definitely separated *iserensis*, and has placed as synonyms *erbaensis* and *tirolensis*, Dum. (non Hauer), and *comensis*, Meneghini, pl. vi, figs. 1, 2.

It is very probable that Oppel had more than one species in view when he gave his description. Considering that Dumortier's *erbaensis* and *tirolensis* both come from the locality noted by Oppel for *iserensis*, and that they are both distinctly different forms from what Hauer described by these names, the chances certainly are that one, if not both of them, were regarded by Oppel as *iserensis.* Therefore Bonarelli is perfectly right in considering Oppel's *iserensis* as "a form quite distinct" from Hauer's *erbaensis.* Still Bonarelli gives *iserensis* too wide an application. From the series I select as the type of *iserensis* the *Am. erbaensis*, Dumortier, non Hauer (see p. xvii).

The fragment figured in Suppl., Pl. II, fig. 1, agrees with the outer whorl of Dumortier's *erbaensis*, but it is not sufficient to found a species upon. For that reason the present figure is not taken as the type. If future examples show that it is distinct from Dumortier's fossil, then it will require a new name.

Locality and Stratum.—Northamptonshire: Moulton, in the Upper *Leda-ovum* beds. Found by Mr. B. Thompson, F.G.S.

Haug[2] says that *erbaensis* belongs to the *jurense*-zone; but Meneghini[3] says that *comensis* (including *iserensis, erbaensis*, &c.) occurs with *Am. bifrons* in the red Ammonitiferous limestone of the Central Apennines, &c.

Date of Existence.—Lilli hemera.

[1] 'Monogr. Lias sup. Lombarde;' Pal. Lombardie, series 4, p. 22, 1867.

[2] Op. cit., p. 634.

[3] Op. cit., p. 30.

2. Denckmannia tumefacta, *S. Buckman.* Suppl., Plate I, figs. 7—10.

Description.—Stenopachygyral, sublatumbilicate, subirregulari-crassornate, bullate, versi-recticostate, septicarinate, subpauciseptate.

Note.—The carina is strong and laterally compressed. On the core of the periphery are slight signs of furrows. The tubercles are elongated in the direction of the ribs, and are therefore technically bullæ. The ornamentation is somewhat irregular.

Distinction.—This species is like the *erbaensis* of Dumortier (non Hauer), but it is distinguished by the difference in direction of the costæ. It is also less umbilicate and more quickly coiled. It is less umbilicate and yet thicker than *robustus*, Denckmann.

Locality and Stratum.—Somerset: Shepton Beauchamp, just above where *Hildoceras bifrons* is plentiful.

Date of Existence.—*Lilli* hemera, presumably,—that is to say, it was probably earlier in date than *variabilis*, and later than *bifrons;* but the strata being very thin, it lies closely associated with them.

3. Denckmannia torquata, *S. Buckman.* Suppl., Plate III, figs. 4—6.

Description.—Platygyral, angustumbilicate, crassornate, bullate, subrursi-flexicostate,[1] septicarinate, subdensiseptate, *L.* broad.[2]

Note.—The umbilicus tends to become excentric, while the costæ and bullæ are retained. The rursi-flexicostate character becomes more pronounced with age.

Distinction.—The much thicker form, and the more rounded, broader periphery separate it from *Haugia illustris* (Denckm.). The combination of coarse ornamentation with a small excentric umbilicus and rather thick whorls (relatively to similarly umbilicate species) is the distinctive character of the present species.

Remarks.—The retention of the bullæ and the strong character of the ribbing, in connection with a compressed form and a small umbilicus, indicate a possible connection with *Denckmannia tumefacta.* In the same direction does the somewhat small carina point. The subrursi-flexicostate character seems to be only a later acquirement, and is not necessarily against such connection.

Locality and Stratum.—Shepton Beauchamp, Somerset, with species of *Haugia*, above *Hildoceras bifrons.*

Date of Existence.—*Variabilis* hemera.

[1] In the latter part of the whorl.
[2] *L.* = superior lateral lobe.

4. DENCKMANNIA ?[1] MALAGMA (Dumortier). Suppl., Plate IV, figs. 1—3.

1874. AMMONITES MALAGMA, *Dumortier*, Pl. xxii, fig. 1 only.

Description.—Substeno-subleptogyral, latumbilicate, subcrassi-subirregulari-bullicostate, rursi-recti-costate, subalti-septicarinate.

Remarks.—The costæ are arranged somewhat in groups of four, whereof two unite into a fairly large bulla, while the other two come close together, are scarcely joined, and have no bulla. Of any four ribs one is distinctly larger than the others, and these larger ribs appear like raised bands across the lateral areas. The largest rib is the first in a series of four, so that the rib-sculpture may be diagrammatically represented thus: $\underbrace{1\ 2}\ 3\ 4$, the bracket denoting the connate pair.

Comparison.—With *malagma*, Dumortier: that author has figured under this name two species, whereof one is much more coarsely costate than the other. It is only with the coarsely costate form (his fig. 1) that comparison need be made. This comparison is not easy because the specimen represented is obviously somewhat ill preserved, so that irregularity of costation has been exaggerated. But certain points may be noticed, as follow: the diameter of Dumortier's figure without carina is 96 mm., with an umbilicus of 39 mm., one whorl back 18 mm., two whorls back 8 mm. Taking the same diameter on my specimen the umbilicus is respectively 39 mm., 20 mm., 9·5 mm. This indicates that my specimen is more concentrically umbilicate. If Dumortier's specimen be correctly drawn, the difference deserves careful consideration; but experience tells that exactly correct drawing in such details is very difficult to obtain.

Further remark may be made with regard to Dumortier's description. He says—" With regard to the bifurcate costæ, it may be noticed that the rib which is in front is always the larger (que c'est toujours la côte qui est en avant qui est la plus volumineuse)." This does not agree with my description, but there may be an ambiguity here. Thus of ribs 1, 2 of the bifurcate series, 1 is the larger in my specimen, not 2, as Dumortier's description seems to infer. Now 1 is the rib which appears first from the point of view of growth, but 2 is the rib which is in front, that is, nearer to the aperture.

Locality and Stratum.—Somerset: Shepton Beauchamp, in the " Upper Lias," just above *Hildoceras bifrons*.

Date of Existence.—*Variabilis* hemera.

[1] The assignment of this and the following species to *Denckmannia* is provisional.

5. DENCKMANNIA ? ASPERA, *S. Buckman.*

1874. AMMONITES MALAGMA, *Dumortier*, iv, Pl. xxii, figs. 2—4 only.
1882. HARPOCERAS VARIABILE, *Wright*, Pl. lxviii.
1890. HAUGIA VARIABILIS, var. *a*, This Monograph, p. 147 (pars).

Description.—Platygyral, sublatumbilicate, irregulari-crassornate, bullate, subrursi-recticostate tending to flexicostate, subalti-septicarinate.

Distinction.—From *variabilis*, by coarser, more irregular ornamentation. In the points where it differs from *variabilis* it most resembles *malagma*, fig. 1, but that is still more coarsely ornate. Dumortier also shows another less coarsely ornate fossil as *malagma* (figs. 2—4), which appears to belong to the present species. It is certainly different from his fig. 1, to which the name *malagma* must be restricted.

Remarks.—A very fine side view is shown by Wright, but not a front view.

Localities and Strata.—Gloucestershire: Nailsworth, Wright's specimen (evidently from the Cotteswold sands); Somerset: Shepton Beauchamp ("Upper Lias").

Date of Existence.—*Variabilis* hemera.

6. DENCKMANNIA ? OBTECTA, *S. Buckman.* Suppl., Plate IV, figs. 4—6.

1890. HAUGIA VARIABILIS, var. *a*, This Monograph, p. 147 (pars).

Description.—Platyleptogyral, angustumbilicate, subparvi - subrursi - subflexicostati-bullate, subalti-septicarinate.

Remarks.—The bullæ fail at a diameter of about 80 mm.; the costæ become irregular and obsolete at about 120 mm.; after that the test is smooth except for some obscure undulations.

Where the bullæ are most prominently developed, the occlusion by the succeeding whorl reaches nearly up to the bullæ themselves, so that there is no costate space between them and the inner edge of the next whorl. Afterwards a costate space appears, partly because the bullæ decline in size, partly because the inner margin recedes.

Distinction.—From *aspera*, less umbilicate and less coarsely costate; from *variabilis*, the earlier failure of tubercles, the less coarse costæ, the want of a regular costate space between bullæ and inner edge of succeeding whorl, greater irregularity of ornament.

Locality and Stratum.—Gloucestershire: Coaley Wood, in the Cotteswold Sands (Bed 16 of section vi, p. 45).

Date of Existence.—*Variabilis* hemera.

IV. *Genus*—Haugia, *S. Buckman.*

(Type: *Haugia variabilis*, d'Orbigny sp.)

1888. Haugia. This Monogr., p. 45, 1889, p. 142.

Definition.—Subplatyleptogyral, sublatumbilicate, subcrassornate, versi-recti-radiate, alti-septicarinate, subdensiseptate, subornati-lobate.

Remarks.—The species placed under *Haugia* are really capable of further division. The arrangement is confessedly somewhat arbitrary.

Distinction.—In general *Haugia* is less strongly ornate than *Denckmannia*, but rather more ornate than *Lillia*. It is more carinate than either.

The comparison of *Haugia* and *Lillia* is difficult because the species referred to the genera are not in the same degree of phyletic development. But Bayle's pl. lxxxii shows in figures of *Lillia Lilli* and "*Hammatoceras Ogerieni*" some of the differences which may be expected between the species of the two genera.

a. The *navis*-group.

The greater proportionate compression in conjunction with similar umbilication, and the greater development of the carina, distinguish this group from *Denckmannia*. The ornamentation of *Denckm. torquata*, much coarser than that of adult *H. navis*, the carina less developed, and the *L.* broad instead of narrow, show that that species cannot belong here.

1. Haugia navis (*Dumortier*). Suppl., Plate II, figs. 5—7.

1874. Ammonites navis, *Dum.*, Pl. xx, figs. 3—5.

Description.—Subplatyleptogyral, sublatumbilicate, subcrassornate, subrursi-recticostate, alti-septicarinate, subdensiseptate, *L.* narrow.

Distinction.—This species is distinguished from *variabilis* chiefly by coarser, more irregular ornamentation. It also seems to be more quickly coiled and rather thicker.

Locality and Stratum.—Somerset: Barrington, near Ilminster, "Upper Lias," above *Hildoceras bifrons*.

Date of Existence.—*Variabilis* hemera.

B. The rursiradiate group.

2. HAUGIA aff. VARIABILIS. Plate XXV, fig. 2.

? 1844. AMMONITES VARIABILIS, *d'Orbigny*, Pl. cxiii, figs. 3, 4.
1878. HAMMATOCERAS OGERIENI, *Bayle*, Pl. lxxxii, fig. 2.
1890. HAUGIA VARIABILIS, This Monograph, Pl. xxv, fig. 2, p. 146 (pars).

The form depicted in these figures seems to differ from *variabilis* chiefly in being rursicostate. This character is shown in d'Orbigny's young specimen (Pl. cxiii, figs. 3, 4). How much and how long it was a character of *variabilis*, if it was a character at all, is somewhat difficult to determine from d'Orbigny's reduced figure of his large specimen.

Locality and Stratum.—North Nibley (Cotteswold Sands).

Date of Existence.—*Variabilis* hemera.

3. HAUGIA sp.

1882. HARPOCERAS VARIABILE, *Wright*, Pl. lxvii, figs. 1, 2.

This is less umbilicate than d'Orbigny's figure of *variabilis*. It also seems to be rursicostate.

Locality and Stratum.—Dorset: "sands between Lias and Inferior Oolite, near Bridport," Wright, p. 448. I have some doubts with regard to the locality and the horizon, as they do not agree with my experience.

C. The *variabilis*-group.

4. HAUGIA VARIABILIS (*d'Orbigny*). Plate A, fig. 34, p. 146 (pars).

1844. AMMONITES VARIABILIS, *d'Orbigny*, Pl. cxiii, figs. 1, 2 only.
1853. — — *Chapuis et Dewalque*, Pl. ix, fig. 2.
? 1882. HARPOCERAS VARIABILE, *Wright*, Pl. lxvii, figs. 5, 6.
1890. HAUGIA VARIABILIS, This Monogr., Pl. A, fig. 34, p. 146 (pars).

The shell depicted by Dr. Wright seems to represent d'Orbigny's species; but there are some slight errors in regard to the drawing,[1] and the reduction in d'Orbigny's figure makes determination somewhat difficult.

[1] See p. 146, foot-note.

Correction.—It is doubtful if the rursicostate character is a feature of this species, for d'Orbigny's small specimen (figs. 3, 4), wherein it is shown, may not really be a young *variabilis.*

Remarks.—In regard to d'Orbigny's figure of *variabilis*, it may be noted—that the costæ are not equally distant, but that they are somewhat bunched in a triform arrangement with wider interspaces; that there is a definite costate space between the nodi and the inner edge of the next whorl; that the umbilicus is large and fairly concentric; and that the compression is considerable.

The specimen which I possess does not show any irregularity in the width between the groups of costæ. It agrees in other respects, but identification with *variabilis* may not be correct; nor does the specimen formerly in Dr. Wright's possession show this irregularity of costation.

Localities and Strata.—Gloucestershire: North Nibley (Cotteswold Sands, Bed 30, section vii, p. 46); Dorset: "sands between Lias and Inferior Oolite, near Bridport," Wright, p. 458. It is possible the writer may have been mistaken on these points.

Date of Existence.—*Variabilis* hemera.

5. Haugia Ogerieni (*Dumortier*).

1874. Ammonites Ogerieni, *Dumortier*, Pl. xix, fig. 5.

Description.— Subplatyleptogyral, sublatumbilicate, versicostate, nodate, septicarinate.

History of Specific Name.—Dumortier figures two specimens as *Ogerieni.* The one marked fig. 5 is more umbilicate than the example placed as figs. 3, 4. Since the latter appears to be the same as Sowerby's *jugosus*, the former may now be taken for the type of *Ogerieni.*

Remarks.—A specimen about 205 mm. in diameter from Shepton Beauchamp is distinct from any other similarly large specimens of *Haugia*, and it appears to be the adult of Dumortier's *Ogerieni* as now defined; but the centre is too ill-preserved to allow of exact comparison.

Localities.—Gloucestershire: North Nibley (Cotteswold sands); Somerset: Shepton Beauchamp ("Upper Lias").

Date of Existence.—*Variabilis* hemera.

6. Haugia patelliformis, *S. Buckman*. Suppl., Plate III, figs. 1—3.

Description.—Platyleptogyral, versi-parvicostate, parvinodate, septicarinate, subdensiseptate, *L.* broad.

Note.—The inclusion decreases with age, so that the species is angustumbilicate in youth, and latumbilicate when adult.

Distinction.—Less ornate than *Ogerieni*. The extreme compression makes it a very distinct form.

Localities and Strata.—Gloucestershire: Coaley Wood (Cotteswold Sands); Somerset: Shepton Beauchamp ("Upper Lias," with other species of *Haugia*).

Date of Existence.—*Variabilis* hemera.

7. Haugia jugosa (*Sowerby*). Plate XXIII, figs. 11—13.

1815. Ammonites jugosus, *Sowerby*, Pl. xcii, fig. 1.
1874. — Ogerieni, *Dumortier*, Pl. xix, figs. 3, 4.
1889. Haugia variabilis, This Monogr., Pl. xxiii, figs. 11—13.
1890. — jugosa, This Monogr., p. 149, in correction.

Description.—Platyleptogyral, subangustumbilicate, versi-recticostate, parviregularinodate, alti-septicarinate.

History.—I refigured Sowerby's *jugosus*, which is a rather unsatisfactory specimen, and compared therewith two other examples, a small and a large one. But they do not strictly agree with it, and their separation is necessary.

The drawing of Sowerby's original specimen given in the body of this work was, owing to defective preservation, somewhat unsatisfactory. In order to make better comparison Mr. G. C. Crick, F.G.S., of the British Museum, has kindly developed the other side of the type. It shows that, in the side view depicted, the nodi are not conspicuous enough, and the costæ are not sufficiently distinct.

Remarks.—If Sowerby's species be now correctly identified with an adult in my collection, then *jugosus* when somewhat fully grown is thicker and costate for a longer time than the specimen depicted in Pl. XXIV.

Localities and Strata.—Somerset: White Lackington Park, near Ilminster, Sowerby's type ["Upper Lias"]: Shepton Beauchamp, near Ilminster ("Upper Lias").

Date of Existence.—*Variabilis* hemera.

8. HAUGIA GRANDIS, *S. Buckman.* Plate XXIII, figs. 14, 15; Plate XXIV; Plate XXV, fig. 1; Plate XXVIII, figs. 1—3 (?); Suppl., Pl. II, fig. 11.

1889. HAUGIA VARIABILIS, This Monogr., Pl. xxiii, figs. 14, 15.
1890. — JUGOSA, Ibid., p. 149; Pl. xxiv; Pl. xxv, fig. 1; Pl. xxviii, figs. 1—3 (?).

Description.—Platyleptogyral, subangust-excentri-umbilicate, subprorsi-recticostate, parvi-subirregularinodate, alti-septicarinate.

History.—A young form, though supposed to be identical with *Am. jugosus*, Sow., was figured first as *Haugia variabilis* for reason given in explanation of Pl. XXIII. This was subsequently altered to *Haugia jugosa*, by which name an adult was also figured.

Remark.—The adult is a little more irregularinodate than the smaller example.

Distinction.—From *jugosa*:—strictly compared with Sowerby's original, the smaller example of this species is slightly less umbilicate, a point of importance where young specimens are concerned. Further, it has smaller ribs less widely separated, the ribs have a slight forward inclination on the lateral area, and they join the carina with a distinct though slight turn forwards on the periphery. It is also slightly thinner altogether.

From *Ogerieni*, more angustumbilicate in youth. From *patelliformis*, more distinctly costate and less acute peripherally.

Localities and Strata.—Gloucestershire: Coaley Wood (Cotteswold Sands, Bed 16, sect. vi, p. 45); North Nibley (Cotteswold Sands, Bed 30, sect. vii, p. 46); Chalford Waterworks, near Stroud ("Upper Lias"). Somerset: Pipley Bottom, North Stoke (in an ironshot limestone—E. Wilson, F.G.S.).

Date of Existence.—*Variabilis* hemera.

9. HAUGIA ILLUSTRIS (*Denckmann*).

1887. AMMONITES (HAMMATOCERAS) ILLUSTRIS, *Denckm.*, Pl. vi, fig. 1.

Remarks.—Denckmann shows three specimens under the name *illustris*, of which one (Pl. iii, fig. 6) is not the same genus, not even one of the *Lillia-Haugia* series. The other two differ in degree of coarseness of costation. The larger specimen is selected as the type.

A specimen well in agreement therewith has been obtained from Shepton Beauchamp at a horizon corresponding with that noted by Denckmann—namely, beneath *striatulus*. This specimen differs from those figured in this Monograph as *illustris*—from fig. 3 (Pl. XXVI) by smaller umbilicus, from fig. 4 by less definite tubercles but rather more definite costæ.

Localities and Strata.—Somerset: Shepton Beauchamp ("Upper Lias," between *bifrons* and *striatulus* [*toarcensis*]). Gloucestershire: North Nibley (Cotteswold Sands).

Date of Existence.—*Variabilis* hemera.

10. HAUGIA aff. ILLUSTRIS. Plate XXVI, figs. 3—5.

1890. HAUGIA ILLUSTRIS, This Monogr., Pl. xxvi, figs. 3—5.

Remarks.—The reference of these specimens to *illustris* can scarcely be maintained.

The two specimens can hardly both belong to one species, but the material is insufficient and badly preserved.

11. HAUGIA COMPRESSA, *S. Buckman.* Suppl., Plate II, figs. 8—10.

1844. AMMONITES VARIABILIS, *d'Orbigny*, Pl. cxiii, figs. 5, 6 only.
1887. AMMONITES (HAMMATOCERAS) ILLUSTRIS, *Denckm.*, Pl. v, fig. 2 only.

Definition.—Platyleptogyral, angustumbilicate, parvibullate, versi-subflexi-parvicostate, septicarinate.

Note.—The adult would no doubt be subexcentri-latumbilicate.

Distinction.—From *jugosa*—less ornate; from *Ogerieni*—the same, and less umbilicate; from *patelliformis*—more distinctly tuberculate, more distinctly and more closely costate; from *Werthi*—less flexicostate, more distinctly tuberculate.

Localities and Strata.—Gloucestershire: The Waterworks, Chalford, near Stroud ("Upper Lias," with other tuberculate species of *Haugia*); Coaley Wood (Cotteswold Sands). Somerset: Shepton Beauchamp ("Upper Lias").

Date of Existence.—*Variabilis* hemera.

The non-tuberculate, or *Eseri* group.

This name may describe the platyleptogyral, angustumbilicate, non-tuberculate species of the *Lillia-Haugia* series. It is almost certain that they are polygenetic, the development of different tuberculate species. Somewhat enlarged costæ near the inner margin in certain cases point to ancestral tubercles, elongated on account of greater involution.

The description of the species as *Haugia?* is merely a matter of convenience. It is probable they belong to more than one genus, some perhaps to *Lillia* as descendants of *Lillia Lilli*, some to *Phymatoceras*, &c.

12. Haugia? occidentalis (*Haug*). Plate XXVII, figs. 1, 2.

1890. Haugia occidentalis, This Monogr., Pl. xxvii, figs. 1, 2, p. 154.

Remarks.—The specimen figured with the above name differs from the example depicted by Haug; it is certainly more umbilicate and more coarsely costate. It may deserve separation.

Locality and Stratum.—Gloucestershire: Little Sodbury (Sands).

Date of Existence.—*Striatuli* hemera.

13. Haugia? Eseri (*Oppel*). Plate XXV, figs. 3, 4.

1890. Haugia Eseri, This Monogr., Pl. xxv, figs. 3, 4, p. 155.

Remarks.—The specimen referred to seems to agree particularly with what must be taken as the type, namely, Quenstedt's *Ammonites radians compressus* in 'Cephalopoden,' pl. vii, fig. 9.

It was pointed out at p. 156 that the other specimens do not agree so well. It seems desirable to separate them.

Localities and Stratum.—Gloucestershire: Coaley Wood; Cam Down; North Nibley; Whitehall Farm, Alderley (in all cases lower portion of the Cephalopod bed).[1]

Date of Existence.—*Striatuli* hemera.

[1] This and the associated species of the group are generally found just on the top of the lowest limestone band.

14. Haugia ? fascigera, *S. Buckman.* Plate XXV, fig. 7.

1890. Haugia Eseri, This Monogr., Pl. xxv, fig. 7, p. 156.

Remarks.—This is a more compressed, more umbilicate form than *Eseri*, and it is also distinguished by somewhat irregular fasciation of rather more flexed costæ.

Localities and Strata.—Gloucestershire: Stinchcombe Hill, and North Nibley (Cephalopod bed with *Eseri*); Sodbury (in a sandstone rock).

Date of Existence.—*Striatuli* hemera.

15. Haugia ? inæqua, *S. Buckman.* Plate XXV, figs. 5, 6; Plate A, fig. 37.

? 1862. Ammonites Eseri, *Oppel*, Pal. Mitth., pl. xliv, fig. 3.
1890. Haugia Eseri, This Monogr., Pl. xxv, figs. 5, 6; Pl. A, fig. 37, p. 156.

Remarks.—This form agrees in umbilication with the true *Eseri*, but is distinguished by irregularity of costation, and it is slightly thinner. It is less umbilicate than *fascigera*. The specimen figured by Oppel is more regularly costate.

Localities and Strata.—Gloucestershire: North Nibley, Stinchcombe, and Breakheart Hill, near Dursley (in the Cephalopod-bed with the foregoing). Somerset: Dundry Hill (E. Wilson, F.G.S.).

Date of Existence.—*Striatuli* hemera.

16. Haugia ? sculpta, *S. Buckman.* Plate XXVI, figs. 1, 2.

1890. Haugia Eseri, This Monogr., Pl. xxvi, figs. 1, 2.

Remarks.—This is really quite distinct from true *Eseri*—the coarse, fasciate costæ will separate it. It is, however, also more umbilicate and thicker. Costation and thickness distinguish it from *fascigera*.

Locality and Stratum.—Gloucestershire: North Nibley (with the foregoing).

Date of Existence.—*Striatuli* hemera.

Of this *Eseri*-group there are in my cabinets just as many forms again which require to be figured and named.

V. *Genus*—Phymatoceras, *Hyatt*.

(Type: Phymatoceras tirolense, *Dumortier*[1] sp.)

1867. Phymatoceras, *Hyatt*, Bull. Mus. Comp. Zool., No. 5, p. 88.
Lillia, pars, auct.

Definition.—Steno-subleptogyral, rursi-flexiradiate, tuberculate, septicarinate.

History.—The species named by Hyatt as examples of his genus have not been figured, so the genus has never really had recognition.

In answer to my queries the Professor writes to me,[2] "The *Phymatoceras robustum* is the young of *Am. tirolensis*, Dum., Pt. iv, Pl. xxiv," wherefore that species becomes the type of the genus.

Distinction.—The flexiradiate character sufficiently separates this genus from either *Lillia* or *Haugia*, but mode of growth and manner of ornament also distinguish the type species.

Remarks.—The species now ranged under *Phymatoceras* (see p. xi) are placed here from their possession of the flexiradiate character; but more division is obviously required on account of mode of growth and other characters.

Some of the *Eseri*-group are perhaps non-tuberculate descendants of some of the species arranged under *Phymatoceras*, and should therefore bear the generic title of such species.

1. Phymatoceras Dumortieri, *S. Buckman*. Plate XXIII, figs. 16, 17; Plate A, fig. 36.

1889. Haugia Ogerieni, This Monogr., Pl. xxiii, figs. 16, 17; Pl. A, fig. 36.
1890. — Dumortieri, Ibid., p. 152, in correction.

Description.—Platy-subpachygyral, angustumbilicate, flexicostate, parvituberculate,[3] subparvi-septicarinate.

Remarks.—This species has the combination of small umbilicus, thick whorls, and tubercles, characterising the *Bayani*-group. But it cannot belong there, because the periphery is not sulcate and the carina is hollow.

[1] This is not the same as the *tirolensis*, Hauer, and so the type of the present genus will require a new name.

[2] June 1st, 1897.

[3] The tubercles are not so definite as shown in the figure. They are somewhat obscure, elongate bulgings.

Distinction.—The flexicostate character is a good noticeable feature.

Locality and Stratum.—Gloucestershire: North Nibley (Cotteswold Sands, Bed 18, section vii, p. 46).

Date of Existence.—*Variabilis* hemera.

2. Phymatoceras pauper, *S. Buckman.* Suppl., Plate III, figs. 7—9.

Description.—Platyleptogyral, angustumbilicate, subflexi-parvi-densicostate, parvituberculate, septicarinate.

Distinction.—The species is distinguished from *Am. Werthi*, Denckmann, by smaller umbilicus and more distant, straighter ribbing.

Localities and Stratum.—Gloucestershire: Coaley Wood (in Bed 13 of the section given at p. 45 : it is therefore rather more than ten feet above *Haugia grandis:* it occurs with large *Limæ*, probably *L. toarcensis*, Dum.) ; North Nibley (Bed 20, p. 46).

Date of Existence.—*Variabilis* hemera.

VI. *Genus*—Brodieia,[1] *S. Buckman.*

(Type: Brodieia curva, sp. n.)

The *Bayani*-group.

Definition.—Platypachygyral, excentri-angustumbilicate, flexiradiate, parvicarinate.

Remarks.—In their mode of growth the species of this genus differ from all other members of the *Lillia-Haugia* series. There is a combination of a small umbilicus, stout whorls, a broad periphery, and a small carina, in which even if there were any septation such a character would be recognised only with great difficulty. In other members of the *Lillia-Haugia* series, when a small umbilicus is attained, the whorls are thin, and the carina is strongly elevated with a very noticeable septation. The nearest approach in shape is found in *Phymatoceras Dumortieri,* but the elevated septicarina at once forms a distinction in that case.

For the present the species of the *Bayani*-group may be known as *Brodieia;* but probably further separation will be required, as there are recti- and flexiradiate forms. There is a noticeable scarcity of any of these species in this

[1] In memory of the Rev. P. B. Brodie, F.G.S., my father's friend and fellow-worker.

country, so that the present classification depends mainly on figures. But it may be remarked that the true *Bayani*-group would be the recticostate species, while circumstances render it desirable to choose as the type of *Brodieia* a flexicostate form. Wherefore it is possible that in the future the true *Bayani*-group, that is the recticostate species, may require another generic name than *Brodieia*.

1. Brodieia juncta, *S. Buckman.* Suppl., Plate IV, figs. 7—9.

Cf. 1874. Ammonites Bayani, *Dumortier,* Pl. xiv, figs. 7—9.

Description.—Platypachygyral, excentri-angustumbilicate, subrursi-parvi-sub-recticostate, parvicarinate.

Remarks.—The small carina is set in a slightly flattened area of a rather broad periphery, and so the periphery might be termed obsoletely carinati-sulcate.

Two, sometimes three costæ are connate on the inner area to form larger ribs.

Distinction.—The periphery distinguishes it from *Bayani*, which is distinctly carinatisulcate. Excentri-umbilication also begins earlier in this form.

Locality and Stratum.—Barrington, Somerset ("Upper Lias," with *Haugiæ*).

Date of Existence.—*Variabilis* hemera.

2. Brodieia curva, *S. Buckman.* Plate XXII, figs. 35, 36.

1889. Incertæ sedis, This Monogr., Pl. xxii, figs. 35, 36.

Description.—Platypachygyral, excentri-angustumbilicate, flexicostate, non-tuberculate, connaticostate, parvicarinate.

Remarks.—The style of ribbing is fairly well shown in the figure. A slightly stouter rib on the inner area breaks into two waved ribs. The ribs have not much peripheral projection, but still there is a decided forward turn.

Localities and Stratum.—Gloucestershire: North Nibley (Cotteswold sands, Bed 30, section vii, page 46).

Date of Existence.—*Variabilis* hemera.

The next species is only placed as *Brodieia?* for convenience. It is not that genus, though it has somewhat similar ornament; but it lacks the association of stout whorls with angustumbilication. It is nodate, and yet leptogyral. It has

SUPPLEMENT, PLATE I.

Lilli hemera.

Figs. 1—6.—LILLIA LILLI, *Hauer*.

Fig. 1.—Side view of a typical but immature specimen without test. The + shows the position of the last septum, and the O where the partition-band terminated, as indicated by the shape of the periphery. Shepton Beauchamp, Somerset. My Collection. (Page xiv.)

Fig. 2.—A portion of the periphery taken at the place marked *a*. Attached to the lower part may be seen a piece of the infilling of the septicarina: this infilling has been shifted, and has become cemented again during fossilisation.

Fig. 3.—Outline of the whorl at the commencement of the body-chamber. What appears as carina is only the infilling.

Fig. 4.—Portions of three consecutive septa, taken at a diameter, for the middle one, of about 40 mm., showing the long *L* and also the very small *l* on the upper edge of the inner margin—the dotted line.

Fig. 5.—Radial curves.

Fig. 6.—Portion of the body-chamber of a large adult (senile?) specimen, which probably measured over 300 mm. in diameter. It is not certain that it is *L. Lilli*, but it belongs to a closely related fossil. It probably measured 68 mm. in whorl-thickness, but the other side is incomplete. Found loose at Trent, Somerset; but its horizon is unmistakable, as embedded in the back of it are portions of two examples of *Hildoceras bifrons*.

Figs. 7—10.—DENCKMANNIA TUMEFACTA, *S. Buckman*.

Fig. 7.—Side view, showing the large, coarse ribs. The specimen possesses the test, but is not altogether in good condition; the centre of the umbilicus is wanting. From just above *Hildoceras bifrons*. Shepton Beauchamp, Somerset. My Collection. (Page xix.)

Fig. 8.—Peripheral view.

Fig. 9.—Outline of the whorl-section.

Fig. 10.—Portions of two septa. The superior lateral lobe of one and the siphonal lobe of its successor are given in position to illustrate the size of the loculus. The superior lateral lobe is apparently tridactyloid, with very isosceloid terminal lobule, and much abbreviated inner lobule.

Dumortieria hemera, probably.

Figs. 11—15.—CHARTRONIA BINODATA, *S. Buckman*.

Fig. 11.—Side view of a poorly preserved specimen destitute of test. Purchased from the Collection of the late Dr. Wright, F.R.S. It is labelled "Frocester Hill." It is certainly from the Cephalopod-bed; and by the matrix probably from the *Dumortieria*-bed. Now in my Cabinet. (Page xvi.)

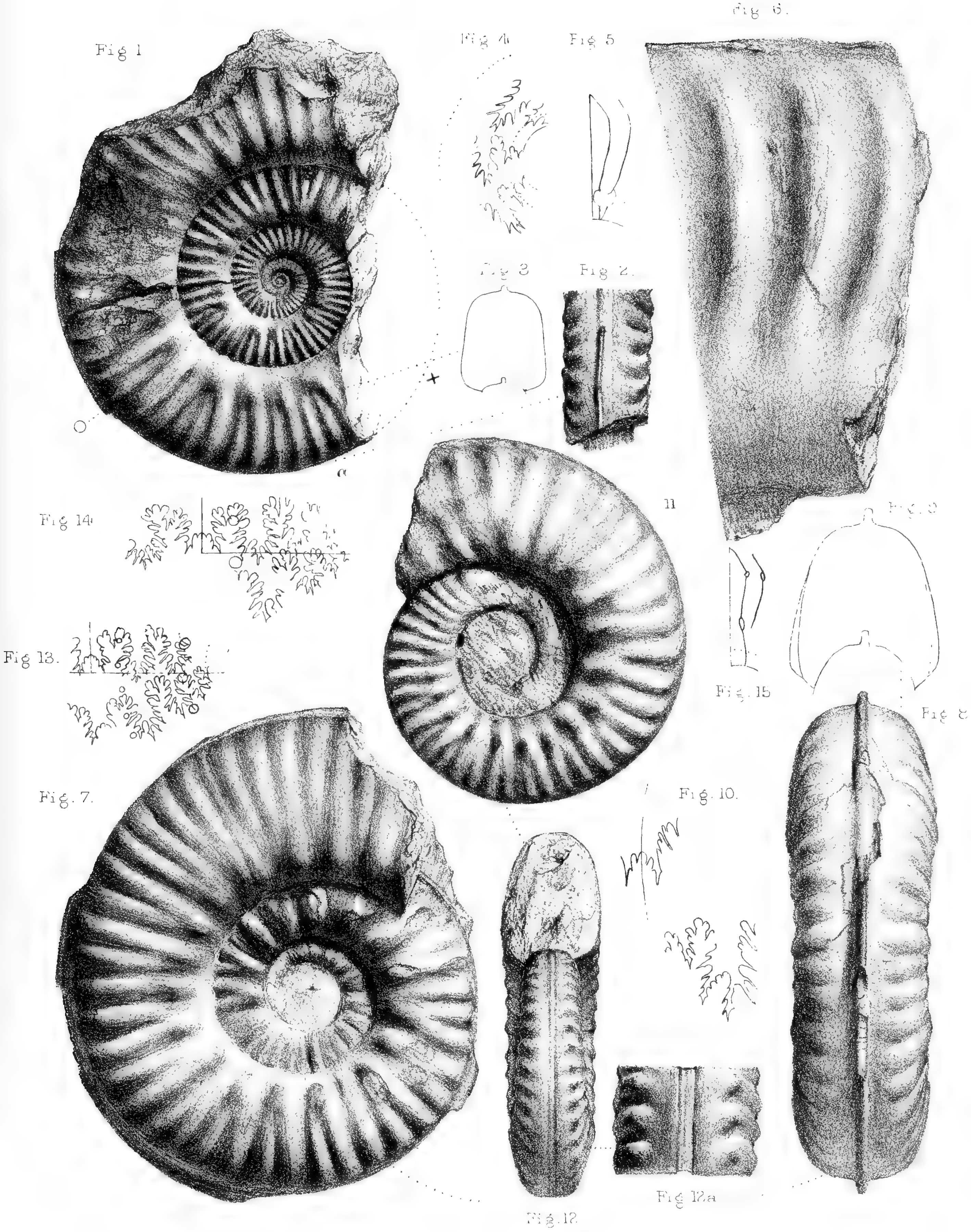
Fig. 12.—Front view of the same specimen to show the presence of rudimentary nodi towards the outer ends of the costæ. These pimples are situated on the edge of the periphery, between the siphonal and superior lateral lobes. The septicarina of this specimen is lost, but there remains a distinct imprint of the partition band.

Fig. 12 *a*.—Part of the periphery enlarged twice, to show the small nodi and the imprint of the partition band.

Fig. 13.—Portions of two suture-lines at 56 mm. diameter.

Fig. 14.—The same at 67 mm. diameter. The superior lateral lobe is not dactyloid, but may be said to be somewhat claviform.

Fig. 15.—Radial curves of the same specimen.



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SUPPLEMENT, PLATE II.

Lilli hemera.

Figs. 1, 2.—DENCKMANNIA ? ISERENSIS (*Oppel*).

Fig. 1.—Side view of a fragment found in the Upper *Leda-ovum*-beds at Moulton, near Northampton, by Mr. B. Thompson, F.G.S. In his Collection. (Page xvii.)

Fig. 2.—Outline of the whorl-section, one side restored.

Figs. 3, 4.—LILLIA NARBONENSIS, *S. Buckman.*

Fig. 3.—Side view of a very inferior fragment reduced one-half natural size. From the Upper *Leda-ovum*-beds, Moulton. Collection of Mr. B. Thompson, F.G.S. (Page xiv.)

Fig. 4.—Outline of the whorl-section, natural size.

Variabilis hemera.

Figs. 5—7.—HAUGIA NAVIS (*Dumortier*).

Fig. 5.—Side view of a somewhat poorly preserved wholly septate specimen. From the so-called "Upper Lias," Winsmoor Hill, Barrington, Somerset. My Collection. (Page xxii.)

Fig. 6.—Front view.

Fig. 7.—Parts of two consecutive suture-lines.

Figs. 8—10.—HAUGIA COMPRESSA, *S. Buckman.*

Fig. 8.—Side view of a wholly septate specimen. From a bluish-green marl usually called "Upper Lias." The Waterworks, Chalford, Gloucestershire. My Collection. (Page xxvii.)

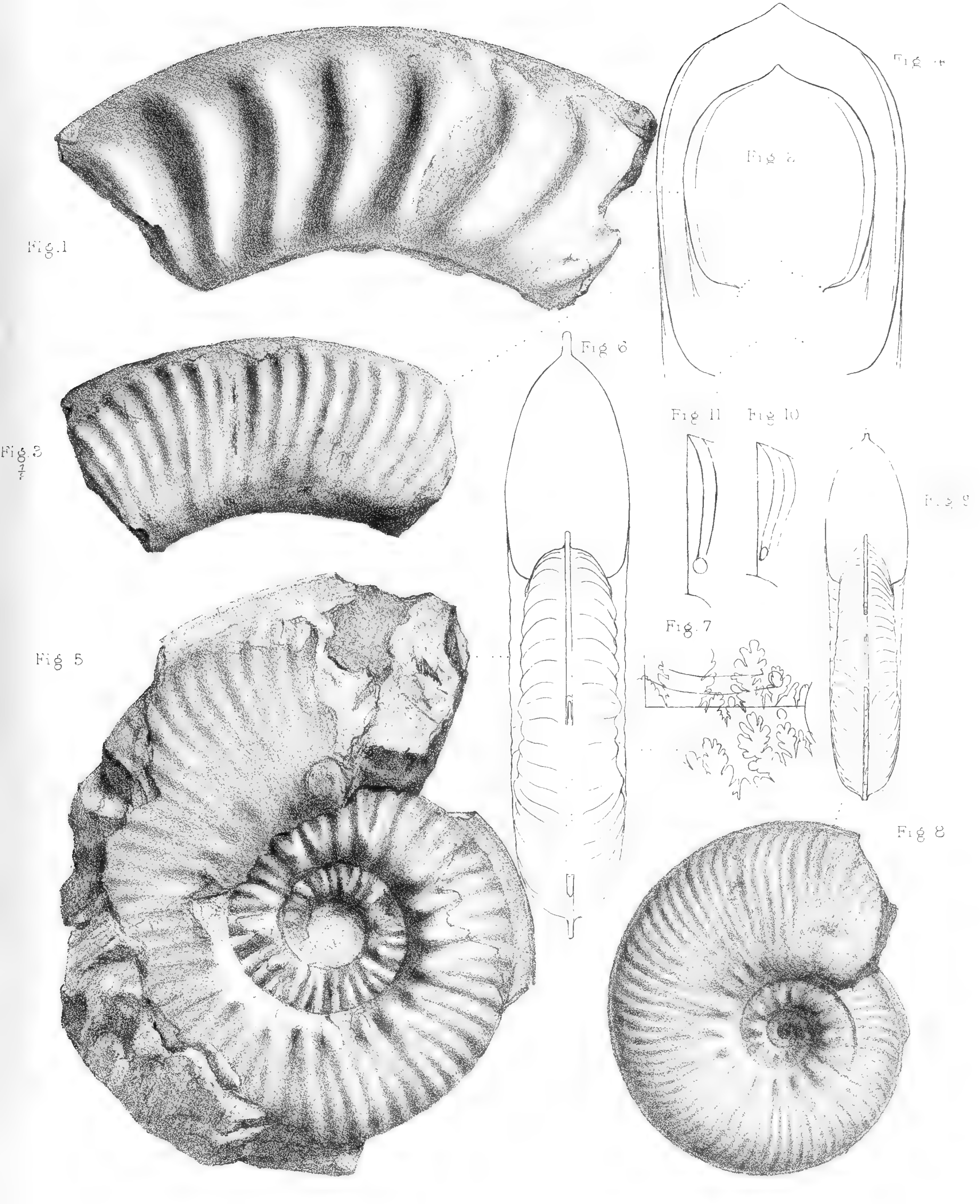
Fig. 9.—Front view.

Fig. 10.—Radial curve.[1]

Fig. 11.—HAUGIA GRANDIS, *S. Buckman.*

Fig. 11.—Radial curve of the shell figured in Pl. XXIII, figs. 14, 15. (Page xxvi.)

[1] The curve in the septicarinate spines is followed up to, but is not continued over, the carina.



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SUPPLEMENT, PLATE III.

Variabilis hemera.

Figs. 1—3.—Haugia patelliformis, *S. Buckman.*

Fig. 1.—Side view of a portion of a wholly septate specimen. The details have been supplemented from the other side. From the so-called "Upper Lias," Shepton Beauchamp, Somerset. My Collection. (Page xxv.)

Fig. 2.—Outline of the whorl-section.

Fig. 3.—Suture-lines.

Figs. 4—6.—Denckmannia torquata, *S. Buckman.*

Fig. 4.—Side view of a wholly septate specimen, reduced to two-thirds of the natural size. From the so-called "Upper Lias," Shepton Beauchamp, Somerset. My Collection. (Page xix.)

Fig. 5.—Outline of the whorl-section, natural size.

Fig. 6.—Suture-lines and radial curves.

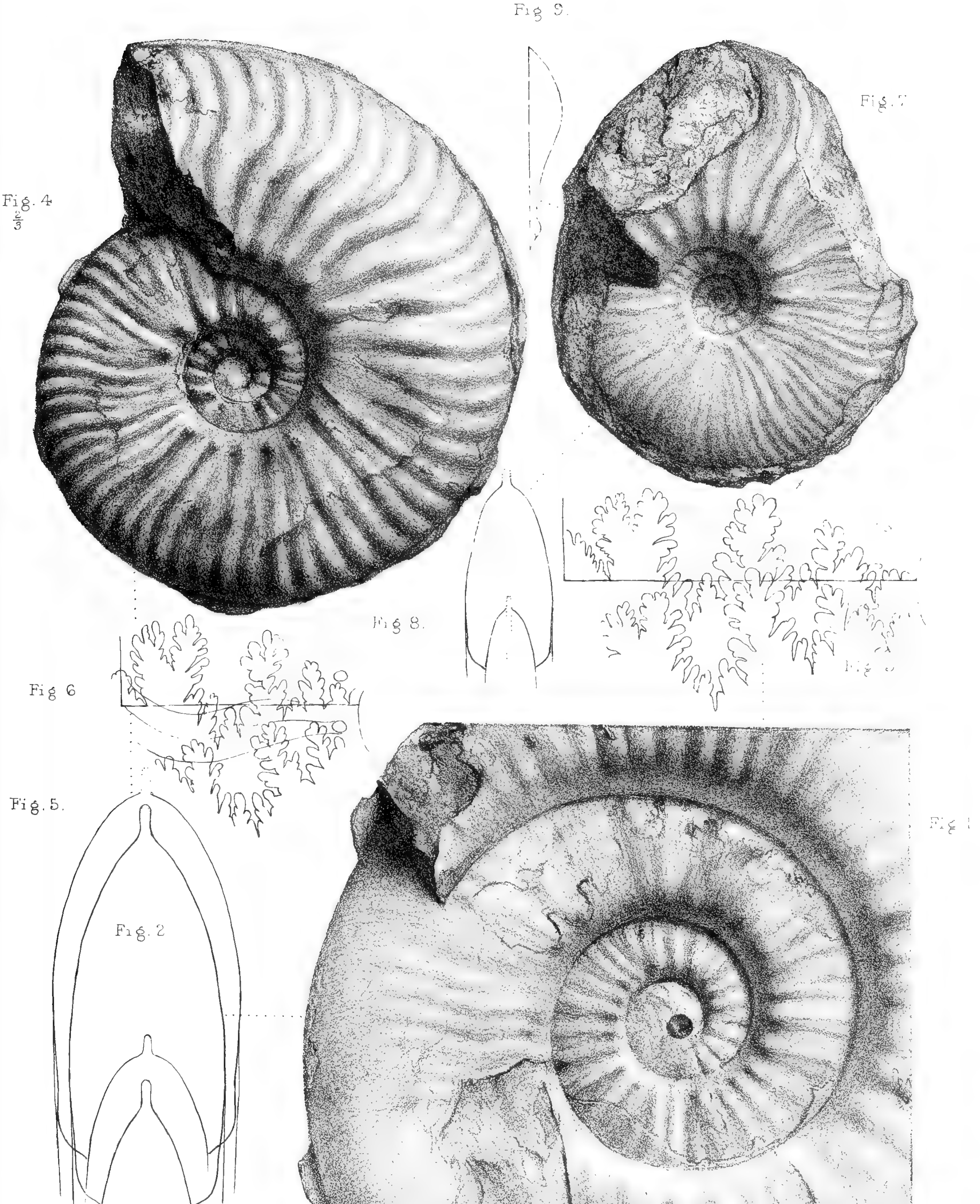
Figs. 7—9.—Phymatoceras pauper, *S. Buckman.*

Fig. 7.—Side view of a somewhat poorly preserved shell. Details have been supplemented from the other side. From the Cotteswold Sands, Coaley Wood (Bed 13, section vi, p. 45). (Page xxxi.)

Fig. 8.—Outline of the whorl-section, restored slightly.

Fig. 9.—Radial curve.

SUPPL:, PLATE III.



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SUPPLEMENT, PLATE IV.

Variabilis hemera.

Figs. 1—3.—DENCKMANNIA? MALAGMA (*Dumortier*).

Fig. 1.—Portion of the side view of an example from the so-called "Upper Lias," Shepton Beauchamp, Somerset. My Collection. (Page xx.)

Fig. 2.—Outline of the whorl-section.

Fig. 3.—Radial curve.

Figs. 4—6.—DENCKMANNIA? OBTECTA, *S. Buckman.*

Fig. 4.—Portion of the side view of a specimen from Cotteswold Sands, Coaley Wood (Bed 16, section vi, p. 45). My Collection. (Page xxi.)

Fig. 5.—Outline of the whorl-section.

Fig. 6.—Radial curve.

Figs. 7—9.—BRODIEIA JUNCTA, *S. Buckman.*

Fig. 7.—Side view. From so-called "Upper Lias," Barrington, Somerset. My Collection. (Page xxxii.)

Fig. 8.—Outline of the whorl-section.

Fig. 9.—Parts of suture lines. 9 *a.*—Radial curve.

Murchisonæ or *Bradfordensis* hemera.

Figs. 10—12.—COSMOGYRIA OBTUSA (*Quenstedt*).

Fig. 10.—Side view. Dundry, Somerset. Collected by the late Mr. E. Wilson, F.G.S., to whom I am indebted for its addition to my cabinet. (Page liii.)

Fig. 11.—Outline of the whorl-section.

Figs. 12, 12 *a.*—Suture lines. 12 *b*, *c*, *d.*—Radial lines.

Bradfordensis hemera.

Figs. 13—15.—COSMOGYRIA SUBTABULATA, *S. Buckman.*

Fig. 13.—Side view. Quarry Hill, Chideock, Dorset; from the "red beds." My Collection. (Page liii.)

Fig. 14.—Peripheral view (outline). 11 *a.*—Outline of whorl-section.

Figs. 15, 15 *a.*—Suture lines. 15 *b.*—Radial line.

Figs. 16—18.—WELSCHIA RUSTICA, *S. Buckman.*

Fig. 16.—Side view. Stoke Knap, Dorset; from the "Building Stone." My Collection. (Page lii.)

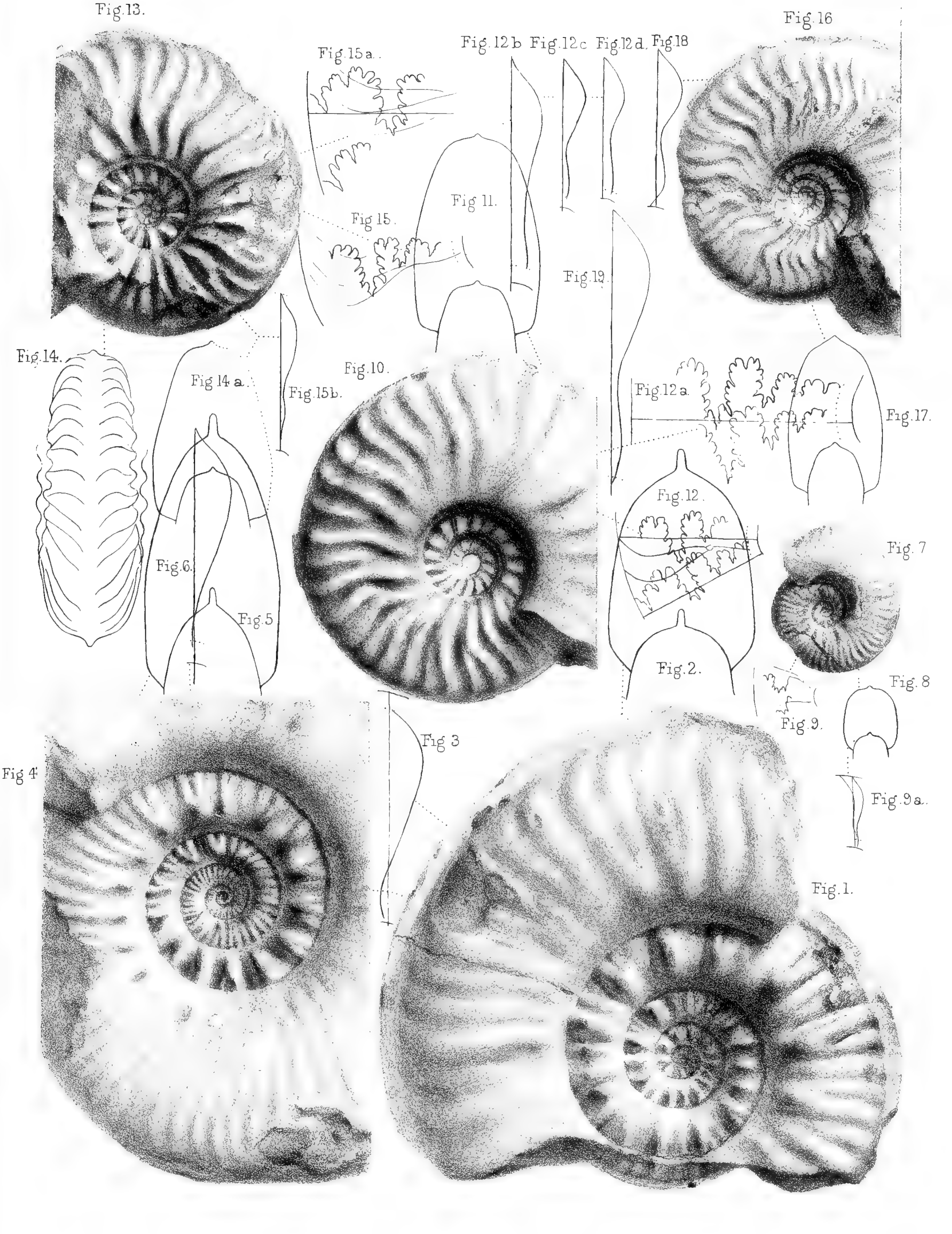
Fig. 17.—Outline of whorl-section.

Fig. 18.—Radial line.

Murchisonæ hemera.

Fig. 19.—WELSCHIA OBTUSIFORMIS, *S. Buckman.*

FIG. 19.—Radial line of the specimen figured in Plate I as *Ludwigia Murchisonæ*, which should now be altered. (Page lii.)



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THE

PALÆONTOGRAPHICAL SOCIETY.

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MONOGRAPH

ON THE

CARBONIFEROUS CEPHALOPODA

OF

IRELAND.

BY

ARTHUR H. FOORD, Ph.D. (Münch.), F.G.S.

PART II.

CONTAINING THE FAMILIES

ORTHOCERATIDÆ (concluding Part), ACTINOCERATIDÆ, CYRTOCERATIDÆ, and POTERIOCERATIDÆ.

Pages 23—48; Plates VIII—XVII.

LONDON:

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1898.

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

ORTHOCERAS SOLLASI, *A. H. Foord.* Plate VIII, figs. 1 *a—f.*

ORTHOCERAS SOLLASI, *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. 32.

Description.—Shell straight, of medium size, tapering at the rate of 1 in 8. Section slightly elliptical, the ratio of the two diameters as 37 : 32. Body-chamber of moderate size, about one-fourth the length of the shell; edge of the aperture undulating; below it on the cast there is a well-defined shallow, crescentic depression, which at each extremity of the longer axis of the shell is 10 mm. below the edge of the aperture, from whence it passes down and forms a shallow sinus on the broader aspect of the shell. Septa deeply concave, horizontal, distant from each other about two-fifths of their own diameter. Siphuncle cylindrical, about one-eighth the width of the shell; nearly central. The surface of the cast, where it is well preserved, shows admirably the fine "wrinkles" and minute punctures described by the Brothers Sandberger under the name of "Runzelschicht" ('Die Verstein. Nassau,' 1856), which have been ascribed to the markings on the mantle of the animal preserved through the medium of the extremely fine sediment which filled the body-chamber, and sometimes too the septate parts of the shell after the death of the animal, but before the decay of the soft parts. The ornaments in this specimen are very conspicuous; they consist of fine imbricating striæ, disposed with great regularity, the edges of the imbrications being directed towards the aperture. Four of them occupy the space of 1 mm.; they are therefore visible to the naked eye, at least in the older parts of the shell (Pl. VIII, fig. 1 *c*, natural size, and giving nearly the number of striæ of the part figured).

Size.—The most complete specimen, wanting only a portion of the apical end, measures 190 mm. in length, the diameter at the apertural extremity being 35 mm., that at the apical one 13 mm.

Affinities.—This species is closely related to *Orthoceras Clanense*, and the question naturally arose as to whether it might not have been the young of that form. There are, however, some points which weigh against this supposition: chief among these is the rate of tapering, which is much quicker in *O. Clanense* (1 : 6) than in the present species (1 : 8); further, the septa in *O. Sollasi* are horizontal, while they are oblique in *O. Clanense*. The ornaments, though finer in *O. Sollasi* than in the latter species, are the same in character in both, and constitute the main and obvious feature in the relationship of the two forms.

Remarks.—The occurrence in the Clane quarries of several examples of this beautiful form, all stamped with its characteristic features, impart the requisite stability to it as a species. Two of the best specimens are figured, the test being exquisitely preserved in the one represented by fig. 1 *a*; in the other (fig. 1 *e*) the surface is considerably eroded, though the strength of the markings has preserved them here and there from complete destruction, and thus the identity of the species has not been lost. I regret that the apical end is not present in any of the specimens before me. Most of the fossils which come into the hands of the palæontologist have already suffered from the effects of the sledge-hammer of the quarryman, whose untrained eyes allow these valuable pieces to remain embedded in the rock, and thus many a precious fragment is thrown aside or shot into the fiery depths of the lime-kiln! The species is named after Professor W. J. Sollas, F.R.S., of Oxford.

Locality.—Clane, county of Kildare.

ORTHOCERAS MULTISTRIATUM, *A. H. Foord.* Plate VIII, figs. 2 *a*, *b*.

ORTHOCERAS MULTISTRIATUM, *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. 31.

Description.—Shell straight, elongate, tapering at the rate of 1 : 10, measured along the larger diameter. Section somewhat elliptical, whether naturally so or by rock-pressure it is difficult to determine; the ratio of the two diameters is as 38 : 30. Body-chamber imperfect, so that its size in relation to the complete shell cannot be computed. Septa oblique, 8 mm. apart where the diameter of the shell stands at about 20 mm.; necks of the septa short and hooked. Siphuncle cylindrical and rather wide (Pl. VIII, fig. 2 *b*). Test ornamented with fine, irregularly spaced, imbricating striæ, the edges of which are directed upwards; about two of the striæ fill the space of 1 mm., they are therefore visible to the naked eye (Pl. VIII, fig. 2 *a*).

Size.—The length of the most complete specimen known to me is about 195 mm., the greatest diameter 40 mm., the least 18 mm.

Affinities.—The ornamentation of this species naturally suggests affinities with *O. perellipticum*, but the general form is quite different, the rate of tapering being very low in the present species and very high in *O. perellipticum*. While thus agreeing in the character of its ornamentation with the latter, *O. multistriatum* is in its shape and septation more akin to *O. Sollasi*, from which, however, it separates itself by its much finer ornamentation and larger siphuncle. On the whole it is a fairly well-marked species. It has been found up to the present time only in the Cork district.

Locality.—Little Island, near Cork.

ORTHOCERAS PERELLIPTICUM (*A. H. Foord*), *F. M'Coy*. Plate VIII, figs. 3 *a—c*.

1844. ORTHOCERAS (LOXOCERAS) DISTANS, *F. M'Coy*. Synopsis of the Char. of the Carb. Limest. Foss. of Ireland, p. 8, pl. iv, fig. 1 (not of Sowerby).

1888. — PERELLIPTICUM, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 1, p. 104.

1896. — — (*A. H. Foord*), *M'Coy*. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 30.

Description.—Shell of medium size, straight, rate of increase rapid, being at the rate of 1 : 5. Section elliptic, the ellipticity probably at least in part caused by rock-pressure; the proportion of the two diameters in the type specimen as 12 : 8. Body-chamber unknown. Septa undulating, rather widely separated (hence M'Coy's name), distant from each other 6 mm. where the diameter of the shell is 18 mm., the space between them increasing to 8 mm. where the diameter of the shell is 26 mm. Siphuncle central or nearly so (Pl. VIII, fig. 3 *b*), its structure unknown. Shell thin, ornamented with very fine, upwardly imbricating striæ, arranged with approximate regularity, running obliquely across the surface of the shell. Six or seven of these striæ occupy the space of 1 mm. When highly magnified (Pl. VIII, fig. 3 *c*) they are seen to be of unequal size, though their general aspect when looking over the surface of the shell with a hand-lens gives the impression of their being fairly regular.

Affinities.—Its elliptical form and high rate of tapering enable this species to be readily distinguished from *O. multistriatum*. These features exist in all specimens to which I have had access, including the type specimen contained in the Dublin Museum of Science and Art (Griffith Collection), and others in the general collection in that museum; also the one figured, which is from the museum of Queen's College, Cork. It is easily distinguished from *O. Clanense* and *O. Sollasi* by its much finer sculpture, added to the characters mentioned above.

Remarks.—I have not refigured the type specimen because it is almost entirely denuded of the test, owing to which circumstance M'Coy overlooked the striations upon its surface; these are, however, actually preserved upon a fragment of the test to which my attention was drawn by my friend Mr. G. C. Crick, of the British Museum. But for this fortunate discovery it would not have been possible to identify M'Coy's species with any other form without much uncertainty. Owing to M'Coy's *O. distans* being preoccupied by J. de Carle Sowerby (in Murchison's "Silurian System," p. 619, pl. viii, fig. 17), I was compelled to re-name the present species when describing it in the 'Catal. Foss. Cephal. British Museum' (1888, pt. 1, p. 20).

Locality.—Little Island, near Cork.

[ORTHOCERAS CINCTUM, *J. de Carle Sowerby.* Min. Conch., vol. vi, 1829, p. 168, pl. dlxxxviii, fig. 3.

ORTHOCERAS CINCTUM, *A. H. Foord,* 1896. Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 37.

The original of this species, which should be in the "Sowerby Collection" in the British Museum, has been lost, and there is therefore only the author's brief description and accompanying figure by which to identify it. Sowerby's description is as follows: "Shell nearly cylindrical, surface ornamented with numerous sharp, annular striæ; siphon central. In this species the septa are rather more concave than is usual, and also distant. The transversely striated surface is what it is best distinguished by, and seems to indicate a shell formed outside the animal. I have seen but one specimen. . . . . Near Preston, Lancashire."

The short description given by Sowerby, and the sketchy character of his figure, make any attempt to identify *O. cinctum* with actual specimens a very risky matter, considering that several species ornamented with striæ of different kinds can now be identified from England, Scotland, Ireland, and Belgium.

The appearance, therefore, of the name "*Orthoceras cinctum*" in lists of fossils cannot be taken as in any way authoritative for the occurrence of Sowerby's species in the particular locality indicated, since we are ignorant as to what that species is. Caution in this case is all the more necessary since it was not formerly the practice to examine minutely into the character of the ornamentation upon the surface of such shells, and apparently no distinction was made between what are properly termed "imbricating" lines and other fine transverse lines of a totally different nature.

I would suggest, therefore, that the name "*Orthoceras cinctum*" be given up, since its further employment can only lead to confusion.]

B. Brevicones.

Orthoceras perconicum, *A. H. Foord.* Plate VIII, figs. 4 *a*, *b*.

1896. Orthoceras perconicum, *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. 36.

Description.—Shell abruptly conical; rate of tapering very rapid, that is about 1 : 2. The transverse section is slightly elliptical, the proportion of the two diameters being as 35 : 29. The body-chamber is very large, occupying fully half the length of the entire shell, and far exceeding it in bulk. Only the sutures are seen, the septa themselves, as a section proved, having been completely destroyed; they are perfectly horizontal. The siphuncle is not preserved. The only example obtained measures 86 mm. in length; the greater diameter amounts to 47 mm., the lesser to 16 mm. (this is considerably above the apex). The test is perfectly smooth.

Size.—Length (imperfect at both ends) 86 mm.; greatest diameter 47 mm., least 16 mm.

Affinities.—In seeking for a species related to the present one, that described by de Koninck from Visé, Belgium, under the name of *Orthoceras cucullus*[1] at once presents itself to our notice. This consists only of the chambered part of the shell, so that the proportions of the body-chamber in relation to the complete shell cannot be compared with those of *O. perconicum.* The rate of increase in the diameter of the Belgian species is 1 : 2·66; that of the Irish species, as indicated above, 1 : 2. The sutures are rather wider apart in *O. cucullus* than they are in *O. perconicum;* that is, in an interval of 28 mm., measured off at the smaller end of each specimen, there are five chambers in the latter against four and a half in the former. Both species are unfortunately only imperfectly known. In *O. cucullus* the body-chamber and the test are wanting, in *O. perconicum* the siphuncle and the septa (not their sutures) have been destroyed. There are thus

[1] 'Descrip. Anim. Foss. Belg.' (Suppl.), 1851, p. 54, pl. lix, fig. 1.

two elements of difference between these species, viz. the rate of increase and the width of the intervals between the sutures.

This may be regarded as a very rare species, only one specimen having been found in the course of several years of collecting.

Remarks.—The group of forms to which Barrande[1] gave the name "*Orthocères brévicones*" are rare in the Carboniferous rocks. I am only acquainted with three European species, viz. *O. dilatatum*, de Kon.,[2] *O. cucullus*, de Kon.,[3] and *O. perconicum*, Foord. The other Carboniferous species assigned by Barrande to the brevicone group prove to be species of *Poterioceras;* these are "*Orthoceras*" *cordiforme*, J. Sow., and "*O.*" *latissimum*, Portl. The latter was even suggested by its author to be "*O.*" *cordiforme*, its condition being too imperfect to admit of certainty as to its true position. I shall have occasion to refer to this fragment again later on.

Family Actinoceratidæ.

Genus Actinoceras, *Bronn*, 1837.

Actinoceras giganteum, *J. Sowerby*, sp. Plate IX, figs. 2 *a*—*c*.

1821. Orthocera gigantea, *J. Sowerby.* Min. Conch., vol. iii, p. 81, pl. ccxlvi.
1836. Orthoceras giganteum, *J. Phillips.* Geol. of Yorkshire, pt. 2, p. 237, pl. xxi, fig. 3.
1840. Actinoceras Simmsii, *C. Stokes.* Trans. Geol. Soc., ser. 2, vol. v, pt. 3, p. 708, pl. lix, figs. 4, 5.
1843. — — *J. E. Portlock.* Rep. on the Geol. of Londonderry, &c., p. 391.
1844. Orthoceras giganteum, *L. G. de Koninck.* Descrip. Anim. Foss. Belg., p. 510, pl. xliv, fig. 2; pl. xlv, fig. 3; pl. xlvi, and pl. xlvii, fig. 1.
1844. Actinoceras giganteum, *F. M'Coy.* Synop. Carb. Foss. Ireland, p. 11.
1844. — pyramidatum, *F. M'Coy.* Ibid., p. 11, pl. i, fig. 5.
1854. — giganteum, *F. A. Roemer.* Beitr. z. geol. Kenntn. des nordwest. Harzgeb., Palæontographica, Band iii, p. 93, pl. xiii, figs. 27 *a*—*c*.
1855. Orthoceras (Actinoceras) giganteum, *F. M'Coy.* British Pal. Foss., fasc. 3, p. 571.
1862. Actinoceras giganteum, *R. Griffith.* Journ. Geol. Soc. Dublin, vol. ix, pp. 33 and 55.
1874. — — *J. Young and J. Armstrong.* Trans. Geol. Soc. Glasgow, vol. iv, p. 280.

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[1] 'Syst. Sil. de la Bohême,' vol. ii, p. 18.
[2] 'Descrip. Anim. Foss. Belg.,' 1842–4, p. 515, pl. xlv, figs. 8, 9.
[3] Idem, Suppl., 1851, p. 54, pl. lix, fig. 1.

1880. Orthoceras giganteum, *L. G. de Koninck.* Faune Calc. Carb. Belg., tom. v, p. 75, pl. xliv, figs. 5—10.

1888. Actinoceras giganteum, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 1, p. 187.[1]

Description.—Shell very large, straight. Section nearly circular. Rate of increase varying from 1 : 7 to 1 : 5. Septa moderately convex, somewhat oblique in the upper part of the shell, increasing somewhat rapidly in their distance apart; for example, in a specimen measuring 850 mm. in length the septa are only 2 mm. (about) distant at the smaller extremity, while at the larger the interval between them has increased to 25 mm. There is a large fragment contained in the Museum of Science and Art, Dublin, from the red limestone of Castle Espie, county of Down, which has the following dimensions: length 750 mm., greatest diameter 280 mm., least 155 mm. Another specimen, collected by myself at Clane, in the county of Kildare, has a length of 910 mm., the greatest diameter being 240 mm., the least 35 mm.; this gives a rate of tapering of about 1 : 4·5. The distance of the last three septa from each other is from 40 to 50 mm., that of those at the smaller end (where the diameter is 55 mm.) from 11 to 12 mm. The length of the portion of the body-chamber preserved is 240 mm. The specimen is chemically eroded, the surface roughened and destroyed, and showing no trace of the test. The siphuncle is not large in proportion to the size of the shell; it is a little excentric in position in the young shell, tending to become more nearly central in the adult; it is much inflated between the septa, where it forms depressed spheroidal segments twice as wide as long. The outer surface of the test is generally wanting, and the inner layer being quite smooth has led to the species being described as having a perfectly smooth shell. There is a specimen, however, in the British Museum which has a distinctly striated surface above the smooth layer, the ornaments consisting of fine transverse lines, of which there are about three in the space of 2 mm.[2]

Affinities.—The only species with which the present one may be compared is that next to be described, and the characters separating the two species being enumerated under the latter, it is not needful to mention them here.

Remarks.—Of the records of this species in foreign localities of the Carboniferous rocks only two need be referred to, viz. that of de Koninck and that of Roemer. The former of these authors has described and figured the species in his well-known work on the Carboniferous fauna of Belgium, where it occurs in several localities. The latter has figured and very briefly described a fragment from the Kulmkalk of Grund, in the Hartz Mountains (‘Palæontographica,’ 1854,

[1] The list here supplied gives only the more important synonyms and references; it does not claim to be exhaustive.

[2] The specimen showing these markings is registered C 325 in the collection.

Band iii). The species occurs in several places in the British Isles, chief among which are Closeburn in Dumfriesshire (the locality whence Sowerby's type was obtained), and Castle Espie, county of Down, where specimens of this rather common species occur of such a size as fully to justify the name given to it by Sowerby. It has been found also at Orchard, near Glasgow, and at Bolland in Yorkshire.

The specimens of *A. giganteum* yielded by the Carboniferous rocks of Belgium present the same differences when compared with *A. insulare* as do those of Scotland and Ireland, of which the closer septa in the Belgian form is the most important one. To this must be added the striated test described above, whose presence might seem to have been strangely overlooked among the many specimens of this form passing through the hands of palæontologists. I have not observed the test, however, upon any of the specimens from Closeburn or Castle Espie, whence most of the specimens to be seen in museums have come. It is not so astonishing, therefore, that it should all along have been supposed that the species had a smooth shell.

I am indebted to the kindness of Prof. J. Joly, F.R.S., for the use of some examples of this species from the museum of Trinity College, Dublin. These show the structures of the siphuncle remarkably well, considering the highly crystalline condition of the rock in which they are preserved (Pl. IX, figs. 2 *a*—*c*).

Locality.—Castle Espie, county of Down (specimens figured). Other localities are mentioned above.

Actinoceras insulare, sp. nov. Plate X, figs. 1 *a*—*d*.

Description.—Shell (fragment) large, straight. Section elliptical, at least in the lower half of the specimen, the ratio of the two diameters here being as 58 : 48. Rate of increase about 1 in 7. Septa very concave, increasing rather rapidly in their distance apart; that is, at a place where the diameter of the shell is 58 mm. they are 17 mm. apart, and where this has increased to 125 mm. they are 35 mm. distant. The length of the portion of the shell thus measured is 260 mm., out of a total length of 345 mm. for the whole fragment. The septa are strongly oblique in the upper part of the shell, where they have been exposed by the accidental removal of the test in breaking the rock away from the shell; in the lower half they cannot be seen, as the test is there preserved and covers them. Their obliquity makes an angle of about 20° with the horizontal axis of the shell. The siphuncle is well seen in longitudinal (polished) sections (Pl. X, fig. 1 *d*), and its position is also indicated on the convex surface of the smaller end of the specimen (Pl. X, fig. 1 *b*). It forms, as usual with *Actinoceras*, sac-like swellings between the septa, and is traversed through the centre by the endosiphuncle, whose radiating tubuli are given off circumferentially from these swellings (Pl. X, fig. 1 *d*). The siphuncle is somewhat compressed laterally, perhaps through partial collapse, though it would be naturally less inflated than in species having closer septa. Its outline, seen in section, is only slightly inflated, so as to make each segment of it a little higher than wide. The necks of the septa are distinctly seen in several places (Pl. IX, figs. 1 *c*, *d*; Pl. X, fig. 1 *d*), and in some places the perforations in the walls of the siphuncle (at the second tubule from the bottom of the figure, Pl. X, fig. 1 *d*; the perforation is not indicated in the drawing). The position of the siphuncle is markedly excentric, being about two-fifths across the shorter diameter of the shell, measured to the centre of the siphuncle; it is also not quite central in relation to the longer diameter. Its position may be best realised by looking at the figure (Pl. X, fig. 1 *c*). The test is perfectly smooth.

Size.—Length of the fragment 345 mm.; greatest diameter 120 mm., least 45 mm.

Affinities.—The fragmentary condition of the only example of this species known to me up to the present time makes the question of its relationship with other species a difficult one to settle. If the external characters are examined the differences observed between the present species and *Actinoceras giganteum* are found to consist in the smoothness of the test, the much greater width of the septa, and the more compressed character of the segments composing the siphuncle in the former as compared with the latter. In *A. insulare* the septa are 16 mm. apart where the diameter of the shell is 58 mm., whereas in a specimen of *A. giganteum* from Orchard, near Glasgow, the septa, at the same diameter of the shell, are only 13 mm. apart; or, measuring in another way, three chambers of the Cork species require 43 mm. to span them, while in the Scotch specimen only 34 mm. are necessary. The diameter of the shell for this measurement is the same in both cases, viz. from about 50 mm. up to 58 mm. It would appear also that the position of the siphuncle is more nearly central in *A. giganteum* than it is in the present species.

The obliquity of the septa, which is so strongly marked in *A. insulare*, is not unknown in *A. giganteum*, and I find a reference in my note-book to a specimen in the British Museum coming from Ireland in which this feature is well developed. On the other hand, in the Belgian examples figured by de Koninck (‘Faune Calc. Carb.,’ v, pl. xliv) the septa are perfectly horizontal. Reliance could not, therefore, be placed upon this character alone in distinguishing the two species, as it seems to be one that is subject to variation.

Remarks.—Attention should be directed still more particularly to the flatness of the outline of the siphuncular segments in *A. insulare* as compared with

A. giganteum, in which they are strongly inflated or bulbous (cf. Pl. IX, fig. 2 *c*, with Pl. X, fig. 1 *d*). The greater width between the septa in *A. insulare* may have caused the segments to be more drawn out, and thus to approach the cylindrical form which they must have assumed if this process had been carried still farther; whether, however, this would have been compatible with the existence of the endosiphuncle and its appendages is questionable, since it is evident that the development of these organs could not have taken place within a very contracted space. It is at least certain that in such a form as *A. insulare* there could not have been developed so great a number of tubules as are indicated by the perforations in such a form as *Actinoceras Bigsbyi* (cf. 'Cat. Foss. Ceph. British Museum,' 1888, vol. i, p. 164, fig. 21).

I may take the opportunity before leaving the subject of the structure of *Actinoceras* to refer to an important contribution to the literature of the fossil Cephalopoda by Prof. Hyatt, viz. his "Phylogeny of an Acquired Characteristic" ('Proc. Amer. Phil. Soc.,' vol. xxxii, No. 143, August, 1894). Under the heading "Ontogenetic Stages," in which the embryology of the group is very fully discussed, some important observations are made with reference to the siphuncle of *Endoceras*, *Piloceras*, and *Actinoceras*, and justification is found for the use of the term endosiphon (or endosiphuncle), to which F. A. Bather, in his able critical summary of recent views and discoveries ("Cephalopod Beginnings," 'Natural Science,' vol. v, December, 1894), takes exception. The following extract from Hyatt's memoir has a direct bearing upon the subject:—"The structure of the apex in *Endoceras*, *Piloceras*, and *Actinoceras* indicates large and direct, open, tubular connection between the protoconch and the animal when in this first chamber through which the endosiphuncle in the generalised Nautiloids, Endosiphonoidea, opened into the protoconch. The tubular opening of the apex in *Endoceras*, *Piloceras*, and *Actinoceras*, and other genera having a marked endosiphuncle, is not closed by the cæcum of the siphuncle as was formerly supposed. It is, on the contrary, directly continuous with the endosiphuncle, as was first pointed out by Foord in his 'Catalogue of Fossil Cephalopoda in the British Museum,' part 1, 1888, p. 165. This is an attenuated, central, more or less irregular tube or axis formed by the extension of the points of successive endocones or sheaths. It is more or less interrupted by pseudo-septa, and is a separate and distinct part occupying the axis of the large siphuncle. This organ is continuous with some corresponding part in the embryo which existed in the protoconch. On the other hand, the true siphuncle, including the cæcum of the first air-chamber, is a secondary organ formed by the funnels of the septa."

The "endocones or sheaths" and "pseudo-septa" referred to by Hyatt in the above quotation do not occur in *Actinoceras* or its congeners, but the analogy between the inner tube in the siphuncle of the latter and that which is found in

Endoceras and *Piloceras* is too clear to be doubted. Whether their functions were alike is quite another question. Of the functions of the radiating tubuli given off by the endosiphuncle of *Actinoceras*, which are not present in *Endoceras* or in *Piloceras*, the explanation suggested by Owen seems a very rational one, viz. that they served for the passage of blood-vessels to the lining membrane of the air-chambers. They also afforded support to the endosiphuncle, and held it in its central position in the siphuncle.

Locality.—Little Island, near Cork.

ACTINOCERAS PROPINQUUM, sp. nov. Plate IX, figs. 1 *a*—*e*.

This is a fragment of the septate part of a rather slowly tapering species (1 in 7). The septa are deeply concave and wide apart, varying very little in their distance as the shell increases in diameter. The necks are recurved. The siphuncle, which is badly preserved, is composed of somewhat flattened elements (cf. *A. insulare*), with the endosiphuncle indistinctly seen as a dark patch running through the centre of the tube, having obscure indications of the characteristic tubuli. The position of the siphuncle is decidedly excentric (figs. 1 *c*—*e*). The test is perfectly smooth.

Remarks.—Though I originally intended to include the fragmentary form here referred to in *Actinoceras insulare*, I have since decided that it is better to keep them separate despite their resemblance. This consists in the character of the septa and siphuncle; in both species the former are relatively wide apart, and in both the elements of the siphuncle are compressed as seen in section (Pl. IX, fig. 1 *c*; Pl. X, fig. 1 *d*). The complete horizontality of the septa, however, in the present form, and its apparently more slender habit, caused me to hesitate about uniting the two forms without having more satisfactory material than the fragment here described provides.

Locality.—Little Island, near Cork.

Family CYRTOCERATIDÆ.

CYRTOCERAS (MELOCERAS) APICALE, sp. nov. Plate XI, figs. 1 *a*, 1 *b*, 2 *a*, 2 *b*, 3; Plate XII.

? 1854. ORTHOCERAS UNGUIS, *Haughton*. Journ. Geol. Soc. Dublin, vol. vi, p. 48, pl. —, fig. 3 (not of J. Phillips).

Description.—Shell of moderate size, rather sharply curved in the lower third of the septate portion, but becoming almost straight above this, so that a fragment consisting only of the upper two-thirds of the shell would scarcely exhibit any curvature. Upon a chord of 38 mm. subtending the concave side of the apical region of the shell the greatest curvature is 5 mm. The rate of tapering above this curved part is about 1 : 4, which is a rapid increase in diameter. The section is very nearly circular, the siphuncle close to the margin of the outer curvature of the shell. The body-chamber considerably exceeds one-third of the length of the entire shell; its basal line is indicated by the letters *a*, *b*, in fig. 2 of Pl. XII, in which its obliquity is very marked, making an angle with the horizontal axis of the shell of about 18°. The septa are numerous, and being tilted up in a ventro-dorsal direction the sutures have a strong obliquity on the sides of the shell, while they are nearly horizontal on the ventral and dorsal aspects, perhaps with a slight arching upwards on the dorsal aspect (Pl. XII, figs. 1 *a*, 1 *b*). The distance between the sutures in an adult shell (Pl. XII, fig. 1 *b*), where the diameter is about 50 mm., is from 5 to 6 mm.; in a somewhat smaller example (Pl. XII, fig. 3) the sutures are 4 mm. apart where the diameter is 15 mm., 6 mm. apart where it is 37 mm. In a smaller specimen (Pl. XI, figs. 2 *a*, 2 *b*), which is entirely septate, there are twenty-two septa within a distance of 106 mm. The chambers must thus have been very shallow. Exactly in the median line of the ventral aspect, or outer curvature of the shell, there is a straight thread-like line or keel, feebly developed, but clearly perceptible when the surface of the cast has not been abraded; it is represented rather too broad in the figure (Pl. XII, fig. 1 *b*). The siphuncle is exogastric,—that is, it is situated close to the convex or ventral border of the shell; it is strongly inflated in passing through the chambers (Pl. XII, figs. 3, 4 *a*, 4 *b*), casts of it presenting the characteristic bead-like appearance as in the last figures referred to.

The surface of the shell is perfectly smooth.

Size.—The approximate measurements of the most complete specimen give length 190 mm., greatest diameter of body-chamber 53 mm., diminishing to 48 mm. at or close to the aperture, and 6 mm. near the apical extremity.

Affinities.—There can be no doubt that *Cyrtoceras rostratum*, de Koninck,[1] is closely related to the present species. Both forms have quickly tapering, thick shells, with the curvature most marked in the apical region. The distinguishing characters are found chiefly in the septa, which are strongly oblique in *C. apicale*, while they are only very slightly so in *C. rostratum*. The section also in the latter species is distinctly oval (cf. de Koninck, Pl. xxxv, fig. 1 *b*), while it has been shown to be almost circular in the former. The oval form of the section in de Koninck's species is brought out in his figures, in which the narrow ventral aspect is in strong contrast with the much broader lateral one. The section gives a

[1] 'Faune Calc. Carb. Belg.,' 1880, tom. v, p. 26, pl. xxxv, figs. 1, 2.

dorso-ventral diameter of 42 mm., and a lateral one of 38 mm. The position of the siphuncle is the same in both species.

Of other species described and figured by de Koninck, *C. cornu* is a more slender shell and has a stronger curvature than the present species. *C. digitus* is nearer to *C. apicale*, but it tapers much more slowly; a fragment only is figured by de Koninck: the species has been identified by him from Rathkeale, near Limerick. Fragments named by de Koninck *C. hircinum*, *C. impotens*, *C. Nysti*, *C. ignotum*, *C. concinnum*, and others, must be passed over, as they are too imperfect to make a comparison with the present species in any way satisfactory.

Remarks.—It is always instructive to consult the pages of Barrande's great work on the fauna of the Bohemian basin, and to study in the rich illustrations to it the varying forms assumed by such an extensive group as the Cyrtoceratidæ, especially during the period of its greatest development—the Silurian.

The most striking differences between the present species, which may be taken as typical of the Carboniferous development of the group under consideration, and the Silurian (Étage E of Barrande) forms described by Barrande, are to be recognised in the relative dimensions of the body-chamber, and in the septation. Beginning with the first of these characters, it is found that the body-chamber in the Silurian species is generally small, sometimes excessively so, relatively to the size of the shell; it is often less than one-fourth, sometimes even less than one-fifth of the whole length of the shell (cf. Barrande, 'Syst. Sil. Boh.,' ii, pl. cviii, *Cyrt. æquale*, pl. cx, *C. miles*, pl. cxviii, *C. acinaces*). The septa are, as a rule, crowded together to the utmost extent (cf. Barr., pl. cxxxii, *C. nescium*, pl. cci, *C. Scharyi*), indicating a remarkable rapidity of growth in the animal that secreted them. Turning to the siphuncle, it is observable that the beaded character is, in the main, the prevailing one, though this is modified in form by the curvature of the shell, the position of the siphuncle therein, and the width apart of the septa. Some of the modifications assumed by the siphuncle are well illustrated in pls. cxxxiv to cxxxviii of Barrande's work. There are not wanting also types in which the siphuncle is cylindrical, as in the living Nautilus, while there are transitional forms from these to the most inflated kinds (cf. Barr., pl. cix, cxx—cylindr.; pls. cxxvi, cxxviii—transit.; pls. cxxxv, cxlii—inflated).

Of the Devonian species of Cyrtoceras it may suffice to say that their affinities lean more in the direction of their Silurian progenitors than in that of their successors in the Carboniferous period. The Devonian rocks have not yielded very numerous examples of this type either in Europe or in America, but the different forms it assumes are fairly well represented. Thus we have the short, thick, and quickly increasing shell, exemplified in the Eifelian species *C. depressum*, Goldf., the type of the genus; and in contrast with this the slender, beautifully ornamented forms found in the typical rocks of Devon (cf. G. F.

Whidborne, 'Devonian Fauna of the South of England,' Palæontographical Society, 1890, vol. for 1889), and similar forms ornamented with frill-like lamellæ in North America (cf. James Hall, 'Palæont. New York,' 1879, vol. v, part 2). In all these, certain characters recalling the Silurian forms are to be traced; these are the numerous septa and marginal siphuncle, sometimes exogastric, sometimes endogastric, the highly ornate shell being perhaps the only distinguishing mark that can be applied to them as a group.

The Carboniferous species, so far as they are known, present, on the whole, a more simple type of structure than that of their Silurian ancestors as represented in the rich series of forms found in the Bohemian basin. The shells are generally more rapidly tapering and less strongly and uniformly curved, and the septa much less numerous in the Carboniferous species, which thus represent a generalised type in which the features that distinguished the ancestral forms have become greatly modified.

The tendency in this expiring race to a more simplified structure is still more strongly exemplified in the species to which I have given the new name *Eusthenoceras*, a passage form, in all that relates to the structure of the adult shell (the embryo is not known), from *Orthoceras* to *Cyrtoceras*, using these words in a somewhat wide sense.

I may here state that I do not count among species of *Cyrtoceras* all the forms attributed to it by de Koninck ('Calc. Carb. Belg.,' 1880); on the contrary, I would exclude all but the following:—*Cyrtoceras* (*Meloceras*) *cornu*, de Kon.; *C.* (*M.*) *acus*, de Kon.; *C.* (*M.*) *Verneuilianum*, de Kon.; *C.* (*M.*) *arachnoideum*, de Kon.; *C.* (*M.*) *Gesneri*, Mart.; *C.* (*M.*) *rugosum*, Flem.; *C.* (*M.*) *rostratum*, de Kon.; *C.* (*M.*) *digitus*, de Kon.; *C.* (*M.*) *imperitum*, de Kon.; *C.* (*M.*) *acus*, de Kon.; *C.* (*M.*) *Nysti*, de Kon.; *C.* (*M.*) *repertum*, de Kon.

The fragment named by de Koninck *Cyrtoceras cornu-bovis* is difficult to allocate, though it seems on the whole to be more akin to *Cyrtoceras* than to any other group. *Cyrtoceras Antilope*, de Kon., another fragment, has only one Cyrtoceran character, viz. a slight curvature, quite insufficient to establish its connection with the genus to which it is referred by de Koninck. It has considerable resemblance to a species described in the first part of this memoir (1897, p. 19) under the name of *Orthoceras hibernicum*, which is also slightly curved. The latter has a more rapidly increasing diameter and somewhat wider septa, and the elements of the siphuncle are not so inflated nor so wide and flattened as they are in the Belgian species. The two species may, nevertheless, fairly be compared, and it was by an oversight that this was not done under the description of the Irish fossil.

Locality.—St. Doulagh's, county of Dublin.

CYRTOCERAS (MELOCERAS) ARCUATOSEPTATUM, sp. nov. Plate XI, figs. 4, 5 *a*, 5 *b*.

Description.—Shell of moderate size, slightly curved in the lower third, but even less so above this; somewhat compressed, probably in part by rock-pressure (this species being from the cleaved rocks of the Cork district). Rate of tapering 1 : 4. Section elliptical, the ratio of the two diameters being as 31 : 25. Of the body-chamber only a small remnant is preserved in one of the specimens before me. Septa (known only by the sutures) numerous; at a diameter of 10 mm. they are 4 mm. apart, at 23 mm. they are 6 mm., and at a diameter of 32 mm. the interval between them has increased to 8 mm., showing that the growth is slow and gradual. In one of the specimens the sutures bend sharply upwards on one aspect of the shell, with a marked obliquity on the sides whence the arches spring. This distinct arching of the septa may partly arise from pressure, but whether this be so or not it is prevalent throughout the specimen. The siphuncle occupies a position farther from the margin than is usual in typical forms of *Cyrtoceras;* the nature of its elements is difficult to determine, owing to the almost total destruction of all internal structures by crystallisation in the specimen cut for the purpose of examining them. The vestige of the siphuncle preserved shows that it was slightly inflated between the septa, and that is all that can be ascertained. The test is quite smooth, and so thin and transparent that the sutures of the septa are plainly seen through it.

Size.—Length of the longest specimen 180 mm.; greatest diameter of the base of the body-chamber 55 mm.; diameter at the (broken) apex 8 mm.

Affinities.—The very slight curvature of this species is its most striking characteristic, and to this may be added the position of the siphuncle. These features militate somewhat against the Cyrtoceran affinities of this fossil, but on the whole I cannot but regard its affinities as being with the genus to which I have referred it; it seems to indicate the presence of a more generalised type than the form described above under the name of *C. apicale,* which, however, it resembles in its limited curvature.

Remarks.—I have been fortunate enough lately to obtain another specimen of this rare and interesting fossil.[1] It is less compressed than the other two examples, and therefore gives a better idea of the normal form of the species; it is imperfect at both ends, and thus can give no further information as to the body-chamber or the apex.

Attention may be drawn to the fact that fig. 4 represents the narrow aspect of the shell, on which the arching of the sutures is clearly seen; while fig. 5 *a*

[1] This specimen is now in the Dublin Museum of Science and Art.

(another example) is drawn from the broader aspect. These figures show the ellipsoidal shape, whether natural or induced, of the species.

Locality.—Little Island, near Cork.

EUSTHENOCERAS,[1] gen. nov.

This genus is founded upon two Irish species described by de Koninck [2] under the names *Cyrtoceras Hulli* and *Cyrtoceras Bailyi.* I shall endeavour to show that these species do not belong to the genus to which they were assigned by de Koninck, but that they are intermediate in their structure between *Orthoceras* and *Cyrtoceras.* From the latter they are excluded by the general straightness of the shell, by the nearly central position and apparently cylindrical form of the siphuncle, as well as by the great depth of the chambers in the proximity of the body-chamber in the adult shell. From the former they differ in the sharp, hook-like curvature of the shell in the young, and in the peculiar arching of the septa on the dorsal (concave) aspect of the shell.

These oscillations between *Orthoceras* and *Cyrtoceras* seemed to justify the separation of this type from both, rather than to sink its individuality in either, and thus to lose sight of it as a connecting link between them. These connecting forms are as rare as they are interesting, hence it is the more necessary that they should be strictly characterised.

In *Eusthenoceras*, as appears from the enumeration of its structural features above given, there is, on the whole, a leaning towards *Orthoceras;* the sutural characters, however, differ as already shown in important points from *Orthoceras* on the one hand, and from *Cyrtoceras* on the other. From the former by their arching on the concave curvature of the shell, from the latter by their great width anteriorly.

A diagnosis of the genus *Eusthenoceras* may be thus constructed:—Shell large, typically curved only in the apical portion; septa at first approximate, afterwards becoming very widely separated; sutures arching upwards on the dorsal or inner curvature of the shell; siphuncle subcentral in the sense of the ventral region, apparently cylindrical. Type, *Cyrtoceras Hulli*, de Koninck.

I have included *Cyrtoceras Bailyi* in this genus, although the single individual representing it departs in some particulars from *Eusthenoceras Hulli*,—that is, the chambers do not become deeper as they approach the body-chamber, the curva-

[1] From εὐσθενής, stout; κέρας, a horn.

[2] 'Annales de la Société Géologique de Belgique,' tom. ix, 1881–2 (Mémoires), pp. 50—60, "Sur quelques Cephalopodes nouveaux du calcaire carbonifère de l'Irlande."

ture of the shell is more regular and persistent than in *E. Hulli*, and the rate of growth more rapid.

If it should be found subsequently by the discovery of other specimens of *Eusthenoceras Bailyi* that the characters found in the isolated individual described persist in others, it may be necessary to modify the description of the genus as given above, or to restrict it entirely to the single species *E. Hulli*, of which there is abundant material.

EUSTHENOCERAS HULLI, *L. G. de Koninck*, sp. Plate XIII; Plate XIV, figs. 1 *a*—*c*, 3.

1882. CYRTOCERAS HULLI, *L. G. de Koninck*. Annales de la Soc. Géologique de Belgique, tom. ix, 1881-2 (Mémoires), pp. 50—60, pl. vi, figs. 1—3.

Description.—Shell elongate, of robust habit, sharply curved in the young, but becoming straight in the adult. Upon a chord of 45 mm. subtending the concave or dorsal side of the apical part of the shell, the greatest curvature is 9 mm. The section is nearly circular in the young shell, but becomes ellipsoidal in the adult, the ratio of the ventro-dorsal to the transverse diameter in an uncompressed specimen (Oldtown) being as 48 : 43. Body-chamber (Pl. XIII, fig. 1 *a*) not quite complete anteriorly, having a length of 150 mm. as compared with 450 mm. for that of the entire shell, exclusive of the apical part, not preserved in the specimen measured, or in the ratio of 1 to 3. Sutures comparatively close-set in the young shell, varying little in the distance separating them until a certain stage of growth is reached, when they suddenly widen, and continue to do so till the body-chamber is reached. In one of the specimens (Pl. XIII, figs. 1 *a*, 1 *b*) the sutures are 10 mm. apart where the greater diameter of the shell is 47 mm., and where this has increased to 65 mm. the sutures are 20 mm. distant from each other. It may be added that in two adjacent chambers, which are respectively the fifth and sixth from the body-chamber, the space between the sutures augments from 16 mm. to 25 mm., the latter width, or very near it, being maintained up to the penultimate chamber, the last chamber being, as usual, somewhat shallower—21 mm. (Pl. XIII, figs. 1 *a*, 1 *b*).

The direction of the sutures varies with the age of the shell; in the young they are nearly horizontal; at a later stage of growth they become distinctly arched (Pl. XIII, fig. 1 *c*) on the dorsal (concave) aspect, passing obliquely over the sides and maintaining the horizontal direction of the young shell on the ventral (convex) aspect. There are thus three sutural regions—the horizontal, the oblique, and the arched, which probably indicate the form of the aperture. Very fine but distinct ridges or keels, perceptible to sight and touch, traverse the cast longitudinally exactly in the centre of the horizontal and arched sutural regions respectively, and thus diametrically opposite to each other. These ridges are present in all the specimens before me wherever the removal of the test permits of their being seen (Pl. XIII, fig. 1 *c*, drawn a little too broad). Ridges such as these, which are met with on the casts of the shells of Orthoceras, Cyrtoceras, &c., have been called "median" or "normal" lines, but their origin is unknown.

The siphuncle is situated about its own diameter from the centre of the septum, in the region nearest to the ventral border. This agrees fairly well with its position as figured by de Koninck (loc. cit., pl. vi, fig. 3). It is well seen near the apex in de Koninck's type specimen which I have before me, where its position does not differ materially from that which it occupies in the adult shell (Pl. XIII, fig. 1 *e*). In another specimen (Pl. XIV, fig. 3) the siphuncle is almost exactly central; it is seen at the bottom of the deeply concave septum partly indicated in the figure. Some obscure remains of the siphuncle (near the upper part of the figure) seem to show that it was cylindrical, but this may be deceptive; its nearly central position at least is quite clear.

The test, which was apparently thick, is perfectly smooth; it is well preserved upon all the specimens before me.

Size.—The largest uncompressed specimen, that from Oldtown (Pl. XIII), has a total length, excluding the apex which is broken off, of about 450 mm.; its greatest diameter, measured about the middle of the body-chamber, is 73 mm.; the apical end (imperfect) measures about 18 mm. in diameter.[1]

The total length of the specimen (without body-chamber) figured by de Koninck (loc. cit., pl. vi, fig. 1) is 260 mm.; the greatest diameter 70 mm., the least (not far from the apex) 12 mm.

The other specimen figured by de Koninck (pl. vi, fig. 2), though wanting the body-chamber, has indications in the great depth of the last four or five chambers that the latter is nearly reached, though the base of it is not seen. Probably de Koninck's estimate of the total length of this specimen (500 mm.) is not very wide of the mark.

Affinities.—The only species known to me which can be compared with the present one is *Eusthenoceras Bailyi*, de Kon., sp., about to be described. Only a single specimen of it was found, but it happens to be tolerably complete, and therefore admits of a comparison with *E. Hulli*. It consists of the greater part

[1] Though designed to show the arching of the septa and the median line, fig. 1 *c* also illustrates the larger diameter of the fossil as contrasted with the smaller, which is seen in fig. 1 *a*.

of the septate division of the shell with the body-chamber attached. The latter is not quite perfect, but a fair approximation of its form and size may be arrived at. The septa exhibit the closeness of arrangement characteristic of *E. Hulli* in a similar stage of growth, and there is the same arching upwards in them upon the dorsal or inner curvature of the shell (cf. Pl. XIII, fig. 1 *b*—lower portion, from the part marked *a*, *b*).

The differences between the two species may be summed up as follows :—the body-chamber is larger in proportion to the entire shell in *E. Bailyi* than it is in *E. Hulli.* The septa in the former do not increase greatly in their distance apart towards the body-chamber, the reverse of this being the case in the latter species. The section is nearly circular throughout the shell in *E. Bailyi;* it becomes markedly elliptical in the adult in *E. Hulli.* Lastly, the curvature is more regular and continuous in *E. Bailyi* than in *E. Hulli*, in which it becomes nearly straight at about the lower third of the shell.

Remarks.—The great size of the individuals belonging to this species is worthy of note, and did not escape de Koninck's attention in his description of the species. There were giants in those days in the Carboniferous seas of the British and Belgian areas; this may at least be said of the Cephalopoda, for not only did *Actinoceras giganteum* flourish and abound, but there were also gigantic forms of many of the coiled shells, such as *Cœlonautilus cariniferus*, *Asymptoceras dorsale*, and others. Favourable environment, immunity from the attacks of their enemies, and other physical conditions may be invoked to account for such unusual development, which was most marked in the Irish area.

Returning to the subject of these remarks, it cannot but be conceded, I think, that the group to which I have given the name *Eusthenoceras* is transitional in character between *Orthoceras* and *Cyrtoceras;* the persistence of the characters noted in *Eusthenoceras* in several individuals being of such a nature as to allay any suspicion of their representing merely individual variations or abnormalities of some kind. If this be the true interpretation of the phenomena presented by these fossils, it is a further proof that the specialisation characteristic of the race of the Cyrtoceratidæ met with in the Silurian and Devonian rocks was not maintained in the Carboniferous period, but that, contrariwise, a series of forms then appeared in which a more simple structure was the leading feature. These witnessed the dying out of the race, which did not survive the close of the Carboniferous period.

I am again indebted to Prof. Joly, who lent me the fine specimen figured on Pl. XIII, which gives valuable information regarding the structure of the present species not furnished by the other examples.

Localities.—Oldtown, Queen's County; Rathkeale, county of Limerick.

EUSTHENOCERAS BAILYI, *L. G. de Koninck*, sp. Plate XIV, figs. 2 *a*, 2 *b*.

1882. CYRTOCERAS BAILYI, *L. G. de Koninck*. Annales de la Soc. Géologique de Belgique, tom. ix, 1881-2 (Mémoires), pp. 50—60, pl. v, fig. 1.

Description.—Shell (the only example known) of moderate size, strongly curved in the apical part, but becoming straighter as the body-chamber is approached. Upon a chord of 97 mm. subtending the concave side the greatest curvature is 17 mm. The section is circular in the young stage of growth, and does not deviate from this form in the adult. The body-chamber is of considerable length. As to its length in proportion to that of the entire shell only an approximation can be come to, for part of the apex is wanting, and the body-chamber itself is not perfect, but it would appear to have been nearly one-half.

The septa are approximate and deeply concave. At a diameter of 25 mm. they are 6 mm. apart; where the diameter has increased to 38 mm. they are 10 mm. distant, there being an interval of about 40 mm. between the two points measured. It can thus be seen that the septa increase very gradually in their distance from each other.

The sutures arch slightly forwards on the dorsal or inner curvature of the shell, and become straight on the ventral aspect, a condition the reverse of what is generally encountered in these curved shells (cf. Barrande, 'Syst. Sil. de la Bohême,' vol. ii, pl. cli, figs. 28—30).

The siphuncle as seen in the concavity of the last formed septum is about twice its own diameter above the centre, that is towards the ventral or convex side of the shell (Pl. XIV, fig. 2 *b*).

The test is quite smooth.

Size.—Length, measured along the outer curvature, 225 mm., of which the body-chamber occupies about 100 mm.; greatest diameter, measured near the centre of the body-chamber, 56 mm., least 12 mm., the latter not far from the apex.

Affinities.—I was at first inclined to the opinion that the present species was the young of *Eusthenoceras Hulli*, and my doubts upon this point are not entirely dispelled. One of the most marked features in *E. Hulli* is the extraordinary size of the chambers in the adult stage of growth. Should *E. Bailyi* prove to be the young of *E. Hulli* this abnormal development of the chambers could not have been attained. On the other hand, the curvature of the shell in the present species is much less restricted than it is in *E. Hulli*, giving a very different aspect to the shell. Single specimens are always difficult to deal with unless they have some very distinctive features, and it must be left to individual opinion to determine in these cases whether such features are of sufficient importance to entitle their possessor to be treated as an independent species, or, on the other hand, whether it should be merged in one already established. Any future attempt to determine with more certainty the affinities of *E. Bailyi* must depend upon fresh evidence; as the matter at present stands it is preferable to retain de Koninck's name for this fossil.

Locality.—Samphire Island, county of Kerry.

Family POTERIOCERATIDÆ.

Genus POTERIOCERAS, *M'Coy*, 1844.

POTERIOCERAS FUSIFORME, *J. de C. Sowerby*, sp. Plate XV.

1829. ORTHOCERA FUSIFORMIS, *J. de C. Sowerby.* Min. Conch., vol. vi, p. 167, pl. dlxxxviii, fig. 1 (excl. fig. 2).
1836. ORTHOCERAS FUSIFORME, *Phillips.* Geol. of Yorkshire, pt. 2, p. 238, pl. xxi, figs. 14, 15.
1844. POTERIOCERAS FUSIFORME, *M'Coy.* Synop. Carb. Foss. Ireland, p. 10.
1844. APIOCERAS FUSIFORME, *Fahrenkohl.* Bull. Soc. Imp. Nat. Moscou, vol. xvii, p. 781.
1854. ORTHOCERAS FUSIFORME, *Haughton.* Journ. Geol. Soc. Dublin, vol. vi, p. 48, pl. —, fig. 4.
1855. — (POTERIOCERAS) FUSIFORME, *M'Coy.* Brit. Pal. Foss., fasc. iii, p. 569.
1862. POTERIOCERAS FUSIFORME, *Griffith.* Journ. Geol. Soc. Dublin, vol. ix, p. 55.
1876. — — *Armstrong, Young, and Robertson.* Catalogue of the Western Scottish Fossils, p. 59.
? 1880. GOMPHOCERAS FUSIFORME, *L. G. de Koninck.* Faune Calc. Carb. Belg., tom. v, p. 42, pl. xxxvii, figs. 4 *a—c.*
1888. POTERIOCERAS FUSIFORME, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 1, p. 259.

Description.—Shell of medium size, fusiform, gradually expanding, and then contracting towards the aperture, curved in the apical region, straight above; flattened on the ventral or outer curvature, conspicuously inflated on the dorsal side (Pl. XV, fig. 1 *c*). The apical part slender and tapering to a fine point. Upper part of body-chamber contracted in the region of the aperture, which is simple as in *Cyrtoceras.* Septa and base of body-chamber markedly oblique at the sides, the septa nearly horizontal in the siphuncular region, strongly arching upwards along the median line of the dorsal region (Pl. XV, figs. 1 *a*, 1 *c*). Septa fairly approximate, about 5 mm. distant from each other in the vicinity of the body-chamber. Siphuncle near the margin of the ventral, flattened side; strongly inflated between the septa. Test perfectly smooth.

Size.—Length of the most perfect specimen (wanting anterior portion of body-chamber) 160 mm., length of septate part 120 mm., length of portion of body-chamber preserved 50 mm.

Affinities.—The plano-convex form of the shell and the more numerous septa are features that readily distinguish this species from the one next to be described, viz. *Poterioceras latiseptatum*, Foord; its much more slender proportions separate it unequivocally from *Poterioceras cordiforme*, J. Sowerby.

Remarks.—A specimen of this species having been obtained with the apex nearly perfect, a much better conception of the shape of the shell can now be formed than has been possible hitherto. The extreme apical point is unfortunately broken in the specimens available, so that nothing can be ascertained with reference to the presence of a cicatrix or other embryological mark.

Through the kindness of my friend Mr. G. C. Crick, of the Geological Department of the British Museum, I have been enabled to reproduce a drawing he made for me of the posterior end of Sowerby's type specimen of the present species contained in that museum. The principal dimensions of Sowerby's specimen are as follows: total length 162 mm., length of body-chamber 65 mm., length of septate part 97 mm., diameter of base of body-chamber 56 mm. (nearly). It is, of course, not possible to make a very close comparison between the type specimen and the one whose dimensions are given in the above description of the species (see Pl. XV, figs. 2 *a*, 2 *b*), as they are both imperfect, the one anteriorly, the other posteriorly; but, judging by the two measurements, there is probably not much difference between them, the proportions being the more easily realised as the specimens are nearly the same size.

There is a noteworthy agreement in the figures of this species given by different authors in respect to the remarkably plano-convex form of the shell when the ventro-dorsal profile is looked at (Pl. XV, fig. 1 *c*). This shape may not always be equally strongly pronounced, but it asserts itself distinctly enough in most of the figures I have seen, hence it furnishes a good guide for the identification of the species (cf. Phillips, 'Geol. Yorks.,' loc. cit.; Haughton, 'Journ. Geol. Soc. Dublin,' loc. cit.).

De Koninck's figure of this species, which he called unaccountably "*Gomphoceras* fusiforme," represents a longer and more slender form than Sowerby's; it is a question, therefore, in what category it should be placed. It appears to me to be distinct from *P. fusiforme*. In the description de Koninck states that the ventral side is more convex than the dorsal, so that in this point at least there is agreement between the two forms. *P. fusiforme* is nevertheless clearly a much shorter and more inflated form than that to which de Koninck has given the same *specific* name.

De Koninck's allocation of *P. fusiforme* to *Gomphoceras* was unfortunate considering that not only is the aperture simple in *Poterioceras*, but the form of the shell is different from the latter, even allowing for the absence of the apical part in *Gomphoceras*, which gives to this form a stumpy and, if I may so express it, ungraceful outline. The complicated, multilobate aperture of *Gomphoceras* indicates structures in at least the oral parts of the animal which would certainly be regarded as of generic importance in any living form, and it is therefore with no great latitude that we assign a distinct generic position to the fossil.

Localities.—St. Doulagh's, county of Dublin; Millicent (Clane), county of Kildare (M'Coy, Haughton); Kildare, (exact locality not stated) (Phillips); Little Island, near Cork (Dublin Museum of Science and Art).

POTERIOCERAS LATISEPTATUM, sp. nov. Plate XVI.

Description.—Shell of moderate size, fusiform, slender, inflated, the inflation being most prominent dorso-ventrally, and, influenced by the curvature of the shell, a little higher on the ventral than on the dorsal aspect (Pl. XVI, fig. 2 *a*). Section nearly circular when uncompressed. The shell tapers gradually from the very acute apex, the inflation beginning at about the mid-length, becoming contracted in diameter towards the aperture. The apex has a central, very shallow pit, surrounded by a thickened rim; in the centre of the pit there is a circular spot representing the orifice of the siphuncle through which the latter passed out of the protoconch or embryonic chamber. The diameter of the apex is 2 mm. (Pl. XVI, fig. 2 *a*). The body-chamber (partly exposed in some of the specimens by the removal of the test) has an undulating outline at the base, but in a general sense it is horizontal.

The septa are comparatively distant, there being seven in a length of 45 mm. in this species, against ten in *P. fusiforme* in the same length. The last two or three chambers are very shallow in some specimens (Pl. XVI, fig. 4). The course of the sutures is slightly oblique on the lateral areas of the shell (Pl. XVI, fig. 3 *a*).

The siphuncle is situated near the convex margin; fig. 4 shows its position, which is seen to become gradually more nearly central as the shell grows. It has, unfortunately, not been cut quite through the centre in the specimen figured, consequently the segments do not appear to completely fill up the space they occupy between the septa, and owing to this also they have an oval instead of a nearly circular form.

The test is quite smooth.

Affinities.—This species is nearly related to *Poterioceras fusiforme*, J. Sow., sp., from which it is readily distinguished by its wider and less oblique septa, and by its being almost equally inflated on the ventral and dorsal areas.

Remarks.—None of the specimens of this well-marked species have been up to the present time obtained at St. Doulagh's, and it is remarkable that many of the species obtained there differ from those yielded by the Clane quarries, less than twenty-five miles distant. This is especially the case with the Cephalopoda.

Localities.—Clane, county of Kildare; county of Limerick (exact locality unknown).

POTERIOCERAS VENTRICOSUM, *M'Coy*. Plate XVII.

? 1843. ORTHOCERAS LATISSIMUM, *J. E. Portlock*. Rep. on the Geol. of Londonderry, p. 390, pl. xxxv, figs. 2 *a*, *b*.
1844. POTERIOCERAS VENTRICOSUM, *M'Coy*. Synop. Carb. Foss. Ireland, p. 10, pl. i, fig. 2.
1888. — CORDIFORME (pars), *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 1, p. 260.

Description.—Shell large, broadly fusiform, much inflated in the upper half, curved in the apical part, the most inflated part being ventro-dorsal as in *P. fusiforme*. The body-chamber, which comprises the most inflated part of the shell, contracts towards the aperture; the base is markedly oblique, conforming in this respect to the chambers which precede it. The chambers, as indicated by the suture-lines, are very shallow, the distance between them not exceeding 8 mm. where the diameter of the shell varies from 50 mm. to 70 mm. (Pl. XVII, fig. 2 *a*), thus showing a remarkable uniformity of spacing. The same uniformity is found in another somewhat larger specimen, so that it may be taken as a characteristic feature of this species. The section in the young shell is slightly elliptical, the ratio of the two diameters being as 30 : 27. The siphuncle in the young shell is situated at about one-third of the distance across the longer diameter (Pl. XVII, fig. 2 *b*); M'Coy describes it as "large, inflated, and slightly excentric," which probably refers to its position in the adult; if so, it gradually assumes a nearly central position as in some other cephalopod genera.

The surface of the test is beautifully ornamented with a series of faint longitudinal ridges, easily seen when the light falls upon them from the side; they may also be felt (Pl. XVII, fig. 1 *a*). These ridges or bands are crossed by very numerous delicate lines of growth, with stronger ones at intervals.

Size.—Length of the most perfect of the specimens figured (fig. 2 *a*; wanting the apical part), 170 mm.; greatest diameter 110 mm.; least 30 mm. A larger specimen (a cast) collected by myself and now in the Museum of Science and Art, Dublin, has the following dimensions: length 210 mm.; greatest diameter (body-chamber) 120 mm.; least about 20 mm. This specimen is imperfect at both ends, though considerably more than half of the body-chamber remains, as is indicated by its contraction above the inflated part showing proximity to the aperture.

Affinities.—The species most nearly related to the present one is undoubtedly *P. cordiforme*, J. Sow., a very large species found in the Red Sandstone Group of the Calciferous Sandstone, at Closeburn, Dumfriesshire. I have, in fact, in the 'Catalogue of Fossil Cephalopoda, British Museum,' 1888, Part 1, p. 260, made M'Coy's species a synonym of Sowerby's, being at that time unable to find adequate grounds for their separation. With better material at my disposal I now deem it advisable to keep them apart, because, in addition to the ornamentation described above, there is a slight but distinct curvature in *P. ventricosum* in the young shell; this may be seen in both the specimens I have figured. This may be better realised by extending the outline of the apical end of the figures until the lines thus drawn meet together; a very perceptible curvature is the result.

Remarks.—Though only a small fragment, consisting of about six chambers, Portlock's species, *Orthoceras latissimum*, is difficult to distinguish from M'Coy's: the septa are equally distant in the two forms, and the position of the siphuncle, a minor consideration here, is apparently also the same. Portlock's specimen, which is labelled "Kildare" (meaning probably Clane, which is in the county of Kildare), is still to be seen in the Museum of Science and Art, Dublin, having survived the vicissitudes through which the "types" figured by Portlock and M'Coy have passed before reaching their present resting-place.

It is to be regretted that M'Coy should not have referred in his description of *P. ventricosum* either to Portlock's or even to Sowerby's species.

Locality.—Clane, county of Kildare.

The genus *Poterioceras*, with which the uncoiled forms of Cephalopod shells terminate in this memoir, has a wide stratigraphical range, extending from the Ordovician to the Carboniferous. Though the first species described was a Carboniferous one ("*Orthocera*" *cordiformis*, J. Sowerby, 'Min. Conch.,' vol. iii, 1821), the genus originated, as stated above, in rocks of Ordovician age. Under the generic name *Oncoceras*,[1] James Hall described several species from the Ordovician and Silurian rocks of the State of New York. The genus was afterwards recognised by Billings (who employed Hall's generic name) from rocks of the Niagara group in Canada, and a number of species of it were described by him (' Catalogue of the Silurian Fossils of Anticosti,' 1866). M'Coy, in his ' Synopsis of the Silurian Fossils of Ireland,' 1846, described and figured *Poterioceras approximatum* from Ordovician rocks, but this appears to have been a somewhat doubtful determination as regards the genus.[2]

Of Silurian species of *Poterioceras*, Barrande described some from his Étage E, among which may be mentioned *P. heteroclitum* (' Syst. Sil. Boh.,' vol. ii, pl. cxviii) and *P. lumbosum* (ibid., pl. cccclxiv).

The Devonian rocks have yielded a few species, among which may be cited *Orthoceratites subfusiformis*, Münster,[3] *O. subpyriformis*, Münster, and *Gomphoceras sulcatulum*, Murch. de Vern., and de Keyserl.[4] To these may be added the species described by Whidborne in his valuable "Monograph of the Devonian Fauna of the South of England" (Palæont. Soc. vol. for 1889), under the names *Poterioceras vasiforme*, *P. Marri*, and *P. ellipsoideum*.

In the Carboniferous rocks only four species are known to me with certainty as referable to *Poterioceras*: these are *P. cordiforme*, J. Sowerby; *P. fusiforme*, J. de C. Sowerby; *P. ventricosum*, F. M'Coy; *P. latiseptatum*, A. H. Foord. Probably de Koninck's species, *Gomphoceras fusiforme* (not Sowerby's) and *G. lagenale* also belong here.[5]

Poterioceras is nowhere very rich in species, the most numerous in any rocks being those of the Ordovician and Silurian of North America.

[1] M'Coy's name *Poterioceras* has priority over this one, which was adopted by Hall for what he no doubt considered at the time he wrote to be a distinct genus (' Palæont. New York,' vol. i, 1847).

[2] See Blake, ' British Foss. Ceph.,' 1882, pt. 1, pl. xxiv.

[3] ' Beiträge zur Petrefactenkunde,' 1840.

[4] ' Géol. de la Russie d'Europe,' vol. ii, Palæont.

[5] ' Faune Calc. Carb. Belg.,' tom. v, 1880.

PLATE VIII.[1]

ORTHOCERAS SOLLASI, *A. H. Foord.*

Fig. 1 *a*. Specimen showing the body-chamber and the greater part of the septate portion of the shell. (Note the crescentic depression at the anterior end of the body-chamber just below the margin of the aperture.) 1 *b*. Transverse section with siphuncle. 1 *c*. Portion of the test showing the striæ, natural size. 1 *d*. Figure of the striæ (somewhat diagrammatic), enlarged to show bifurcations. 1 *e*. Another specimen, somewhat more complete than 1 *a*, showing the septa where the test is removed; the slight constriction near the aperture is well seen. 1 *f*. Longitudinal section showing septation and a fragment of the siphuncle. Clane. Dublin Museum of Science and Art. (Page 23.)

ORTHOCERAS MULTISTRIATUM, *A. H. Foord.*

Fig. 2 *a*. Fragment with body-chamber and a good deal of the septate part of the shell. 2 *b*. Longitudinal section showing the septa and siphuncle. Little Island. Dublin Museum of Science and Art. (Page 24.)

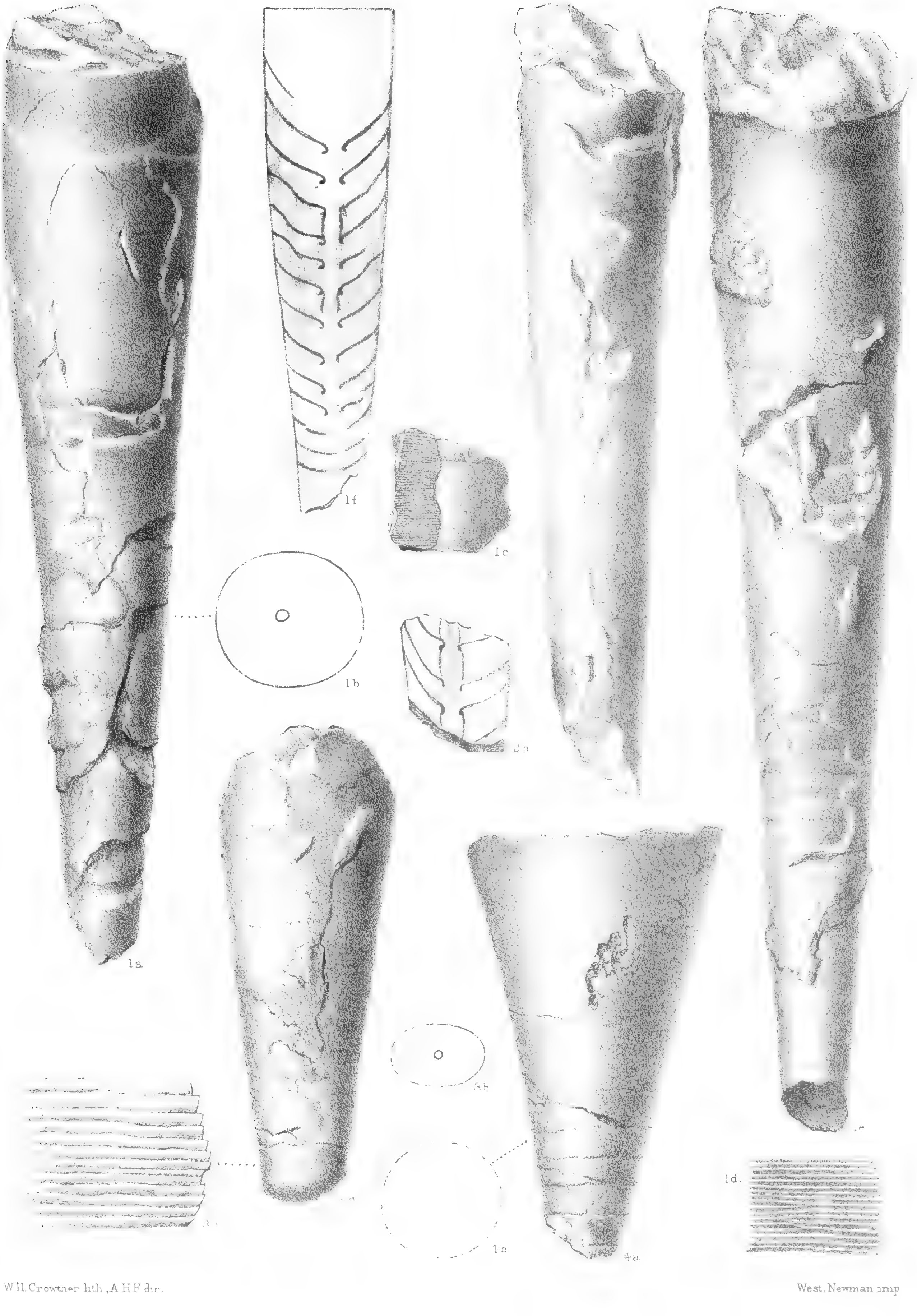
ORTHOCERAS PERELLIPTICUM, *A. H. Foord.*

Fig. 3 *a*. Fragment of the septate part of a specimen. 3 *b*. Transverse section showing siphuncle. 3 *c*. Imbricating striæ greatly enlarged. Little Island. Museum of Queen's College, Cork. (Page 25.)

ORTHOCERAS PERCONICUM, *A. H. Foord.*

Fig. 4 *a*. Fragment showing the greater part of the body-chamber and some of the septa. 4 *b*. Transverse section, the siphuncle not preserved. Clane. Dublin Museum of Science and Art. (Page 27.)

[1] All the figures in this and the following Plates represent the specimens of the natural size unless the contrary is stated.



W.H. Crowther lith, A.H.F. dir.   West, Newman imp.

PLATE IX.

ACTINOCERAS PROPINQUUM, sp. nov.

Figs. 1 *a*, 1 *b*. Fragment of the septate part of the shell, imperfect at both ends; the test has been removed and the under surface polished to show the septa; the apical part, 1 *c*, 1 *d*, is cut longitudinally to show the siphuncle and the endosiphuncle within. 1 *b* is separated from 1 *a* on the plate to enable the specimen to be figured without reducing its size. 1 *e*. Transverse section showing the siphuncle. Little Island. Dublin Museum of Science and Art. (Page 33.)

ACTINOCERAS GIGANTEUM, *J. Sowerby*.

Fig. 2 *a*. Longitudinal section of a fragment, showing *si*, the endosiphuncle, with remains of the tubuli, *t*, *t*, given off from it. 2 *b*. Longitudinal section of another fragment, showing at *n*, *n*, the necks of the septa. No remains of the endosiphuncle are preserved in this specimen, which is filled with crystalline calcite. 2 *c*. Fragment with casts of the bulbous siphuncular segments; one of them shows the puckered appearance characteristic of their calcareo-membranous walls. Castle Espie. Museum of Trinity College, Dublin. (Page 28.)

PLATE IX.

W.H. Crowther lith, A.H.F. dir

West, Newman imp

PLATE X.

ACTINOCERAS INSULARE, sp. nov.

Figs. 1 *a*, 1 *b*. Fragment of a portion of the septate part of a large specimen, showing the very oblique septation; a considerable part of the smooth test is present, so that the septa are not seen on the lower half of the specimen. 1 *c*. Transverse section showing the position of the siphuncle. 1 *d*. Longitudinal section showing siphuncle and endosiphuncle, with obscure remains of the tubuli attached to the latter. Little Island. Dublin Museum of Science and Art. (Page 30.)

PLATE X.

W H Crowther lith. A H F del et dir

West Newman imp

PLATE XI.

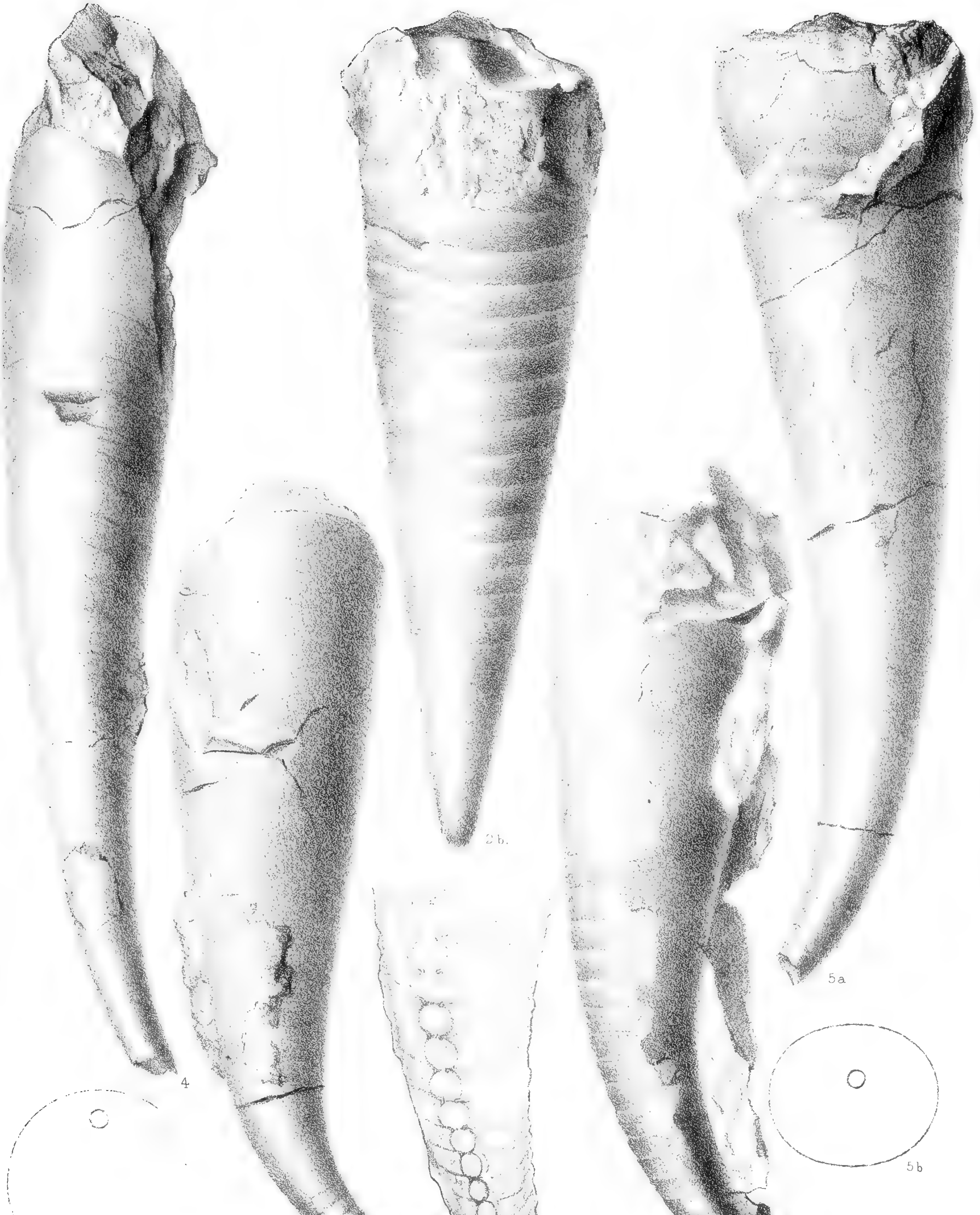
CYRTOCERAS (MELOCERAS) APICALE, sp. nov.

Fig. 1 *a*. A nearly perfect specimen covered with the test, but showing at the apex faint marks of the sutures. 1 *b*. Transverse section of the same. 2 *a*. Another specimen with only the septate part preserved. 2 *b*. Ventral view of the same, showing the horizontality of the sutures in this part of the shell. 3. Longitudinal section displaying the siphuncle and the septa, the latter displaced here and there. St. Doulagh's. Dublin Museum of Science and Art. (Page 33.)

CYRTOCERAS (MELOCERAS) ARCUATOSEPTATUM, sp. nov.

Fig. 4. A polished specimen showing the strongly arched sutures. 5 *a*. Another specimen with a portion of the body-chamber preserved. 5 *b*. Transverse section showing the position of the siphuncle. Little Island. Dublin Museum of Science and Art. (Page 37.)

PLATE XI.



W.H Crowther lith., A H.F. dir

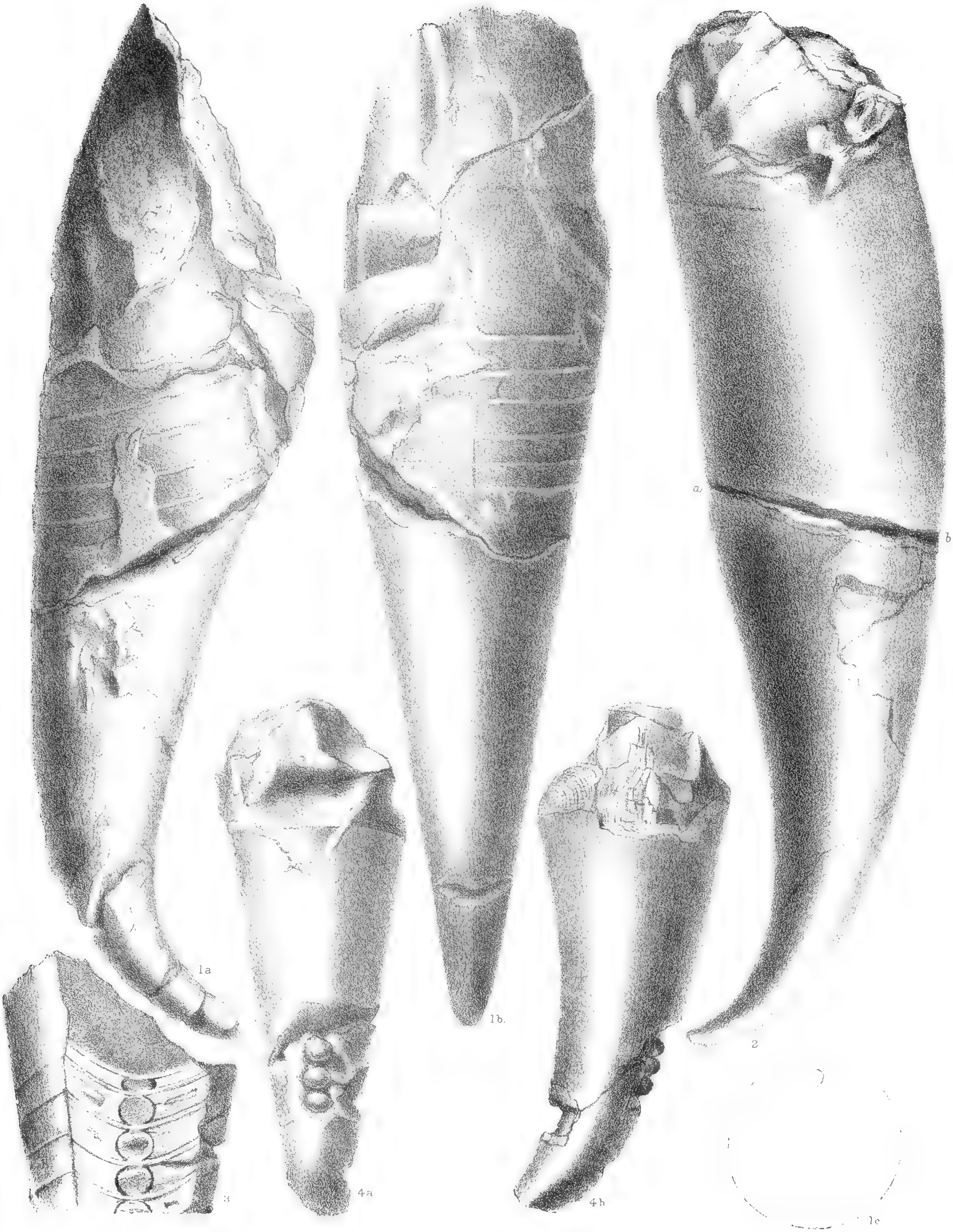
West, Newman imp

PLATE XII.

CYRTOCERAS (MELOCERAS) APICALE, sp. nov.

Fig. 1 *a*. Lateral view of a specimen, nearly perfect at the apical end, showing part of the body-chamber and the obliquity of the sutures on the lateral areas. 1 *b*. Ventral view of the same specimen, showing the horizontality of the sutures on this aspect of the shell; the median line is also seen. 1 *c*. Transverse section showing the position of the siphuncle. 2. Lateral aspect of another specimen, perfect at the apex, but not preserved in such a way as to show any indication of a cicatrix; from *a* to *b* is the base of the body-chamber. 3. Polished longitudinal section of a portion of another specimen showing the siphuncle with its beaded segments. 4 *a*, 4 *b*. Ventral and lateral views respectively of a young individual, showing three of the beaded elements of the siphuncle. St. Doulagh's. Dublin Museum of Science and Art. (Page 33.)

PLATE XII.



W.H. Crowther lith. A.H.F. dir.

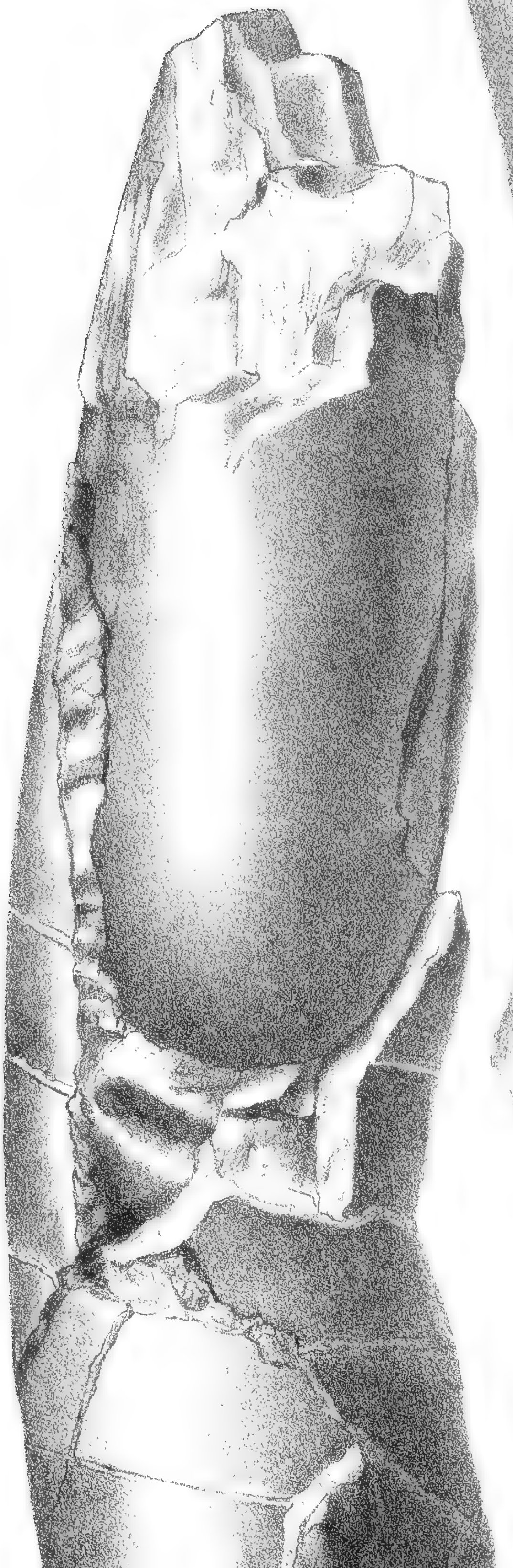
West, Newman imp.

PLATE XIII.

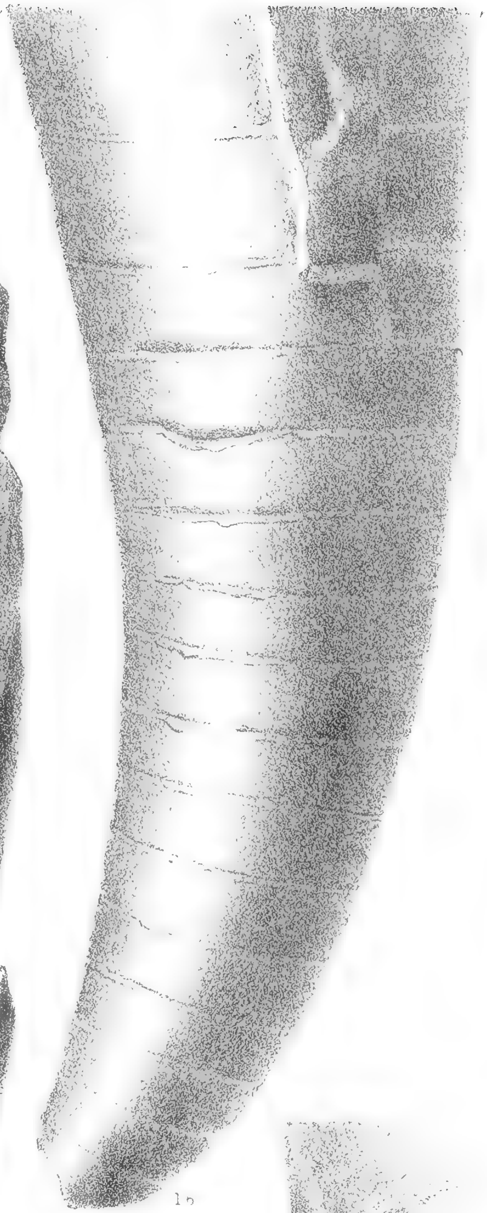
EUSTHENOCERAS HULLI, *L. G. de Koninck*, sp.

Figs. 1 *a*, 1 *b*. A large specimen, imperfect at both ends, but with the greater part of the body-chamber preserved; the letters *a b*, *a b*, show where the two halves of the figures join. 1 *c*. Part of the same specimen, showing the arching of the sutures (in the anterior direction) and the distinct median or "normal" line. 1 *d*. Section taken from the apical part of the shell, showing the septa and their necks (upper part of the figure; but the necks are drawn with too narrow a space between them where the siphuncle would pass through). Obscure lines indicate where the siphuncle has been, but its form cannot be made out. 1 *e*. Transverse section, showing a little circle just above the centre which indicates the position of the siphuncle, but not quite so clearly in the specimen as in the drawing. Oldtown. Museum of Trinity College, Dublin. (Page 39.)

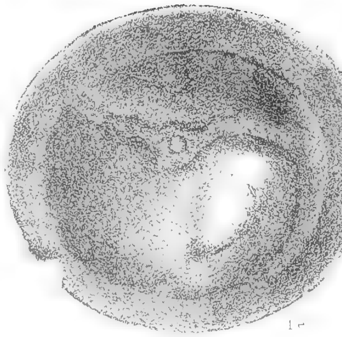
PLATE XIII



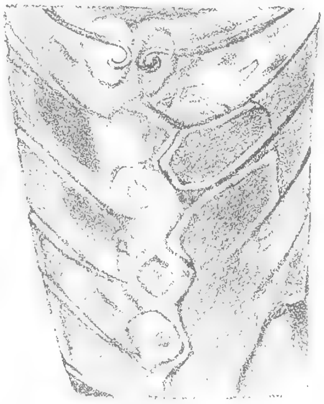
1 a



1 b



1 c



1 d.

1 e

WH Crowther lith, A.H.F. dir

West, Newman imp.

PLATE XIV.

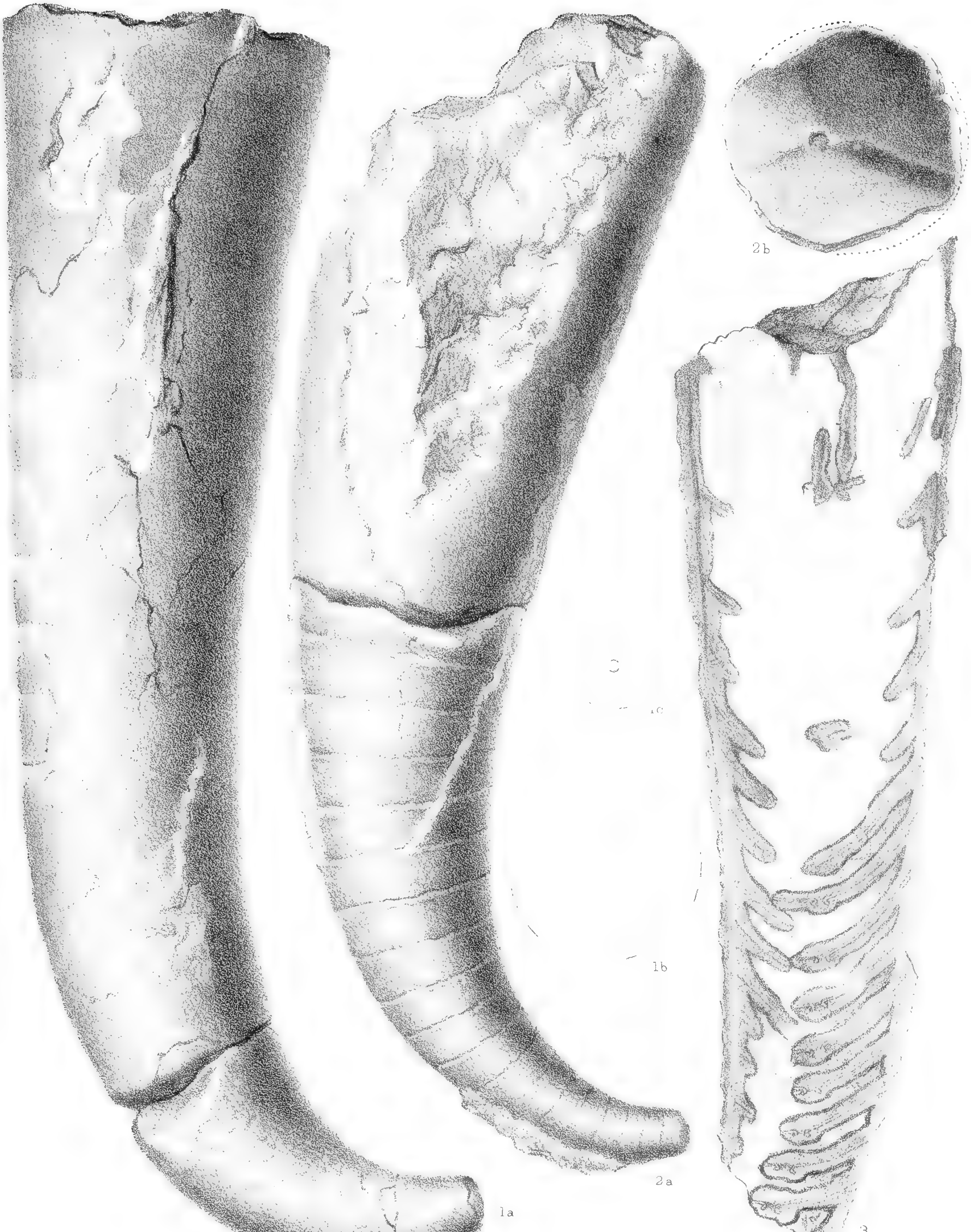
EUSTHENOCERAS HULLI, *L. G. de Koninck*, sp.

Fig. 1 *a*. Lateral view of a specimen wanting the body-chamber and a small portion of the apical end; a short piece (about 15 mm.) of the upper end has been omitted, as it made the specimen too long for the plate. 1 *b*. The nearly circular transverse section showing the siphuncle. 1 *c*. Section at the apical end of an elliptical form. 3. Longitudinal section of another specimen of this species, showing the septa which have become coated over with a crystalline deposit of a fibrous nature; the necks of the septa are well preserved, but the siphuncle has become absorbed in the process of crystallisation; there are obscure remains of it in the upper part of the section, which seem to indicate that it was of cylindrical form, but this is by no means clear. The lighter tinted and white parts of the section represent crystalline calcite, which often fills these chambered shells to the destruction, partial or complete, of the internal parts. Rathkeale. Dublin Museum of Science and Art (Geological Survey of Ireland Collection). (Page 39.)

EUSTHENOCERAS BAILYI, *L. G. de Koninck*, sp.

Fig. 2 *a*. Lateral view of a nearly complete specimen (cast), showing the septa (sutures) and the greater part of the body-chamber; the extreme apex is broken off. 2 *b*. The last chamber viewed from above, showing the position of the siphuncle. Samphire Island. Dublin Museum of Science and Art (Geological Survey of Ireland Collection). (Page 42.)

PLATE XIV



A H Crowther lith., A.H.F. dir

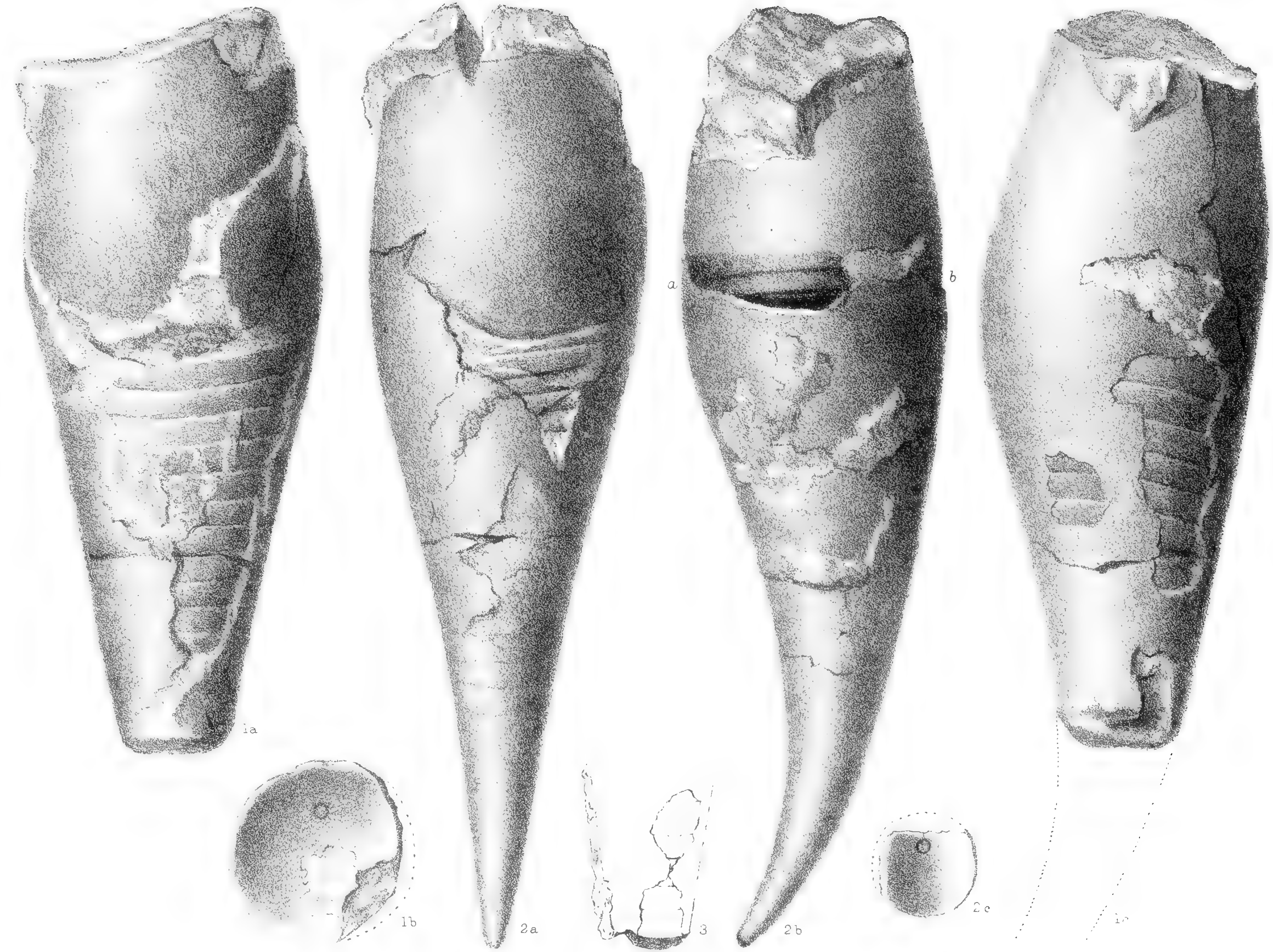
West Newman imp

PLATE XV.

POTERIOCERAS FUSIFORME, *J. de C. Sowerby*, sp.

Fig. 1 *a*. Imperfect specimen showing the septation on the ventral side, and the greater part of the body-chamber. 1 *b*. A septum of the same, showing the position of the siphuncle. 1 *c*. The same specimen viewed laterally, exhibiting the flattened ventral and inflated dorsal profiles. 2 *a*. Ventral view of another specimen, nearly perfect, the septate part almost covered by the test. The base of the body-chamber is seen along the line *a*, *b*, in 2 *b*, which is a lateral view of the same specimen. 2 *c*. A septum of the same, showing the siphuncle. The dotted line added to fig. 2 *c* enables it to be more readily compared with 2 *b*, which is placed for that purpose in the same position. 3. Posterior end of Sowerby's type specimen, contained in the British Museum. St. Doulagh's. Dublin Museum of Science and Art. (Page 43.)

PLATE XV.



W.H.Crowther lith. A.H.F. dir

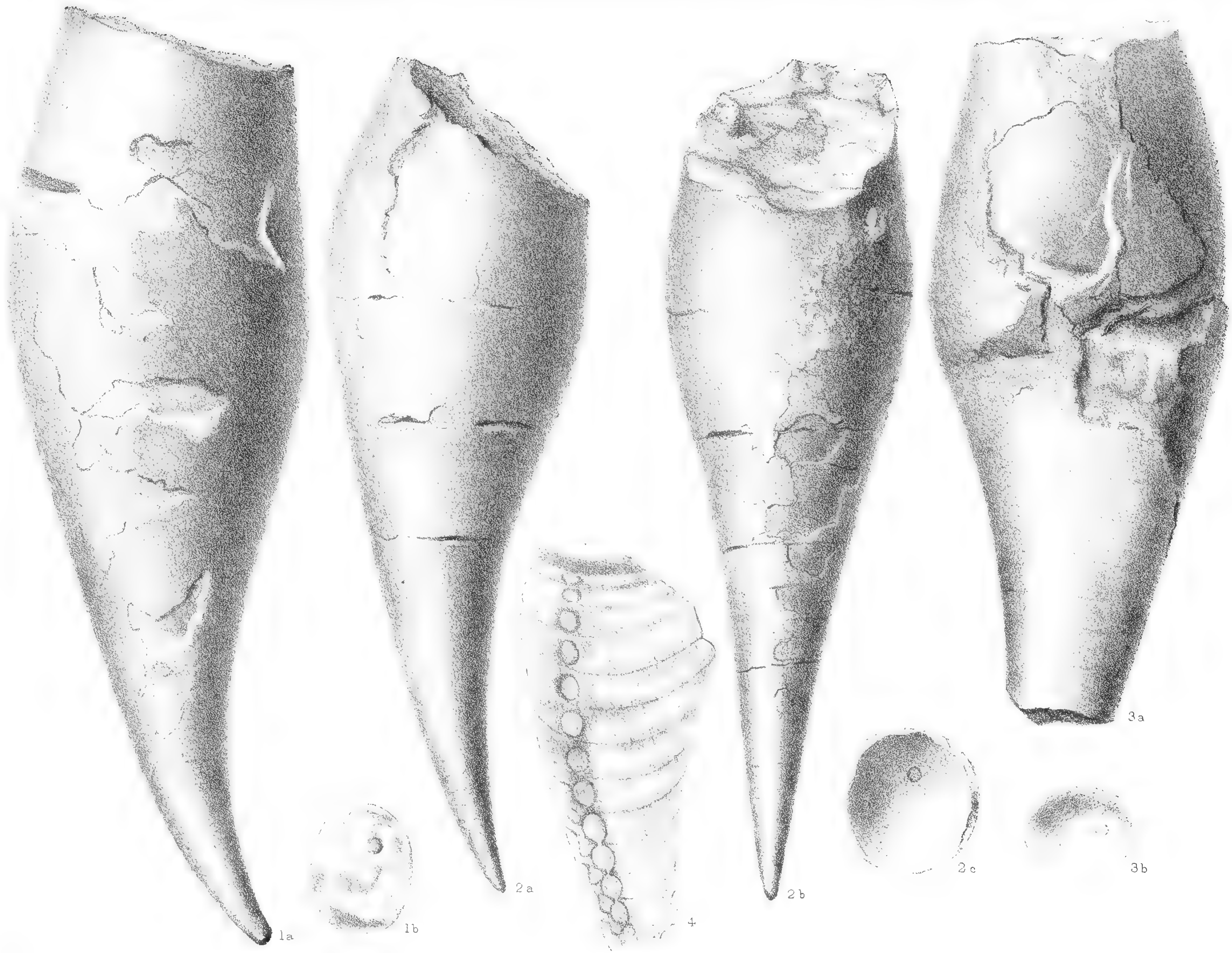
West, Newman imp

PLATE XVI.

POTERIOCERAS LATISEPTATUM, sp. nov.

Fig. 1 *a*. A nearly perfect specimen wanting only a small portion of the apex. 1 *b*. Transverse section of the same showing the siphuncle. 2 *a*. Lateral view of another specimen. 2 *b*. Ventral view of the same. 2 *c*. Section of the same, showing the position of the siphuncle. 3 *a*. Lateral view of an imperfect specimen, showing the widely spaced septa. 3 *b*. Transverse section of the same, showing the position of the siphuncle. The elliptical form of the section is artificial, being due to the specimen having been ground and polished to show the sutures which were covered by the test. 4. Longitudinal section showing the siphuncle (this section was unfortunately not cut through the centre of the siphuncle, whose elements therefore appear oval and less than their full size would be). The last three chambers are extremely shallow. Clane. (Figs. 1, 3, and 4). County of Limerick (exact locality unknown—fig. 2). Dublin Museum of Science and Art. (Page 45.)

PLATE XVI



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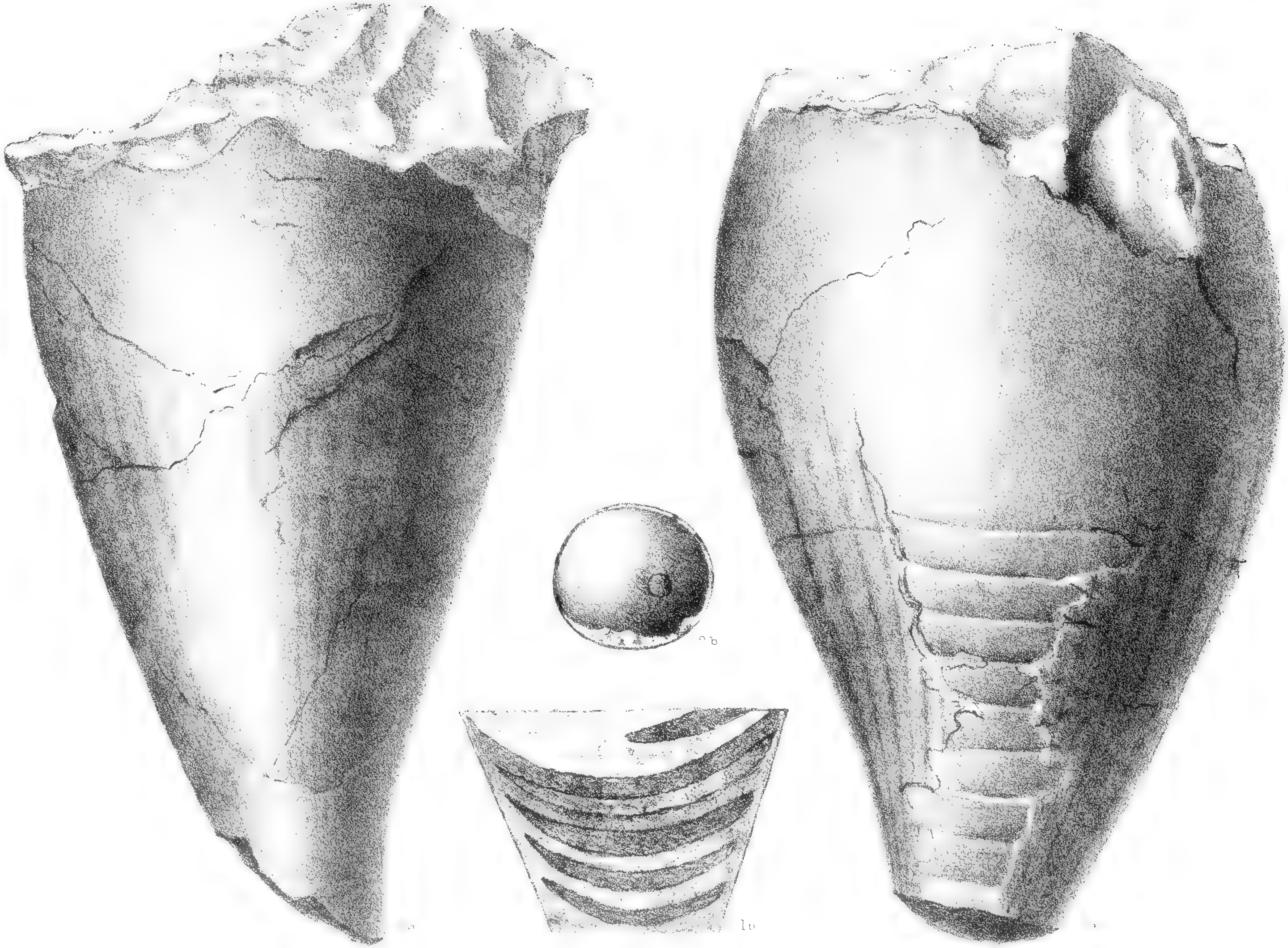
West, Newman imp

PLATE XVII.

POTERIOCERAS VENTRICOSUM, *F. M'Coy.*

Fig. 1 *a*. Lateral view of an imperfect specimen, showing the faint longitudinal ridges. 1 *b*. Longitudinal section showing the septa (dark-tinted spaces) much thickened and obscured by crystalline deposits. 2 *a*. A fine specimen showing the septa and the greater part of the body-chamber. 2 *b*. Transverse section of the same, showing the position of the siphuncle. Clane. Dublin Museum of Science and Art. (Page 46.)



W.H. Crowther lith. A.H.F. del.

West, Newman imp.

THE

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MDCCCXCVIII.

A MONOGRAPH

OF THE

DEVONIAN FAUNA

OF THE

SOUTH OF ENGLAND.

BY

G. F. WHIDBORNE, M.A., F.G.S.

VOL. III.—PART III.

THE FAUNA OF THE MARWOOD AND PILTON BEDS

OF

NORTH DEVON AND SOMERSET

(*continued*).

PAGES 179—236; PLATES XXII—XXXVIII.

LONDON:

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1898.

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2. Chonetes margaritacea, *Whidborne*. Plate XXII, figs. 5, 5 *a*, 6.

1896. Chonetes margaritacea, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Ventral valve small, very transverse, semi-oval. Umbo low, rounded, very slightly extending over hinge. Hinge-line straight, equal to the width of the shell in length, bearing three (or four) nearly perpendicular spines. Margins very gently curved in front, gradually increasing in curvature laterally, and meeting the hinge-line at nearly right angles. Contour of surface moderately convex, becoming flatter on the wings. Ribs about thirty, low, rounded, divided by narrower concave furrows, vanishing on the wings, and crossed by minute regular sharp distant concentric threads, which are twice as close as the ribs.

Size.—Length 7 mm., width 15 mm.

Localities.—In the Porter Collection are six specimens from Roborough, Poleshill, and Pilton; in the Barnstaple Athenæum one from Bradiford; in the Museum of Practical Geology one from Braunton; and in my Collection one from Croyde.

Remarks.—This beautiful shell is distinguishable from *Ch. Hardrensis*, with which it occurs, by its somewhat larger size, its more transverse and oval shape, and its much larger, fewer, and more simple ribs, as well as by its pronounced concentric ornament.

From *Ch. Phillipsii*, Davidson,[1] it differs in its more oval and transverse shape and its considerably finer ornament.

Ch. plebeia, Schnur,[2] appears to be less transverse, and to have less simple ribs and more oblique hinge-spines.

3. Chonetes Illinoisensis, *Worthen?* Plate XXII, figs. 7, 8.

? 1858. Chonetes Logani, *Hall* (not *Norwood and Pratten*). Geol. Rep. Iowa, vol. i, pt. 2, p. 598, pl. xii, figs. 1 *a*—*e*, 2.
? 1860. — Illinoisensis, *Worthen*. Trans. St. Louis Acad. Sci., vol. i, p. 571.
? 1868. — — *Meek and Worthen*. Geol. Surv. Illin., vol. iii, p. 505, pl. xv, figs. 8 *a*, *b*.
1896. — — *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Shell rather small, transverse. Hinge-line straight, nearly as long as the width of the shell. Margins moderately convex in front, their

[1] 1882, Davidson, 'Brit. Foss. Brach.,' vol. v, p. 54, pl. iii, figs. 23, 23 *a*.

[2] 1897, Whidborne, 'Quart. Journ. Geol. Soc.,' vol. liii, p. 454, pl. xxxiii, figs. 1, 2.

convexity gradually increasing on the sides, the extremities of which meet the hinge-line at an obtuse angle. Ventral valve moderately convex. Dorsal valve flat, becoming concave near the margins. Hinge-line with (at least) two very long, thin, slightly oblique spines on each side in the ventral valve. Surface covered with multitudinous elevated, rounded, divaricating and sometimes rather flexuous, minute radiations (probably about 150).

Size.—A distorted specimen is 8 mm. long by 15 mm. wide.

Locality.—In the Porter Collection are two slabs, containing several specimens from Pilton or Fremington.

Remarks.—These fossils appear distinguished by the very great number of the ribs, as well as by the flexuosity of these ribs, which seems to be caused by their frequent divarication at irregular intervals.

They are very similar to *Chonetes Dalmaniana,* de Koninck,[1] as given by M'Coy[2] and Davidson,[3] but appear to differ by their longer, less oblique, and (apparently) fewer hinge-spines, and their rounded cardinal angles.

As far as can be judged from Meek and Worthen's figure, they do not appear distinguishable from *Ch. Illinoisensis,* though in that figure the length of the spines is not shown, and the sides of the shell seem rather straighter.

2. Order—INARTICULATA, *Deshayes,* 1836.

I. *Family*—Craniidæ, *d'Orbigny,* 1847.

1. *Genus*—Craniella, *Œhlert,* 1888.

1. Crania insecura, n. sp. Plate XXII, fig. 9.

Description.—Cast of dorsal or upper valve irregularly quadrate with rounded angles, rather longer than broad, and widest at or about one-third the diameter from the front. Apex small and sharp, slightly in front of the centre. Contour broadly conical, but having two large indistinct swellings before the apex, one on each side, in front of which the surface sinks steeply to the margin. Anterior margin almost straight; lateral margins oblique and slightly arching; posterior margin straight, and only half the width of the anterior. Margins (in cast) with a broad concave border. Occlusor muscle-marks two, concave, ovoid

[1] 1843, de Koninck, 'Discr. Anim. Foss. Terrain Carb. Belg.,' p. 210, pl. xiii, fig. 3; and pl. xiii *bis*, fig. 2.

[2] 1844, M'Coy, 'Synops. Carb. Foss. Irel.,' p. 119, pl. xx, fig. 7. Mons. Œhlert informs me that he questions the identity of M'Coy's and de Koninck's species.

[3] 1861, Davidson, 'Brit. Foss Brach.,' vol. ii, pt. 5, p. 183, pl. xlvi, figs. 7—7 *b*.

or pear-shaped, adjacent in front and slanting outwards, situate immediately behind the apex, and one-seventh of the shell in length. Divaricator scars rather larger and more oval than the occlusors, concave, elongate, not slanting, apparently bisected longitudinally, situate at the postero-lateral corners, and touching the inner edge of the marginal rim. Surface (of cast) traversed by an irregular transverse ornament, reproduced from the organism to which it was attached.

Size.—Length 13 mm., width 12 mm., depth 7 mm.

Localities.—In the Barnstaple Athenæum is a specimen on a slab with *Productus prælongus*, *Rhynchonella Partridgiæ*, &c. Though its locality is not stated, it is clearly from the equivalent to the Top Orchard beds. A doubtful specimen is in the Porter Collection from Pilton, and another in my Collection from Ashhill Quarry.

Remarks.—The figured specimen is indistinct, especially in consequence of its having irregular ridges assumed from some other organism on which it was parasitic. Davidson[1] notes that the free valves of the Carboniferous *Craniæ* are sometimes similarly marked. The broad marginal concavity seems to indicate a massive shell, and the concave marks in the cast show that in the shell the muscle-scars were very convex.

In 1896 I referred this shell to *Craniella Meduanensis*, Œhlert;[2] I am inclined now to think that there are probably not sufficient grounds for this identification; the muscular impressions appear to be smaller and differently shaped, and there appears something in the nature of a border. Moreover, Mons. Œhlert, judging from a photograph submitted to him, regards it as a *Craniella* of the group of *Meduanensis*, but distinguishable by its contour, the situation of the muscles, and the position of the summit.

To the Carboniferous *Crania quadrata*, M'Coy, sp.,[3] it also appears somewhat similar; but it is distinguished by the anterior position of its vertex and its occlusor scars, and by the more transverse shape of its divaricator scars.

Of *Crania proavia*, Goldfuss,[4] I have only been able to find figures and descriptions of the lower or fixed valve, and have therefore been unable to compare it. In shape it would seem to have been more rectangular and transverse.

[1] 1861, Davidson, 'Brit. Foss. Brach.,' vol. ii, pt. 5, p. 195.

[2] 1888, Œhlert, 'Bull. Soc. Étud. Sci. Angers,' (1887), p. 38, pl. x, figs. 1—1 *g*.

[3] 1844, M'Coy, 'Synops. Carb. Foss. Irel.,' p. 104, pl. xx, fig. 1.

[4] 1853, Schnur, 'Palæontographica,' vol. iii, p. 230, pl. xliii, figs. 9 *a*, *b*; and 1871, Kayser, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xxiii, p. 641, pl. xiv, fig. 6.

2. *Genus*—Crania, *Retzius*, 1781.

1. Crania ? ricta, n. sp. Plate XXII, figs. 10, 10 *a*.

1896. Crania ringens, *Whidborne* (not *Höninghaus*). Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Ventral valve flattish, transversely oval. Divaricator scars rather small, transversely oval, slightly convex, strongly defined, crossed by strong oblique ridges, and situated very near each other and near the centre of the posterior margin. Occlusor scars confluent, forming apparently a long transverse oval prominence, covered with transverse ridges, and situate at about the posterior fourth of the median line. Ventral adjustor (?) scars very small, obliquely oval, situate at the antero-lateral margins of the occlusor scars. Inner surface covered by minute closely-arranged tubercles or granules.

Size.—Length about 14 mm., width about 19 mm.

Localities.—A single specimen from Pilton is in the Porter Collection.

Remarks.—I am very doubtful about the generic position of this curious fossil, and only place it provisionally in this genus as its muscle-marks appear not unlike those of some species of *Crania.* In many ways it seems to be remarkable. The specimen, which is almost flat, and may, I think, be regarded pretty confidently as a ventral valve, shows no signs of having been attached to any other organism. The striation of the muscle-scars is very strong and acute; the divaricator scars are unusually proximate to each other, being less than their own width apart; and the width across the pair is less than one-third the width of the whole shell. The surface at the centre of the occlusor scars is blurred, so that it cannot be seen whether they are fully or only partially confluent. At their anterior corners may be seen two much smaller and less distinct scars, which may perhaps belong to ventral adjustors. The most striking feature of the fossil, however, is the coarse tuberculation of its inner surface, which conveys the idea, not of being the casts of pores left in a decayed shell-structure,[1] but of being the original internal face of the shell. This is, perhaps, analogous to the tuberculated border of some species of *Crania.*

I have been unable to find the description of any species at all approaching this shell; and, though its general resemblance to some more recent *Craniæ* makes it just possible that it may be included within the limits of the genus, it is far more likely that further specimens will prove the existence of generic or even greater distinctions.

[1] But compare 1892, Hall and Clarke, 'Pal. N. Y.,' vol. viii, pt. 1, pl. iv H, fig. 7.

II. *Family*—DISCINIDÆ, *Gray*, 1848.

1. *Genus*—DISCINA, *Lamarck*, 1819.

1. DISCINA NITIDA, *Phillips*, sp. Plate XXII, figs. 11, 11 *a*, 12.

1836. ORBICULA NITIDA, *Phillips*. Geol. Yorks., vol. ii, p. 221, pl. ix, figs. 10—13.
1865. DISCINA NITIDA, *Davidson*. Brit. Foss. Brach., vol. iii, p. 104, pl. xx, figs. 9—10 *a*.
1871. — — ? *Kayser*. Zeitsch. Deutsch. Geol. Gesell., vol. xxiii, p. 640.

Size.—Length 23 mm., width 18 mm.

Localities.—In the Museum of Practical Geology is a lower valve from Barnstaple, and two upper valves (the smaller of which was figured by Davidson) from West Angle (Pembrokeshire). In Miss Partridge's Collection is a specimen of each valve from Saunton. I have obtained specimens from Saunton Hotel and the "Laticosta Cave,"[1] Baggy.

Remarks.—The comparison of our specimens with a large series of Carboniferous specimens leaves no doubt of their specific identity. The only differences observable are that the Devonian specimens sometimes are slightly larger and sometimes more elongate and oval, and that the foramen of the lower valve, as seen internally in them, is much smaller than it is as seen externally in the Carboniferous examples, which difference probably is simply due to its character.

In Miss Partridge's specimen of the upper valve, the strong median longitudinal thickening under the apex is more evident than it is in the Yorkshire shells, in several of which, however, it is observable.

III. *Family*—LINGULIDÆ, *King*, 1850.

1. *Genus*—LINGULA, *Bruguière*, 1792.

1. LINGULA SQUAMIFORMIS, *Phillips*. Plate XXII, fig. 13.

1836. LINGULA SQUAMIFORMIS, *Phillips*. Geol. Yorks., vol. ii, p. 221, pl. xi, fig. 14.
1865. — — *Davidson*. Brit. Foss. Brach., vol. iii, p. 105, pl. xx, figs. 11, 12.

[1] "Laticosta Cave" is, of course, not a local name in ordinary use. It is as well to remark again that I have simply used it as an abbreviation to indicate the one spot where (in company with numerous other species) *Rh. laticosta* has hitherto been found.

Size.—Length 19 mm., width 14 mm.

Localities.—Very abundant at Sloly Quarries. Specimens have been found near Baggy Point by Mr. Townshend Hall. A single fine specimen from Saunton is in Miss Partridge's Collection.

Remarks.—The specimens from Sloly sometimes occur in beautiful states of preservation, but are almost always more or less distorted. Occasionally they appear almost circular in shape, and these my friend Mr. Townshend Hall was inclined to separate under the manuscript name *L. circularis;* but, having examined his specimens, I believe that their shape is entirely due to pressure, and that there is no reason to regard them even as a variety of the common form.

On the other hand, I am more doubtful as to the identity of the fine dorsal valve (Pl. XXII, fig. 13) found by Miss Partridge in the Pilton Beds of Saunton. Its almost oblong shape, almost horizontal posterior margin unbroken by the apex, its very convex shoulders, its thin shell, and the five or six radiating lines on the cast in front, seem to indicate that it is at least a marked variation from the form of the species occurring at Sloly.

2. Class—BRYOZOA, *Ehrenberg*, 1832.

1. Order—GYMNOLÆMATA, *Allman,* 1856.

1. Sub-order—CRYPTOSTOMATA, *Vine*, 1883.

Fenestellids are very abundant in the Pilton Beds; but, as usual, their state of preservation is such as not to lend itself to their easy determination. They can in general only be obtained in fragments, crushed and drawn out in different directions, so as to mask their relative dimensions. From the pressure which the fronds have undergone it can rarely be said whether they were originally fan-shaped or conical. From the nature of the rock it is impossible to obtain sections. They occur for the most part either (1) in the condition of internal casts when the cells are visible, but too frequently the dissepiments have disappeared, or (2) in that of external moulds, in which case sometimes the cell-mouths may be recognised, but the dissepiments are frequently blurred by the matrix or missing.

Hence specific determination can only be very tentative. There appears to be sufficiently clear evidence of the existence of at least three or four species, but to define them so as to show their differences or their identity with fossils occurring in other localities is almost impossible; and it is not unlikely that if better specimens were obtainable, differences would be found to exist between some specimens which, under present circumstances, it is necessary to place together.

I. *Family*—Fenestellidæ, *King*, 1849.

1. *Genus*—Fenestella, *Lonsdale*, 1839.

1. Fenestella plebeia, *M'Coy*. Plate XXII, figs. 14—15 *a*; and Plate XXIII, figs. 1, 1 *a*.

1841.	Fenestella antiqua? vars. β? and γ, *Phillips*.			Pal. Foss., p. 24, pl. xii, figs. 35 (*d*, *e*?) *f*, *g*.
1844.	—	plebeia, *M'Coy*.		Synops. Carb. Foss. Irel., p. 203, pl. xxix, fig. 3.
1855.	—	—	—	Brit. Pal. Foss., p. 76.
1879.	—	—	*Shrubsole*.	Quart. Journ. Geol. Soc., vol. xxxv, p. 278.
1881.	—	—	—	Ibid., vol. xxxvii, p. 179.

Description.—Zoarium apparently flabelliform, large. Fenestrules about nine or ten in the length of 10 mm., and thirteen in the width of 10 mm., elongate, oblong. Branches stout, undulating near the base, almost straight in the distal parts, about the width of the fenestrules, and divaricating at first irregularly and farther from the base at very regular distances. Dissepiments apparently small and narrow. Non-poriferous surface ornamented with a few strong longitudinal ridges. Mode of increase sometimes near the base by one or two new branches rising from the closed head of a fenestrule, but generally by the simple fission of the branches, which appears to occur at the rate of once in about ten fenestrules, and at the same level in groups of adjoining fenestrules. Cells arranged in two alternating rows, sometimes with a third cell intercalated at the commencement of a branch, pentagonal in longitudinal section, numbering from four to six, generally five, in the length of a fenestrule.

Size.—A fragmentary specimen is 50 mm. long.

Localities.— Poleshill, Wrafton Lane, Pilton, Ashford Strand, Snapper Quarry, Kingscote (near Brushford), Croyde, &c. It is an abundant species, and is found at most of the Pilton localities, though it is not so frequent in beds where large Brachiopods predominate.

Remarks.—This appears to be the species described by Phillips from North Devon under the name "*Fenestella antiqua*, (?), Lonsdale, var. β and γ," though under these varieties he also included the South Devon form, which I have called *F. fanata*,[1] and from which it differs in its less rapid branching, the larger number of cells to a fenestrule, and other points. M'Coy, in 1855, separated the form found at Petherwyn from the Middle Devonian species, and referred it to his pre-

[1] 1895, Whidborne, 'Dev. Fauna,' vol. ii, p. 165, pl. xviii, figs. 6—10; and pl. xix, figs. 3, 4.

viously described *F. plebeia*, and it appears to me that with that species these Pilton fossils are identical.

The only point in which Phillips's description does not agree with our fossils is that he figures and describes the non-poriferous face as granular, whereas they show it to be striated. A free specimen, however, from Ironpost has it tuberculated, and though the fossil is obscure, it seems most likely that that feature is due to mineral change acting perhaps on a finely granulated matrix, and may have obliterated the original striation.

2. FENESTELLA ? UMBROSA, n. sp. Plate XXII, figs. 16, 16 *a*; and Plate XXIII, figs. 2, 2 *a*, 3, 3 *a*.

Description.—Zoarium large, convex, infundibuliform. Branches undulating, stout, broader than the fenestrules, poriferous on the external face, which is obliquely flattened, and appears to bear a thin sharp median keel. Non-poriferous face with a few very strong longitudinal striæ, of which the central seems strongest, and perhaps forms an incipient keel. Cells two or three (or occasionally even four) to a fenestrule, projecting (?) so as to cause indentations on the sides of the branches. Fenestrules twelve to seventeen in the length of 10 mm., and about twenty-two in the width of 10 mm. Rate of branching about one in seven.

Size.—A doubtful crushed specimen is more than 80 mm. long.

Localities.—In the Barnstaple Athenæum is one specimen from Roborough; in the Woodwardian Museum two from Barnstaple; in the Museum of Practical Geology one from Croyde and one from the Pilton Beds; in the Porter Collection six from Roborough, Poleshill, and Pilton; and in my Collection one from Croyde Rocks.

Remarks.—These specimens appear clearly to indicate a species distinct from the common Pilton *Fenestella plebeia* both in general appearance and detail, and distinguished from it by its stouter, more undulating branches, its smaller and narrower fenestrules, its more rapid branching, its cup-like shape, and other points. At the same time the imperfect state of our specimens, which are almost all moulds or casts, makes it hard to say how much weight may be placed on characters and measurements observable in them, and there are some inconsistencies noticeable in them, rendering it not impossible that they include two similar species, which cannot be separated without better material. Thus—

(1) A specimen in the Woodwardian Museum, another in the Museum of Practical Geology, and another in the Barnstaple Athenæum show that the

zoarium was infundibuliform, either from its developing from a central base or from its sides overlapping each other. In these fossils the poriferous face of the branches is external, and in one of them it appears to show a thin keel.

(2) In a second specimen in the Museum of Practical Geology, however, the poriferous face appears to be upon the concave (or internal) side of the zoarium. This fossil is a mould, and is remarkable for having circular cavities, not quite as numerous as the fenestrules, irregularly placed on its branches, which they equal in width. Whether these cavities indicate spines, as in *F. Lyelli,* Dawson,[1] or ovarian capsules or nodes such as are described in the very similar *F. vera*, Ulrich,[2] does not appear. The specific identity of this specimen must evidently be at present doubtful, unless the appearance of the inner face being poriferous is deceptive.

In the other specimens the number of cells to a fenestrule is sometimes two, sometimes three, while sometimes (unless a dissepiment has been obliterated) it is four. In one or two specimens which seem to belong to the same species, but which are in a different state of preservation, and perhaps more nearly resemble *F. plebeia* in some points, their number is clearly three or four.

Affinities.—F. nodulosa, Phillips,[3] appears to be a closely allied form, resembling our typical specimens in the prominence of the cell-mouths, which nodulate the sides of the branches. Possibly its cells were as a rule slightly more numerous, and its fenestrules wider. Among numerous examples of it in the Woodwardian Museum are two which show its frond to be flabellate, as described by M'Coy[4] (though Phillips called it "radiating," and so figured it). For this reason it seems safer to regard it as distinct.

F. oculata, M'Coy,[5] also is very similar, but appears to branch more rarely, to have no keel on the poriferous face, and to be smooth on the reverse. In these points, perhaps, *F. flabellata*, Phillips,[6] is still nearer, but its branches seem to be slighter, and its fenestrules more regular; it was regarded by Shrubsole as synonymous with *F. membranacea*, Phillips (*i. e. Hemitrypa hibernica*, M'Coy).

M'Coy mentions that in *H. hibernica* there are large irregular spines on the inner face. The fact that the external face is poriferous, and other resemblances, may possibly indicate that our species is really a *Hemitrypa*, but at present there is no direct proof that it is so. The prominence of the pores, at all events, distinguish it from *H. hibernica* as well as from *H. oculata*, Phillips.

[1] 1879, Nicholson, 'Manual Palæont.,' vol. i, p. 420, fig. 262.

[2] 1890, Ulrich, 'Geol. Surv. Illinois,' vol. viii, p. 535, pl. xliv, figs. 1, 1 *a*; and pl. liv, fig. 3.

[3] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 199, pl. i, figs. 31—33; and 1881, Shrubsole, 'Quart. Journ. Geol. Soc.,' vol. xxxvii, p. 183.

[4] 1844, M'Coy, 'Synops. Carb. Foss. Ireland,' p. 203.

[5] Ibid., p. 203, pl. xxviii, fig. 15.

[6] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 198, pl. i, figs. 7—10.

3. Fenestella laxa, *Phillips.*

1836.	Fenestella	laxa,	*Phillips.*	Geol. Yorks., vol. ii, p. 199, pl. i, figs. 26—30.
1841.	—	—	—	Pal. Foss., p. 23, pl. xii, figs. 34 *a*, *b*.
1879.	—	crassa,	*Shrubsole.*	Quart. Journ. Geol. Soc , vol. xxxv, p. 280.
1881.	—	—	—	Ibid., vol. xxxvii, p. 186.

Remarks.—Under this name Phillips identifies fossils from Petherwyn and Croyde with those he had before described from the Carboniferous of Yorkshire. His Devonian figure shows fenestrules about 10 mm. long by 5 mm. wide.

I have met with no specimens of any *Fenestella* at all approaching these dimensions.

4. Fenestella polyporata, *Phillips.* Plate XXIII, figs. 4, 4 *a*, 5, 5 *a*.

1836.	Fenestella	polyporata,	*Phillips.*	Geol. Yorks., vol. ii, p. 199, pl. i, figs. 19, 20.
? 1844.	—	multiporata,	*M'Coy.*	Synopsis Carb. Foss. Irel., p. 203, pl. xxviii, fig. 9.
1879.	—	polyporata,	*Shrubsole.*	Quart. Journ. Geol. Soc., vol. xxxv, p. 280.
1881.	—	—	—	Ibid., vol. xxxvii, p. 185.

Description.—Zoarium composed of very large network, very irregular near the base, but more regular (and rather smaller ?) in the upper parts. Branches much narrower than the fenestrules, sometimes dividing at the same levels. Poriferous face with a blunt angle or keel, and with obliquely flattened (or excavated ?) sides, bearing (close to, but not protruding over, the margin) a row of elevated, elongate, oval cell-mouths, separated by intervals of about half their length. Non-poriferous face rounded (or bluntly keeled ?), roughly granulated (?). Fenestrules oblong, 2 to 4 mm. in length, and about 1 mm. wide; but near the base irregularly ovoid, and sometimes still longer. About eight cells to a fenestrule.

Localities.—A fragmentary specimen, showing the cell-mouths, from the Pilton beds is in Mr. Hamling's Collection, one from Pilton in the Porter Collection, and three from Kingscote, Pouch Bridge, and East Anstey in my Collection.

Remarks.—Carboniferous specimens of *F. polyporata* in the Woodwardian Museum from Hook Head and from Settle are evidently identical with our Pilton examples. In both these cases the stems seem slightly stouter and the fenestrules more oval, but probably our specimens might more resemble them if they were not so cloaked by the matrix, which often almost or entirely covers the dissepiments. *F. multiporata*, M'Coy, is united by Shrubsole with this species, and there certainly seems nothing to distinguish it; the Pilton fossils seem midway between them.

Affinities.—F. quadridecimalis, M'Coy,[1] would appear to branch more rapidly, and to have thinner branches and much more numerous pores.

Whatever the specimens from Pilton referred by Phillips to his *F. laxa* may be, their reticulation (as in the Carboniferous type) was very much larger than that of the present species, *e.g.* in his figure (said to be natural size) it is more than twice the length of that of our fossils, and the stems are wider than the width of our stems and fenestrules together. It could not, therefore, be reasonably regarded as the same species.

II. *Family*—Acanthocladiidæ, *Zittel*, 1880.

1. *Genus*—Penniretipora, *d'Orbigny*, 1849.

Goldfuss defined his genus *Glauconeme*[2] for four of Münster's species belonging to or in the style of *Vincularia*, and afterwards added a fifth species, *G. disticha*,[3] from the Eifel or from Dudley, to which his generic definition was not applicable. The latter species, according to his figure, seems probably congeneric with *G. bipinnata*, Phillips. In 1839 *G. disticha* was described from Dudley by Lonsdale[4] in 'Siluria,' but in terms which imply that the Dudley fossil was more akin to *Ptilopora* than to *G. bipinnata*, which Phillips in 1841 described from the Pilton beds. In 1849 d'Orbigny[5] formed the genus *Penniretipora*, and defined it in terms which, though slight, are consistent with the characters of the present genus. He enumerated eight species, of which probably the first two do not belong to the present genus, and the next four do. Curiously enough he omits *G. bipinnata*, and places it under M'Coy's genus *Ichthyorachis*, having possibly mistaken Phillips's drawing of the reverse side for the obverse. In 1884 Vine[6] formed a new genus, *Pinnatopora*, with *G. bipinnata* for its type, and restricted *Glauconeme* to *G. disticha*, Lonsdale. In 1890 Ulrich[7] followed Vine as to

[1] 1844, M'Coy, 'Synopsis Carb. Foss. Irel.,' p. 204, pl. xxviii, fig. 13.

[2] 1830, Goldfuss, 'Petref. Germ.,' vol. i, p. 100, and p. 101, note on *Vincularia*.

[3] Ibid., p. 217, pl. lxiv, fig. 15.

[4] 1839, Murchison, 'Sil. Syst.,' p. 677, pl. xv, figs. 12—12 *d*.

[5] 1849, d'Orbigny, 'Prodrome,' vol. i, p. 45.

[6] 1884, Vine, 'Report Brit. Assoc.,' 1883 (Southport), pp. 191 and 192 (woodcut).

[7] 1890, Ulrich, 'Geol. Surv. Illinois,' vol. viii, p. 614.

Pinnatopora, but considered that *G. disticha*, Lonsdale, should perhaps be called *Penniretipora*.

Dr. Gregory informed me in 1895 that he considered *Pinnatopora* a synonym of *Penniretipora*, and following him I described two doubtful Lummaton species under the latter name.

It is clear from the above that our fossils cannot be called *Glauconeme*, and that they can be called *Pinnatopora*.

It seems rather doubtful whether *Penniretipora* is sufficiently defined to be valid. D'Orbigny's definition is "Two rows of cells on one side; the whole pinniform, with a stem and free lateral branches." It is perhaps allowable to discard the doubtful species he enumerates, and to restrict the genus to those congeneric with *G. bipinnata*, Phillips; in fact, to treat it as identical with *Pinnatopora*, and therefore on the score of priority regretfully to regard the latter and neater name as a synonym.

1. Penniretipora bipinnata, *Phillips*, sp. Plate XXIII, figs. 6—8.

1841. Glauconeme bipinnata, *Phillips*. Pal. Foss., p. 21, pl. xi, figs. 33 *a*—*g*.
1844. — — *M'Coy*. Synopsis Carb. Foss. Irel., p. 199.

Description.—Zoarium pinnate, elongate, generally curved and rambling, sometimes sending forth a second midrib at an acute angle to the original one. Midrib about ·5 mm. wide near the base, decreasing very slowly in width, striated and perhaps granulated on the reverse side, which appears rounded and possibly rather flattened. Poriferous side with a strong (perhaps nodulated?) keel, and with obliquely flattened sides, each of which has a row of small rounded cell-mouths, which appear to project rather forward, and to be thickened internally. Cells oblong and elongate longitudinally, with thin walls, numbering two on the midrib to each branch. Lateral branches starting from the centre of the sides of the cells, set at an angle of about 70° to the midrib, free, straight, subcylindrical, sometimes 3 mm. long, about half the width of the midrib and about two-thirds the width of the intervals between them, with rounded extremities, and containing two rows of from six to ten alternating cells; from fourteen to eighteen branches occupying a length of 10 mm. on the midrib.

Size.—A defective but longitudinally stretched specimen is 35 mm. long.

Localities.—Saunton Point, Croyde, Upcot Arch Quarry, Poleshill, Bradiford, Frankmarsh, Top Orchard, Brushford. It appears to be of frequent occurrence.

Remarks.—Though from the state of preservation it is hard to be sure of its exact character and dimensions, this species seems to have abundant distinguishing marks, *e. g.* the regularity with which the branches start from the centre of every second cell on the midrib, their angle and length, and the serpentine general form. The divarication of the main stem itself is rare, and I have not observed any specimen in which it occurs more than once. The angle thus formed is curvilinear, and is generally much less than that of the secondary branches; while the new midrib immediately bears similar lateral branches, though probably at first they are not so long as those on the old. The secondary branches alternate with each other, though they sometimes seem nearly level. The dimensions seem to vary a good deal in different specimens.

Affinities.—*Glauconeme pluma*, Phillips, sp.,[1] appears from the figures to have longer and slighter branches, and more cells on the midrib between them.

In *G. pulcherrima*, M'Coy,[2] the habit seems very different, the cell-mouths more central, and the lateral branches "regularly attenuate." In *G. gracilis*, M'Coy,[3] the cell-mouths are much larger and nodulate the sides, and the branches are much broader than the intervals, but in some respects it bears much likeness to our species. None of the American species described by Ulrich in the eighth volume of the 'Geol. Surv. Illinois' at all resemble it.

G. stellipora, Young and Young,[4] is much more irregular, and has stellate cell-mouths; nor do any of the other species described by those authors[5] appear to approach the present form.

2. Penniretipora virgata, n. sp. Plate XXIII, figs. 9, 9 *a*.

Description.—Zoarium small (?), slight, loosely ramose, consisting of a midrib, from which occasional lateral branches start at an angle of about 50°, which in their turn appear to bear similar and similarly set minor branches. Midrib slight, about ·25 mm. wide, straight, slightly tapering. Reverse face rounded, smooth or minutely striated (?). Poriferous face sharply keeled, obliquely flattened on the sides. Cells in two rows, triangular in longitudinal section. Lateral branches few, unequally distant, slight, sometimes about 4 mm. long, with central keel and two rows of cells, and apparently tapering to a subacute point. Numerous (from five to ten ?) cells on the midrib in the intervals between the lateral branches. Intervals unequal, and frequently about 2 mm. in length.

Size.—A specimen (which is probably a fragment) measures 6 mm. long.

1 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 199, pl. i, figs. 13—15.
2 1844, M'Coy, 'Synops. Carb. Foss. Irel.,' p. 199, pl. xxviii, fig. 4.
3 Ibid., p. 199, pl. xxviii, fig. 5.
4 1874, Young and Young, 'Quart. Journ. Geol. Soc.,' vol. xxx, p. 682, pl. xl, figs. 5—11.
5 1876, Iidem, 'Proc. Nat. Hist. Soc. Glasgow,' vol. ii, pt. 2, p. 325; and 1879 ? vol. iv, p. 354.

Localities.—There is a specimen from Croyde Bay in my Collection, and three slabs containing several specimens from Top Orchard in the Woodwardian Museum.

Remarks.—This little species seems rare, but from its slightness it may easily have been overlooked. It is very different from *P. bipinnata*, and I am not aware of any species which it at all resembles. The very large and variable number of cells between adjacent branches, the acuteness of the angle at which the branches are set, the repetition of branching in the lateral branches, and the greatness of the width of the intervals compared with the width of the branches, as well as possibly the shape of the cells, appear to be distinguishing features.

The pieces I have seen are very small, but it is possible that they are only fragments from larger specimens.

III. *Family*—STREBLOTRYPIDÆ, *Ulrich*, 1890.

"Zoaria variable. Zoœcia with primitive portion subtubular or tubular; apertures subcircular, often truncated posteriorly, surrounded by a slightly elevated rim. Front or outer portion of cell, back of the aperture, simply depressed, or with from two to twelve or more small pits. Diaphragms wanting" (Ulrich).[1]

1. *Genus*—STREBLOTRYPA, *Ulrich*, 1890.

"Zoaria ramose, slender, solid. Zoœcia radiating from an imaginary axis, with primitive portion long, tubular; or from a linear axis, when they are somewhat shorter. . . . Apertures regularly elliptic or truncated at the posterior margin, surrounded by a slight peristome, and within this sometimes a narrow sloping area; arranged usually in rather regular longitudinal series. Just back of the aperture, occupying the depressed front of the cell, are from one to twelve small pits, which, when numerous, are arranged in two or three rows. Very small acanthopores occasionally present" (Ulrich,[2] *abbreviated*).

1. STREBLOTRYPA GREGORII, *Whidborne.* Plate XXIII, figs. 10, 10 *a*.

1896. STREBLOTRYPA GREGORII, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Zoarium cylindrical, small, with strong, acute, elevated, undulating, longitudinal ridges dividing the cell-areas. Areas elongate, irregularly

[1] 1890, Ulrich, 'Geol. Surv. Illin.,' vol. viii, p. 402.
[2] Ibid., p. 403.

fusiform, concave, with a large, probably circular cell-mouth, behind which are three or four smaller pits or mesopores.

Size.—Length of fragmentary specimen 9 mm.; breadth about 1 mm.

Locality.—A slab containing two specimens from the Pilton beds is in Mr. Hamling's Collection.

Remarks.—The specimens, though in many respects good, are rather difficult to make out in exact detail. As far as can be judged from external appearance, they belong undoubtedly to *Streblotrypa*, but it is not easy to say whether the smaller pores are only situated on one side of the aperture or on both.

As both our specimens are broken pieces, it cannot be seen whether it is, as most species described by Ulrich, a branching form.

IV. *Family*—RHABDOMESONTIDÆ, *Vine*, 1883.[1]

1. *Genus*—RHABDOMESON, *Young and Young*, 1874.

Of this genus Ulrich[2] says that it only differs from *Rhombopora* in having a solid axial tube. *Rhombopora* he thus defines (*abbreviated*):—"Zoaria slender, ramose, solid. Zoœcia with thick-walled vestibules. Apertures in diagonally intersecting or longitudinal lines. Strong acanthopores at angles of junction, and more numerous smaller spines generally occupying the summit of the ridge-like interspaces between the subelliptical apertures. Diaphragms sometimes present in the axial regions."

Elsewhere Ulrich notes the close resemblance between the *Rhabdomesontidæ* and the *Batostomellidæ*, tracing passages through kindred species in both families.

I feel in great doubt as to which of these two families the species described below—the *Millepora gracilis*, Phillips—belongs.

It appears (as far as can be seen without the aid of sections) exactly to agree with the above definition of *Rhabdomeson*, except that it seems clearly to possess mesopores. In one of the specimens three or four subsidiary cells, chiefly at the corners, are distinctly seen, and these must, I think, be probably regarded as mesopores, and not as acanthopores, while less clear indications of them are visible in one or two other specimens. In the latter, again, are seen prominences which appear in every way identical with the acanthopores and spines described by Ulrich in *Rhombopora*. Besides Phillips's species we find a second form of

[1] Ulrich (*loc. cit. infra*) states that the primitive cell is tubular, that hemisepta are usually present, and that there are no mesopores.

[2] 1890, Ulrich, 'Geol. Surv. Illin.,' vol. viii, pp. 401, 402.

Polyzoa whose exterior is distinguished by the much greater distance of its cell-mouths. Belonging to one of these two species (it is not easy to say which) are sometimes found natural casts and sections. In a few instances the latter are along the centre, and these show clearly a strong cylindrical central tube or axis from which the cells arise—that is, have the distinguishing mark of *Rhabdomeson*.

The history of the genus *Rhabdomeson* is as follows:—Young and Young[1] described a Carboniferous species which they referred (with one expression of uncertainty) to Phillips's *M. gracilis* thus (*abbreviated*): "Stem slender, cylindrical, branching perpendicularly, having a hollow axis or thin calcareous tube with cells ranged round. Apertures oval in funnel-shaped depressions, divided by tuberculated ridges. Tubercles (or in good specimens spines) four, situated at the angles, with sometimes smaller between. Cells conical, turning upwards and outwards, separated at their apex by a thin wall which thickens outwardly, so that the mouths are separated by one-third the diameter of the cell-cavity. Spines solid, but showing a central pit when worn." They name the genus, but leave its characters to be inferred from the species.

That the pits in this description correspond with the subsidiary cells seen in our specimens is possible, but, it seems to me, doubtful. Unless they do, Young and Young's Carboniferous species cannot be congeneric with ours, and in any case can only retain its specific name, if ours, which is Phillips's original species, proves to belong to a different genus.

For the present it seems best to refer the Pilton species provisionally to *Rhabdomeson*, as, with the exception of this difficulty of the character of the minute pores, it is probable that it fulfils the requirements of that genus.

1. Rhabdomeson? gracile, *Phillips*, sp. Plate XXIII, figs. 11—15 *a*.

1841.	Millepora gracilis,	*Phillips.*	Pal. Foss., p. 20, pl. xi, figs. 31 *a*, *b*.
? 1874.	Rhabdomeson gracile,	*Young and Young.*	Ann. Mag. Nat. Hist., ser. 4, vol. xiii, p. 335, pl. xvi, figs. B 1—6.
? 1875.	— —	*Young and Young.*	Ibid., vol. xv, p. 333.
? 1884.	— —	*Vine.*	Report Brit. Assoc., 1883, p. 205.

Description.—Zoarium small, straight, cylindrical. Axis strong, cylindrical, about one-eighth the width of the zoarium. Cells elongate, tubular, rising obliquely from the branches at a greater or less angle, and with their vestibules recurved, so as to become approximately horizontal. Interior of cells unknown.

[1] 1874, Young and Young, 'Ann. Mag. Nat. Hist.,' ser. 4, vol. xiii, p. 335.

Surface with circular or longitudinally oval cell-mouths set in quincunx, separated from each other by intervals less than their diameters. Interspaces elevated, ridge-like, bearing nodes or acanthopores on their summits, and three or four mesopores (?) situated generally at the corners of the apertures. About three cell-mouths to 1 mm.

Size.—A specimen measures 20 mm. long and 1 mm. wide.

Localities.—Top Orchard Quarry, East Anstey, Ironpost.

Remarks.—The difficulties in describing this and the following species have been stated above, and the descriptions must be taken as tentative in some respects.

There is, I think, no doubt that this species is the original *Millepora gracilis* of Phillips. His enlarged figure accurately represents the appearance that rather worn specimens retaining the surface assume.

If the Carboniferous *Rh. gracile* of Young and Young is congeneric, that form would require a new specific name, as it is certainly not identical.

To the above description it may be added that in some of the natural cylindrical sections showing the central tube there seems a point at which the cells become horizontal, and beyond which they are set obliquely with a slope in the opposite direction to that upon the other side of it. This would appear to be a point of origin, and if so the organism would probably be free. In these specimens I have not seen any signs of branching.

Affinities.—Carboniferous specimens of "*Rhabdomeson gracile*" in the Woodwardian Museum, from Hook Head and other localities, appear to me to be totally unlike our fossils; their cells are in perpendicular ranges, their acanthopores are very prominent and bead-like, and I can see no trace of anything like mesopores. *Rhombopora dichotoma*, M'Coy, sp.,[1] and *Rhabdomeson rhombiferum*, Phillips, sp.,[2] as represented by specimens in the same Museum, seem quite different in structure from the present fossils. On the other hand, *Rhabdomeson interporosum*, Phillips, sp.,[3] appears, from its specimens, to be very much more like them; it seems to have mesopores, or at least subsidiary cells or pits of the same character as those in our fossils, and may certainly be regarded as belonging to the same genus.

[1] 1844, M'Coy, 'Synopsis Carb. Foss. Irel.,' p. 198, pl. xxvii, fig. 15.
[2] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 199, pl. i, figs. 34, 35.
[3] Ibid., p. 199, pl. i, figs. 36—39.

2. Sub-order—TREPOSTOMATA, *Ulrich*, 1882.

I. *Family*—Batostomellidæ, *Ulrich*, 1890.

1. *Genus*—Leioclema, *Ulrich*, 1882.

1. Leioclema? distans, *Whidborne*. Plate XXIII, figs. 16, 16 *a*.

1896. Rhabdomeson? distans, *Whidborne*. Proceed. Geol. Assoc., vol. xiv, p. 376.

Description.—Zoarium small, ramose, cylindrical. Zoœcia small, elongate, oval, separated from each other by interspaces considerably greater than their diameters. Interspaces apparently flat, and occupied by numerous thin-walled mesopores (?) Cell-mouths possibly covered with convex opercula (?).

Size.—A specimen measures 11 mm. long, and 1 mm. in the width of the branch.

Localities.—In the Woodwardian Museum are two slabs containing two specimens from Top Orchard, and in Mr. Hamling's Collection two slabs with two or three specimens from rocks to the north-west of the "Laticosta Cave," Croyde.

Remarks.—This species is similar in habit to *R. gracile*, but is clearly distinguished from it by its smaller and much more distant cell-mouths, and by the existence of numerous small mesopores round the larger cells, evidence of which is seen in the Woodwardian specimens, which are in the form of moulds, and which also show slight ridges dividing the cell-areas.

In the Croyde specimens, on the other hand, which retain the surface, though probably worn, the cell-mouths form small convex projections, which may perhaps mean that they were covered by opercula. In parts of the latter specimens which are worn to form rough natural sections the cells appear to be short conical tubes, rapidly curved, and enlarged in the mature part or vestibule.

In this species (assuming that sections like that shown on Pl. XXIII, fig. 15, do not belong to it) we do not appear to have any approach to *Rhabdomeson*, while it presents a general likeness to *Batostomella;* its external resemblance to *Leioclema gracillimum*, Ulrich,[1] is so strong, that it seems advisable to refer it provisionally to that genus.

The genus *Hyphasmopora*, Etheridge,[2] certainly appears to have much in common with it. Its cells are in vertical lines, separated by a cancellated network

[1] 1890, Ulrich, 'Geol. Surv. Illinois,' vol. viii, p. 429, pl. lxxv, figs. 6—6 *b*.

[2] 1875, J. Etheridge, jun., 'Ann. Mag. Nat. Hist.,' ser. 4, vol. xv, p. 43, pl. xiv, figs. B 1—4.

of irregularly formed pores, but cell-mouths are almost entirely absent from the reverse side,—a feature which does not appear from our specimens, though it is quite possible that it may exist.

II. *Family*—Fistuliporidæ, *Ulrich*, 1882.

1. *Genus*—Fistulipora, *M'Coy*, 1849.

1. Fistulipora? sp. Plate XXIII, figs. 17, 17 *a*.

? 1841. Manon cribosum, *Phillips*. Pal. Foss., p. 17, pl. ix, fig. 26.
1896. Berenicea irregularis?, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Zoarium forming a very thin expansive layer, in which no signs of attachment to other organisms have been discerned. Zoœcia short, stout, cylindrical, set perpendicularly to the face of the layer, divided by walls which, though appreciably thick, are much thinner than the diameter of the cells, and crowded together in such a way that irregular circular patterns may frequently be traced in the mass. Ten zoœcia occupying a distance of about 5 mm. Cell-mouths possibly contracted.

Size.—A specimen is 40 mm. long and more than 10 mm. wide; it seems about 1 mm. thick.

Localities.—There is a specimen in the Porter Collection from Poleshill, and another in my Collection from Saunton Hotel.

Remarks.—Of these fossils little can be said, except that they appear to be so similar in pattern to *Berenicea irregularis*, Lonsdale,[1] that it is possible that they may prove to be akin. The same irregular arrangement appears to be observable in the Silurian species. I have observed a very similar fossil in the Ilfracombe beds.

Whether they are the same as the very similar fossil which Phillips described from these beds as *Manon cribosum*, Goldfuss,[2] I am uncertain, as his figure shows a texture which, though much finer than that in Goldfuss's figure, is much coarser than that of our specimens. As I have only seen these little fossils in the condition of casts it has been quite impossible to arrive at their true character, and it therefore seems best to leave them for the present in the genus *Fistulipora*, which was formed by M'Coy "to include *Manon cribosum*, Goldfuss, and some new species."[3] One of our specimens shows vacant spots, which may, or may not, represent monticules.

[1] 1839, Murchison, 'Sil. Syst.,' p. 679, pl. xv, figs. 20, 20 *a*.
[2] 1826, Goldfuss, 'Petref. Germ.,' vol. i, p. 3, pl. i, figs. 10 *a*, *b*.
[3] 1855, M'Coy, 'Brit. Pal. Foss.,' p. 11.

2. Fistulipora? sp. Plate XXIII, figs. 18, 19.

Description.—Zoarium formed of a very thin layer encrusting crinoid stems and other organisms. About twenty-five cells in a distance of 5 mm. Cells probably opening obliquely.

Size.—A specimen measures about 20 mm. long and 10 mm. wide.

Localities.—A specimen from Frankmarsh is in the Barnstaple Athenæum, one from Barnstaple in the Woodwardian Museum, and one from Saunton Hotel in my Collection. I have observed other specimens, and it does not appear to be uncommon.

Remarks.—Whether this is more than a young stage or dwarfed encrusting variety of the last species I am unable to say. In the specimens before me the cells seem distinctly smaller and more oblique near the margins of the layer, and it therefore seems better to keep them apart, at least for the present.

ANNULOSA.

1. Order—TUBICOLA, *Cuvier* (?).

1. *Genus*—Cornulites, *Schlotheim*, 1820.

Without expressing an opinion as to the systematic position of these fossils, except offering the remark that their resemblance to *Spirorbis*, as may be seen by the figures given by Hall, seems favorable to their being placed among the Tubicolous Annelids, it may be observed that their presence in the Pilton Beds is not favorable to theory that they are "horns of Cystideans," as no Cystideans occur in these beds.

1. Cornulites devonianus, *Whidborne.* Plate XXXVII, figs. 1—3.

1896. Cornulites devonianus, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 377

Description.—Tubes conical, solitary, straight curved or irregularly flexuous, generally elongate, but occasionally short and rapidly increasing; apparently unattached. Surface (of cast) crossed by very strong annulations, which usually are broad (about three in a length equal to the width), nearly regular and in the form of consecutively truncated inverted cones, but sometimes are very irregular, close and confluent.

Size.—Length from 3 to 12 mm.

Localities.—In the Barnstaple Athenæum is a specimen from Top Orchard; in the Porter Collection five from Pilton, one from Roborough, and one from Poleshill; and in my Collection one from Pouch Bridge, one from Kingdon's Shirwell, and one from Laticosta Cave, Baggy.

Remarks.—Our specimens being chiefly casts do not show any cellular structure, and only in two cases faint signs of longitudinal striation. From their form and general character, however, there can be no doubt that they belong to the genus *Cornulites*. In the smaller specimens the annulations are, as a rule, fairly regular (though occasionally they appear to vanish over a portion of the circumference) and the shape is a very elongate cone, sometimes straight, sometimes recurved. In one or two specimens, which are larger, the annulations have become very irregular and confused, the shape is a broader cone, and there is a more rapid expansion near the mouth or broader end. I have not observed any signs of their being attached to other bodies, but it is most likely that they were so attached by the apex.

From the Silurian *C. serpularius*, Schlotheim,[1] our fossils are widely different in size and the width of their annuli, and they also appear to differ in the same respects, though in a less degree, from *C. proprius*, Hall,[2] and the other species described by him. A comparison of Hall's figures[3] is interesting, as they show that the same variations with age occurred in his species as in ours.

ECHINODERMATA.

1. Class—ECHINOIDEA, *Breyn*, 1732.

1. Sub-class—PALECHINOIDEA, *Zittel*, 1890.

1. Order—PERISCHOËCHINIDÆ, *M'Coy*, 1849.

I. *Family*—Melonitidæ, *Zittel*, 1890.

1. *Genus*—Lepidesthes, *Meek and Worthen*, 1868.

"Subspheroidal; interambulacral areas narrow, with plates imbricating from below upwards, and from the middle outwards; ambulacral areas very wide, composed of numerous small pieces scarcely differing in form, and all imbricating from above downwards, the lower edges of each lapping upon the next series

[1] 1820, Schlotheim, 'Petrefact.,' p. 378, pl. xxix, fig. 7.

[2] 1888, Hall, 'Pal. New York,' vol. v, pt. 2, Suppt., p. 19, pl. cxvi, figs. 1—21.

[3] Ibid., pls. cxv, cxvi, cxvi *a*.

below; ambulacral pores two in each piece, and nearly central. Anal opening and apical disc unknown. Jaws well developed. Entire surface ornamented with numerous very small granules of uniform size, probably for the articulation of minute spines, as in *Palæchinus*."[1]

The species described below seems so nearly to fall within the limits of the above description that in the crushed condition of our fossils it hardly seems safe to form a new genus for it at present, especially as the generic definition gathered from a single specimen of a single species may perhaps require some modification.

The chief particulars in which our species disagrees are—(1) that the interambulacral plates bear six or eight irregular small tubercles of different sizes; (2) that the ambulacral plates seem smooth; and (3) that there seem to be very numerous minute acicular spines, mixed with a comparatively few larger ones. It must here be distinctly observed that it fails to meet *accurately* the requirements, not only of the genus, but of the family.

Its imbricated plates, together with their large numbers in both areas, separate it from all the other genera of this order mentioned by Zittel except *Pholidocidaris*,[2] which differs among other things in the much larger comparative size of the adambulacral plates, and in many of the interambulacral plates bearing a large central tubercle.

Perischodomus[3] has only two rows of ambulacral plates in each area.

Hybechinus, of Meek and Worthen,[4] chiefly differs from *Lepidesthes* in having the imbrication exactly opposite, *i. e.* from above downwards in the interambulacral zones, and from below upwards in the ambulacral (so that their lower part is covered). Its interambulacral plates are rhombic instead of being hexagonal, as in our species. The granules seem very much more minute; they are not visible in the drawing of *H. spectabilis*, Worthen and Miller,[5] the type species.

1. Lepidesthes? devonicans, *Whidborne*. Plate XXIV, figs. 1—2; and Plate XXV, figs. 3 *a—f*.

1896. Lepidesthes? devonicans, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Test very large, regular, composed of very numerous plates, which are approximately equal in height and breadth. Interambulacral areas with

[1] 1868, Meek and Worthen, 'Geol. Surv. Illinois,' vol. iii, p. 522 (slightly abbreviated).

[2] 1873, Ibid., vol. v, p. 510.

[3] 1849, M'Coy, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. iii, p. 254.

[4] 1883, Worthen and Miller, 'Geol. Surv. Illinois,' vol. vii, p. 331.

[5] 1883, ibid., p. 332, pl. xxxi, figs. 5 *a—d*.

about seven rows of subhexagonal plates, which appear to be of uniform size in all the rows at the same level, and to be imbricated from below upwards. Interambulacral plates about 2 mm. in diameter, minutely granulated over their whole surface, and ornamented by (1) an irregular circle of five small unequal tubercles or warts, which have a minute perforated mamelon on a sloping elevated boss, and are bordered by a minute linear furrow or areola, and (2) several much smaller warts of various sizes. Spines very numerous (or crowded), acicular, sometimes 5 mm. long, covered with microscopic longitudinal grooves, and slightly expanded at the base, which seems to be concave with a slight median projection. Ambulacral areas with numerous (probably about seven) rows of rather smaller and narrower plates (apparently of a rather wide curvilinear polygonal shape), each of which bears close-set twin ambulacra, and which generally seem smooth, though small tubercles are observable upon a few of them. Lantern-apparatus composed of very large, smooth, wedge-shaped bones, some of which are 12 or 15 mm. long.

Size.—A flattened distorted specimen is about 120 mm. long and 55 mm. wide.

Localities.—A large flattened example (on two slabs split horizontally) from "the Pilton Beds, North Devon," is in the Museum of Practical Geology, and another (almost entirely hidden by the matrix), from Croyde, is in my Collection.

Remarks.—The best of these specimens appears to be an almost complete test, but, having been flattened and then split through the centre, the plates have become so confused that it is almost impossible to decipher it accurately, though most of its characters may be said to be nearly clear. Occasionally the hexagonal form of an interambulacral plate is evident; and their imbricating character is undoubted, though it is not so easy to be sure of the direction of the imbrication. These interambulacral plates do not all seem tuberculated, but all are granulated. Their tubercles are clear and vary in size, but they are always small: though irregularly placed, a roughly circular arrangement of the five largest may often be traced. In one part seven plates at least may be counted across the area. The ambulacral plates, again, are obscure in shape, but they appear sometimes rather broader than high, and irregularly polygonal or pentagonal, with some concave sides. They do not, as a rule, show any ornament or granulation, but in one or two cases spiniferous tubercles can be seen upon them. They evidently imbricate, and the imbrication seems probably to be in the opposite direction to that of the interambulacral plates. The ambulacra are large and very distinct, and perhaps are obliquely arranged, but this is not certain. Judging from the casts of the ambulacra, the test must have been thin. The spines, though always very small, seem to vary in length and thickness.

From the present dimensions of our crushed specimens we may conclude that the test in its original shape could hardly have been less than three inches in diameter, and possibly was considerably larger.

Affinities.—*Lepidesthes Coreyi*, Meek and Worthen,[1] differs in having much smaller and more numerous (eighteen to twenty-five) warts, which are all equal in size, both on the interambulacral and ambulacral plates. Its test also appears to have been much smaller.

II. *Family*—ARCHÆOCIDARIDÆ, *M'Coy*, 1855.

1. *Genus*—PROTOCIDARIS, gen. nov.

Interambulacral plates with a small central perforated tubercle, consisting of a minute mamelon on a base without a distinct areola or bounding ring round the base, and with five or six minute subsidiary tubercles. Spines acicular, finely striated.

The central perforated tubercles show that the species described below may be regarded as belonging to the family *Archæocidaridæ*, but the absence of a "ring or slight projection round their base" excludes it from the genus *Archæocidaris*, in which genus, moreover, the spines are (with very rare exceptions) covered with thorny points.

Neither does it appear referable to *Eocidaris*, Desor,[2] though it agrees with it in the absence of the bounding ring or slight projection. In that genus as described by Hall,[3] and in *E. Drydenensis*, Vanuxem, sp.,[4] it is stated that there is only one spine to each plate, whereas our species would seem to have had several subsidiary spines. Desor, moreover, in his original description, states the spines to be spinuliferous, whereas ours are simply striated.

In *Lepidocidaris*,[5] which appears to be a genus founded by Meek and Worthen for their *Eocidaris? squamosus*,[6] the central tubercles appear very much larger, bordered by a groove, though without a bounding rim, and surrounded on the margins of the plate by crowded granules; its spines, however, are similar in shape to ours.

There seems, therefore, only to remain the genus *Lepidechinus*,[7] with which

[1] 1868, Meek and Worthen, 'Geol. Surv. Illinois,' vol. iii, p. 525, woodcut A.
[2] 1858, Desor, 'Synopsis des Échinides Fossiles,' p. 155.
[3] 1867, Hall, 'Twentieth Rept. Regent's Univ. N. Y.,' p. 297.
[4] Ibid., p. 298.
[5] 1873, Meek and Worthen, 'Geol. Surv. Illinois,' vol. v, explan. of pl. ix.
[6] Ibid., p. 478, pl. ix, figs. 15 *a*—*g*.
[7] 1861, Hall, 'Desc. N. Sp. Crinoidea,' Preliminary Notice, p. 18.

our species may be compared. In Hall's definition of the genus and of the type species (*L. imbricatus*) no tubercles are mentioned. In his second species, *L. rarispinus*,[1] a few of the interambulacral plates bear very much elevated tubercles. The characters of these tubercles are not very evident from the description of the species, but judging from the figure it seems extremely unlikely that they tally with ours.

It therefore is most probable that its genus is distinct, although at present this can be only very imperfectly defined.

1. Protocidaris acuaria, *Whidborne*, sp. Plate XXV, figs. 1—2 *a*.

1896. Eocidaris? acuaria, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Interambulacral plates large, 4 or 5 mm. in diameter (probably sometimes hexagonal in shape), bearing a small central perforated tubercle consisting of a mamelon surmounting a boss, but without any distinct areola, and surrounded by an irregular circle of five or six minute granules or warts. Spines cylindrical, of various sizes, sometimes being more than 11 mm. long, finely striated longitudinally, but without lateral spicules, and slightly constricted above the base, which is expanded in the shape of an inverted truncated cone. Dental apparatus large, apparently more than 30 mm. in size, some of its ossicles being covered on one side with transverse, and on another with obliquely rugose, markings.

Size.—The test was probably very large, a fragmentary specimen, which shows comparatively few plates, being about 65 mm. in length.

Locality.—In the Museum of Practical Geology are three fragmentary specimens, all probably portions of a single animal, from "East of Barnstaple."

Remarks.—The only specimens of this species with which I am acquainted yield but very imperfect information about its characters. They consist of the casts of confused groups of plates and spines, the latter having helped to obscure the shape of the former. I have not recognised any ambulacral plates among them, and it is therefore probable that the ambulacral areas occupied a comparatively small portion of the test. Though the margins of the plates are for the most part obliterated, their general size and character are clear, and, with the following exception, I have not been able to recognise anything very similar to them in the descriptions of recorded species.

Cidaris lævispina, Sandberger,[2] which Desor[3] refers to *Eocidaris*, though

[1] 1867, Hall, 'Twentieth Report Regents Univ. N. Y.,' p. 295, pl. ix, fig. 10.

[2] 1856, Sandberger, 'Verst. Rhein. Nassau,' p. 382, pl. xxxv, figs. 2—2 *b*.

[3] 1858, Desor, 'Synopsis Échinides Fossiles,' p. 156, pl. xxi, figs. 18—22.

remarking that it perhaps differs generically from another species which he places beside it, seems very nearly akin to the present form, but its subsidiary tubercles are very much larger and more regularly placed.

2. Class—ASTEROIDEA, *Grey*, 1840.

1. Order—ENCRINASTERIÆ, *Bronn*, 1860.

1. *Genus*—Palæaster, *Hall*, 1852.

1. Palæaster longimanus, *Whidborne*. Plate XXVI, figs. 1—4; and Plate XXIX, fig. 3.

1896. Palæaster longimanus, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 376.

Description.—Upper surface of body of medium size, convex, without any expanded disc, and with five very long slightly tapering arms. (Madriporiform tubercle unobserved.) Surface covered with polygonal or subquadrate tesselated plates, each bearing a large rounded central tubercle. Plates arranged in from seven to five longitudinal rows on the arms, the central row being the largest, and the lateral rows smaller, the plates gradually diminishing from the centre.

Under surface having narrow transverse ambulacral plates with large grooves, bounded by a row of large transverse adambulacral plates which alternate with a row of smaller marginal plates.

Oral plates small, triangular. Arm-plates in more than fifty transverse rings.

Size.—Length of a single arm about 20 mm.; hence the animal, if regularly expanded, would measure about 35 mm.

Localities.—In the Museum of Practical Geology are four specimens labelled "Park, near Braunton," "Braunton Down," "Baggy Point," and "North Devon." In the Woodwardian Museum are two specimens from Top Orchard; in the Porter Collection one from Pilton; and in my Collection one from Top Orchard.

Remarks.—I have repeatedly searched these specimens, which are all casts, for a madriporiform body, but, probably from their state of preservation, have not been able to discover anything resembling one. The external skeleton of the arms seems generally to consist of a large central plate, having on each side a smaller proximate plate, three very small lateral plates, a larger marginal plate, and a still larger transverse adambulacral plate, so that the ring is composed normally of thirteen rows, but occasionally an additional row seems to be present. The shape of the plates of the body and back, their bevelled margins, flat surfaces, and large central oval bead-like tubercles are well shown in one of the specimens in the Museum of Practical Geology. The oral plates are not distinct; they are probably either very small, or have their surface divided by a depression. The arms seem unusually long for this genus; in two of the specimens (Pl. XXVI, fig. 4, and Pl. XXIX, fig. 3) the arms appeared at first sight shorter and more conical, but a slight development of the specimens (after they had been drawn) showed that their arms were really longer than at first appeared, and there seems little doubt that their semblance of shortness is due to their being twisted and covered with matrix.

Affinities.—The length of the arms and the much fewer number and larger size of the rows of plates appear to distinguish this species from *P. asperrimus*, Salter.[1] From *P. coronella*, Salter,[2] it seems separated by the absence of a corona, and from *P. obtusus*, Forbes, sp.,[3] and *P. Ruthveni*, Forbes, sp.,[4] by the character of the ornament. Most if not all of the species of *Palæaster* described by Hall[5] in his Twentieth Annual Report are distinguished by the much greater shortness of the arms.

Asterias asperula, Ferd. Römer,[6] seems, on the other hand, to be still slighter in shape, and to have relatively longer arms. From its state of preservation the figures are not easily compared with ours, but the description indicates that there were two alternating central rows of plates instead of a single large central row, as in the present species.

The arms of *P. Caractaci*, Salter, are much shorter, and the surface arrangement quite different.

2. Order—EUASTERIÆ, *Zittel*, 1895 (= Asteriæ veræ, *Bronn*).

1. *Genus*—Medusaster, *Stürtz*, 1890.

1. Medusaster parvus, n. sp. Plate XXXVII, fig. 4.

Description.—Animal minute, with a large round disc and sixteen arms. Disc rather thick, flatly cushion-shaped, and apparently covered by numerous large nodular plates. Angle-ossicula apparently very large and long, leaving in the cast long triangular ridges, which extend from the point of junction of the bases

1 1857, Salter, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. xx, p. 325, pl. ix, fig. 1.

2 Ibid., p. 326.

3 1849, E. Forbes, 'Mem. Geol. Surv.,' Decade 1, p. 2, pl. i, fig. 3.

4 Ibid., p. 1, pl. i, fig. 1.

5 1867, Hall, 'Twentieth Ann. Report Regents Univers. N. Y.,' p. 283, pl. ix, figs. 1—4.

6 1863, Ferd. Römer, 'Palæontographica,' vol. ix, p. 146, pl. xxiv, figs. 1—5; pl. xxvi, fig. 6; and pl. xxvii, fig. 1.

of the arms almost half-way to the centre of the disc. Arms rather longer than the width of the disc, slight, composed of rows of few long and level ossicula, bearing on each side at long regular intervals a single large, long, thorn-like spine (which in the fossil is occasionally bent, possibly from accidental causes).

Size.—Total width of specimen 8 mm. (If perfect and untwisted it probably would measure 9 or 10 mm.) Disc 2·5 mm. Arms between 3 and 4 mm. long.

Locality.—A single specimen from north-east of Harford Landkey is in Mr. Hamling's Collection.

Remarks.—It was only after the description of the last species was in print that I found this interesting little fossil in a slab sent to me by my friend Mr. Hamling. Though minute, and in such defective preservation that it is impossible to make out the arrangements of its plates, it is sufficiently clear to leave no doubt whatever as to its general character. Its sixteen arms can be definitely counted, and the few long distant spines that margin them are evident, though sometimes they seem curiously bent. The plates of the arms have the appearance of being remarkably long.

Affinities.—This species appears to be congeneric with *M. Rhenanus*, Stürtz,[1] but is distinguished from it by its small size, its much larger disc, its more numerous arms, and several other particulars.

Helianthaster Rhenanus, Ferd. Römer,[2] is very much larger, its disc is relatively smaller, the plates of its sixteen arms more numerous and differently arranged, and the spines much more numerous.

3. Class—OPHIUROIDEA, *Wright*, 1857.

1. Order—OPHIUREA, *Zittel*, 1879.

I. *Family*—Ophio-encrinasteriæ, *Stürtz*, 1886.

1. *Genus*—Protaster, *Forbes*, 1849.

Stürtz[3] and Dr. Gregory[4] have both pointed out that various species, differing in important particulars from each other, have been referred to this genus, and that it greatly needs revision. While, therefore, until this be done, it may be necessary still to refer species of unlike aspect to it, it is best to remember that neither *P. Miltonii*, Salter, nor *P. Forbesii*, Hall, nor *P. brisingoides*, Gregory,[4] but

[1] 1890, Stürtz, 'Palæontographica,' vol. xxxvi, p. 229, pl. xxxi, figs. 34, 35.
[2] 1863, Ferd. Römer, 'Palæontographica,' vol. ix, p. 147, pl. xxviii, fig. 1.
[3] 1886, Stürtz, 'Palæontographica,' vol. xxxii, p. 79.
[4] 1889, Gregory, 'Geol. Mag.,' Decade 3, vol. vi, p. 24, woodcuts 1—4.

P. Sedgwickii, Forbes, is the type of the true genus *Protaster*, from which the superfluities will have to be removed.

1. Protaster granifer, *Whidborne*, sp. Plate XXVI, figs. 5, 5 *a*, 6, 6 *a*.

1896. Eugaster granifer, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Animal with a moderately large pentagonal disc, and rather long arms, which are slightly fusiform at first, and then taper very slowly to a distant extremity. Upper surface of disc marked by a large impressed stellate corona, which is bounded by elevated sides, and is about half the width of the disc in diameter. Upper and lower surface of disc and upper surface of arms covered with an integument composed of minute convex scales, irregularly scattered among still more numerous and minute granules. Mouth apparently small and central. Oral or buccal plates apparently large, deep, and elongate. Upper surface of arms having (1) two central alternating rows of transverse sub-hexagonal plates, divided transversely by a linear groove, and (2) an alternating lateral row of slightly convex squamose or imbricating plates, at the lower margins of each of which are situated one or more short, broad, ovate, slightly curved spines. Under surface of arms with two alternating rows of narrow ambulacral plates, excavated on their outer margins by pores, which are outwardly enclosed by a row of obliquely protruding adambulacral plates, at the outer or lower extremities of which the spines are situated.

Size.—A nearly perfect, but perhaps slightly elongated, arm measures 50 mm. The size of the expanded animal was therefore probably about 90 mm.

Localities.—In the Museum of Practical Geology is a very fine specimen (seen as casts of the upper and lower surfaces) from "the Pilton Beds of North Devon."

Remarks.—Casts taken from the under surface of this specimen and from the under surface of specimens of *Protaster Sedgwickii*, Forbes,[1] in the same Museum appear accurately to agree in all points of the arrangement of the arms and plates. The arrangement of the buccal plates appears also to be similar. Hence, as *P. Sedgwickii* is the type of the genus, it appears that this is a species of *Protaster*, in spite of the disc having a pentagonal form more in the shape of that of the genus *Eugaster*, Hall.[2]

From *P. Sedgwickii* it differs in the large size of the corona and many other minor particulars.

[1] 1849, Forbes, 'Geol. Surv.,' Decade 1, p. i, pl. iv, figs. 1—4.

[2] 1867, Hall, 'Twentieth Report Regents University, N. Y.,' p. 290.

2. Protaster ? (Drepanaster) scabrosus, *Whidborne.* Plate XXIX, figs. 1—2 *a*.

1896. Protaster scabrosus, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Animal small, with long, narrow, regularly tapering arms. Disc probably one-fourth or one-fifth the width of the expanded animal, subcircular, covered on its dorsal surface with comparatively large squamiform overlapping plates, which appear to be subquadrate in shape. Dorsal surface of arms covered with similar, but smaller, squamiform plates. Ventral surface of arms with (1) a double median row of ambulacral plates, excavated at their outer ends by moderately large pores, and (2) a marginal row of elongate arching adambulacral plates, whose proximal ends in part bound these pores, and each of which bears a group of two or three spines. Buccal plates (ten ? paired) apparently rather large, giving, in the cast, the appearance of a short-rayed star on the under side.

Size.—A specimen with twisted arms measures 22 mm. One of the arms is about 20 mm. long, so that the expanded animal probably measured about 37 mm. across.

Localities.—There is a good specimen from Croyde in the Barnstaple Athenæum, and another from Braunton Down in the Museum of Practical Geology.

Remarks.—It is to be observed that the ambulacral plates in this species distinctly alternate. This appears to be consistent with Forbes's original definition of the genus *Protaster ;* though, from Salter [1] having described them in *P. Miltonii* as level (by way of exception), Hall and others seem to have come to regard this as a generic character—Hall, however, questioning it, as in *P. Forbesii*, Hall,[2] they slightly alternate. It appears to me, however, that for various other reasons, *P. scabrosus,* together with *P. Forbesii*, with which it appears to be congeneric, will have to be separated from the genus *Protaster* as defined by Forbes ; from the shape of its adambulacral plates it might perhaps bear the name of *Drepanaster*.[3]

3. Protaster ? (Drepanaster) scabrosus, var. Plate XXVII, figs. 1—3 ; and Plate XXVIII, figs. 1—2 *b*.

Description.—Animal small, five-rayed. Disc large, circular, covered with very small plates. Rosette large, subpentagonal. Arms long, rather stout at the base, regularly and rather rapidly tapering, and having on their under side a double alter-

[1] 1857, Salter, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. xx, p. 330, pl. x, figs. 4—4 *c* (cf. p. 325, where "*Protaster*, nov. gen.," is evidently a misprint).

[2] 1867, Hall, 'Twentieth Report Regents University, N.Y.,' p. 293, pl. ix, figs. 5, 6.

[3] *Δρέπανον*, a sickle.

nating row of stout ambulacral plates (probably thirty in number) excavated on their outer margins by large round pores, which are bounded outside by elongate, curving or bent, adambulacral plates. Surface of plates minutely granulated. Oral plates large, wedge-shaped, paired into close connection at their apices.

Size.—An arm measures 28 mm., so that the expanded animal must have measured about 50 mm.

Localities.—In the Museum of Practical Geology are three specimens from Croyde, and one (cast and reverse) from North Devon; in Mr. Hamling's Collection one (cast and reverse) from Top Orchard Quarry; and in the Porter Collection an indistinct specimen from Fremington.

Remarks.—While these specimens have much resemblance to those last described, several dissimilarities are to be noted in them. Thus the disc (usually very indistinctly seen) appears much larger and covered by much smaller plates, the rosette seems larger, the arms stouter and more quickly tapering, and the ambulacral plates much broader. In some of the specimens the adambulacral plates appear to have been pushed out of place. At the same time it does not seem certain, in the defective state of our specimens, how much real value these dissimilarities have,—whether they are partly caused by their imperfection, or are indicative of a specific difference. It has seemed advisable, therefore, to keep them separate for the present, as an unnamed variety of the former species.

2. *Genus*—Eugaster, *Hall.*

1. Eugaster ? perarmatus, *Whidborne*, sp. Plate XXVII, figs. 4—6 *a*.

1896. Protaster perarmatus, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Animal large. Upper surface of the plates of the disc and arms minutely granulated. Arms very stout, rather rapidly tapering, covered on the upper surface by a median row of broad, convex, subhexagonal plates (which seem slightly to imbricate inwardly) alternating on each side with a row of still wider subpentagonal plates, which in their turn are followed by a row of smaller plates on the perpendicular sides, bearing at their lower extremities long lateral spines at the rate of two or three to each plate. Spines thorn-like and probably about the width of the arms in length. Under side with a double row of level ambulacral plates, succeeded on each side by a row of narrow adambulacral plates, which are separated from the former by very large transverse hexagonal excavations, of which probably only the outer portions are occupied by the pores themselves.

Size.—A small portion of an arm is 30 mm. long; another is 10 mm. across. Though the specimens are too fragmentary to convey much idea of the size of the animal, it is clear that it must have been considerably larger than any of the accompanying species.

Localities.—In the Museum of Practical Geology are confused masses of the arms of two animals (in three specimens) from Braunton Down. In the Porter Collection are two fragmentary portions of another animal and a third specimen from Pilton.

Remarks.—Though these specimens are too fragmentary or confused for full description, their very large size, the stoutness of the arms, and the shape and arrangements of the plates, both above and below, show that they belong to a species quite distinct from the other star-fishes of these beds—so distinct, indeed, that it must probably be removed from the genus *Protaster.* The arrangement of the lower side of their rays appears, as far as can be seen, to have much in common with that of Hall's genus *Eugaster*, but the plates appear not to alternate but to be perfectly level.

II. *Family*—Ophiuridæ, *Agassiz*, 1835.

1. *Genus*—Ophiurella, *Agassiz*, 1835.

1. Ophiurella ? gregaria, *Whidborne*, sp. Plate XXVIII, fig. 3.

1896. Protaster gregarius, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Animal small, with five very long slight arms, which taper very slowly to a very acute termination. Disc circular? with a finely granulated surface, occupied almost entirely by ten very large, curved, paired, radial plates, which form a prominent petalloid corona. Arms composed of about forty rings of squamose plates in distinctly level rows; these rows consisting on the dorsal face of a prominent, apparently indented median row, and a row on each side, the plates of which appear to have a triangular depression and to bear a series of four or five small obliquely set comb-like spines. Ambulacral plates large, level, margined by a large circular pore.

Size.—An arm (probably wanting a few terminal joints) is more than 25 mm. long.

Locality.—In the Museum of Practical Geology is a slab, containing the remains of numerous specimens, from Braunton Down.

Remarks.—This species is distinguished from the accompanying forms by its prominent corona, the character of its plates, the absence of alternation in the rows of plates, and the extreme length and tenuity of its arms. From the mode of their occurrence, however, the specimens may possibly be the immature state of some other form known or unknown. It has been very difficult to distinguish between the upper and lower faces of the arms, which probably very closely resemble each other in general appearance.

Among British Palæozoic starfish this species seems most nearly to resemble *Protaster leptosoma*, Salter,[1] both on its upper and under surfaces, but in that species the central pentagon is smaller and the shape still slighter. Comparing these two species with *Furcaster palæozoicus*, Stürtz,[2] it seems probable that they may be members of the same group. Moreover, Mesozoic species referred by Wright[3] to *Ophiurella* seem sufficiently similar to make it possible they may be congeneric, while a Devonian species *O. primigenia* is referred to *Ophiurella* by Stürtz.[4] Again, the figures of *Ophiura rhenana*, Stürtz,[5] show details which might correspond with the indications seen in our less well-preserved fossil. On the whole it may be well to leave it temporarily in the genus *Ophiurella*, to which, even if not actually belonging, it probably is nearly allied. It certainly has nothing to do with *Protaster*.

4. Class—BLASTOIDEA, *Say*, 1825.

1. Order—REGULARES, *Etheridge* and *Carpenter*, 1886.

I. *Family*—Pentremitidæ, *d'Orbigny*, 1852.

The species described below appears to fall within this family (as amended by Etheridge and Carpenter) from (1) possessing, as far as can be judged, minute irregularly rhombic deltoids, which occupy the extreme summits of the inter-radial sinuses, and (2) the spiracles being apparently situated in the oral space beyond the deltoids and not within their margins, the ambulacra being rather broad, and hydrospire-slits not being exposed outside them.

With regard to its generic position, it may be noted that its ambulacra are very long and are broader than the intervening sinuses. Its shape too, as far as can be seen, is more or less a prolate spheroid; but in none of our specimens

[1] 1857, Salter, 'Ann. Mag. Nat. Hist.,' ser. 2, vol. xx, p. 331, pl. ix, fig. 5.

[2] 1886, Stürtz, 'Palæontographica,' vol. xxxii, pl. viii, p. 79, figs. 4—5 *a* ; and 1890, ibid., vol. xxxvi, p. 214, pl. xxxi, figs. 40, 40 *a*.

[3] 1866, Wright, 'Brit. Foss. Echinod. Oolitic Form.,' vol. ii, p. 154, pl. xviii, figs. 3 *a*, *d* ; and p. 154, woodcut 40.

[4] 1886, Stürtz, 'Palæontographica,' vol. xxxii, p. 77, pl. viii, figs. 1—2 *a*.

[5] 1893, Stürtz, 'Verh. n. h. Vereins Preuss. Rheinl.,' vol. l, p. 7, pl. i, figs. 1—3.

is the base visible, though enough of the radial plate is seen to show that the basal parts were probably at least slightly extended beyond the extremities of the arms.

It seems to differ from most species of *Pentremites* by the narrowness and arrangements of its arms; from most species of *Pentremitidea* by the length of its sinuses, and from most species of *Mesoblastus* by the width of its arms, the apparent shape of its spiracles, and the probable presence of an under-lancet-plate. On the whole there seems to be least difficulty in assigning it for the present to the genus *Pentremitidea*, but this must only be regarded as a provisional arrangement until the discovery of specimens sufficiently perfect to decide the point.

1. *Genus*—PENTREMITIDEA, *d'Orbigny*, 1849.

1. PENTREMITIDEA PHILLIPSII, n. sp. Plate XXIX, figs. 5, 5 *a*, 6.

1841. PENTREMITES OVALIS, *Phillips* (not *Goldfuss*). Pal. Foss., p. 29, pl. xiv figs. 40 *a*, *b*.
1886. *Etheridge and Carpenter.* Catal. Blast. Brit. Mus., p. 129.

Description.—Calix probably more or less prolately spheroidal; summit flatly convex, broad; base unknown. Ambulacra (*i. e.* ambulacral areas) moderately broad, rather rapidly tapering, extending very far down the calix. Radial plates very large; bodies convex, much shorter than the limbs. Limbs very long. Interradial sinuses elongate, lanceolate, with sharp raised margins, not reaching far into the summit, and slightly narrower on the whole than the ambulacra. Deltoids indistinctly seen, very small, apparently irregularly rhombic. Spiracles apparently subcentral, undivided by septa, situate above the tops of the deltoids. Lancet-plate exposed, with a central groove and with rather distant branches, both being margined with long and coarse crenulations (which seem also to extend to the side-plates). Side-plates squarish.

Three or four hydrospire-folds seen at the distal extremity of one of the ambulacra, probably exposed by the breaking off of part of the under-lancet-plate, which appears to cover all the area between the side-plates. Radials marked with microscopic rounded lineations, slightly radiating towards the sides of the interradial sinus.

Size.—A specimen appears to be about 7 mm. long.

Localities.—In the Barnstaple Athenæum is a specimen from Strand, Ashford, and another from Bradiford; and in my Collection is one from Wrafton Lane.

Remarks.—These specimens are all fragmentary, and consequently it is very difficult to make out the character of the species from them, or from the figure of Phillips's equally defective specimen, the original of which appears now to be lost. At the same time their resemblances to each other are so close that there can be no doubt that all four fossils belong to the same species.

(1) The Strand specimen is the largest. It is an inside cast. It appears to show a radial with the included ambulacrum, and (?) a deltoid (the division, however, of which from the radial is very indistinct) and the beginning of an adjoining ambulacrum. The hollows for the side-plates (and casts of the pores ?) are visible.

(2) The Bradiford specimen is the cast of a single ambulacrum. It shows the median food-groove and its side-branches; the coarse crenulations upon them are very evident; the shape of the lancet-plate is perhaps discernible.

(3) The Wrafton Lane specimen is the mould of parts of the summit, of three ambulacra and of two radials. There seem to be signs of two spiracles. The impressions of the ambulacra seem very perfect, and show their median groove and branches, the side-plates (the marks on which are not easy to decipher), and the hydrospire pores. There are also seen two deltoids (very indistinctly) and one interradial sinus, the surface-ornament and the raised sides of which are very evident.

(4) Phillips's specimen appears to be lost. In his figure the ambulacra seem slightly broader and more triangular. The structure shown in his enlarged drawing may be either a deformity or an indication of the appearance which, in some lights, the ambulacra from our Wrafton Lane specimen assume. He describes "the general figure" as "oval, attenuated at the base," but does not show the shape of the base in his drawing.

Phillips identified his specimen with *Pentremites ovalis*, Goldfuss.[1] The resemblance, as far as the figures can be compared, is certainly considerable. In the German figure, however, the ambulacra are broader and slightly more petaloid, the side-branches are longer, narrower, and much more numerous, the interambulacral areas are more triangular and acute, and do not extend quite so high, and the ornament of these areas, though similar, is coarser. Thus Goldfuss's fossil comes nearer to Etheridge and Carpenter's definition of the genus *Pentremites* as restricted by them, and though it is not absolutely proved to be different from our English species, there is the greatest probability that it is so, not only specifically but generically. Moreover it is said to have come from a Carboniferous quarry, though from beds in it which Professor Ferdinand Römer thought might possibly be Devonian. Under these circumstances it does not seem desirable to retain the German name for our Pilton fossil.

[1] 1826-33, Goldfuss, 'Petref. Germ.,' vol. i, p. 161, pl. l, fig. 1 *a*—*c*.

II. *Family*—Codonasteridæ, *Etheridge and Carpenter*, 1886.

1. *Genus*—Codonaster, *M'Coy*, 1849.

1. Codonaster conicus, n. sp. Plate XXIX, figs. 4, 4 *a*.

Description.—Calix very elongate, subfusiform. Base apparently trilobate. Summit very gently convex. Radial plates nearly half as long again as the basal, and separated from them by a slightly zigzag suture. Section of upper parts of the calix distinctly pentagonal, apparently becoming slightly stellate at the summit. Upper margins of the interradial sinus forming a very low triangle. (Shape of deltoid plates unobserved.) Ambulacra apparently moderately narrow, short, curving gently downwards near their distal ends. Deltoid plates apparently bearing a strong ridge along their centre. Anus semicircular, situated very near the centre? Hydrospire-slits few and coarse.

Size.—Length about 6 mm., width about 3 mm.

Locality.—A single specimen (with part of its mould) from Top Orchard Quarry is in the Woodwardian Museum.

Remarks.—This little specimen is crushed, and being in the state of preservation usual in these beds its details are indistinct. This is especially the case at its summit, where not only is it squeezed together but its surface has been mostly carried away with the mould. From its general shape, however, and what indications of its structure remain, there seems no reason for doubt that it belongs to the genus *Codonaster*. The spaces in the ambulacra seem very few and coarse, indications of three or four of them being seen. Three or four ridges (more or less parallel) outside some of the ambulacra, where the surface is broken away, appear to be the upper part of the hydrospire-slits. Remains are seen of a circular or semicircular wall round the central area, and there is a round pit, which may be the anus. The upper margins of the interradial sinuses are defective, but they appear to have been elevated into low triangles and probably to have been bent obliquely inward at the summit. Five short coarse radii, dividing the interradial areas on the summit, appear to be the ridges on the deltoid plates.

Affinities.—From the Carboniferous *C. trilobatus*, M'Coy[1] (which, including *C. acutus*, M'Coy,[1] is the only described English species), our Pilton form is totally different in shape; but to the Upper Devonian *C. Hindii*, Etheridge and Carpenter,[2]

[1] 1849, M'Coy, 'Ann. Mag. Nat. Hist.,' vol. iii, p. 251.

[2] 1886, Etheridge and Carpenter, 'Catal. Blastoid. Brit. Mus.,' pp. *passim*, pl. xii, figs. 4—7.

its likeness is very great indeed, both in general appearance and as far as can be seen in the arrangement of the ambulacra. In form, however, it distinctly differs in being still more elongate; while (though it is not possible to speak positively) it also appears more stellate in the shape of its summit and has wider ambulacra.

Its similarity to an American species of equivalent age is interesting.

5. Class—CRINOIDEA, *J. S. Miller,* 1821.

1. Order—FLEXIBILIA, *Zittel*, 1895.[1]

I. *Family*—Ichthyocrinidæ, *Wachsmuth and Springer*, 1879.

1. *Genus*—Taxocrinus, *Phillips* (apud *Morris*), 1843.[2]

1. Taxocrinus macrodactylus, *Phillips*, sp. Plate XXXIII, figs. 2—4 *a*.

1841. Cyathocrinus? (Isocrinus) macrodactylus, *Phillips*. Pal. Foss., pp. 29, 30, pl. xv, figs. 41 *a*—*g*.
1843. Taxocrinus macrodactylus, *Morris*. Catal. Brit. Foss., p. 90.
1879. — — *Wachsmuth and Springer*. Proc. Acad. Nat. Sci. Philad., 1879, p. 272.

Description.—Column cylindrical, expanding considerably in the immediate proximity of the cup. Columnars rather short, alternating, becoming gradually very short as their diameter increases, having milled faces, and, as a rule, flat lateral margins, though occasionally at some distance from the cup some joints occur with convex margins. (Under basals unobserved). Basals five, very narrow, triangular. Radials five, very large, transversely quadrate. Primibrachs 5 × 3 (or sometimes 2?), similar to the radials except the uppermost, which is pentagonal and axillary. Secundibrachs 10 × 5, similar to the primibrachs but smaller. Succeeding series of brachials similar but progressively smaller and slightly more numerous in their rows, there being five or six series of brachials in all. Arms uniserial, sometimes curling in at their extremities. No interradials visible.

Size.—Phillips's type specimen measures 88 mm. from the bottom of the cup to the curled extremities of the arms.

Localities.—In the Museum of Practical Geology are one of Phillips's type specimens from Pilton and five other specimens from North Devon; in my

[1] Cf. 1898, F. A. Bather, 'Geol. Mag.,' Decade 4, vol. v, p. 324.
[2] Cf. 1879, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1879, p. 270.

Collection is a specimen of the stem, showing its expanded proximal end, from Ashhill Quarry; and in the Porter Collection are two specimens from Fremington.

Remarks.—The specimens are all obscure about the base of the dorsal cup. The shape of the basals is clearly seen from the mould, though their number is only gathered by inference.

It seems probable that Phillips's figure, 41 *c*, does not belong to this species.

Affinities.—*Taxocrinus nobilis*, Phillips, sp.,[1] seems remarkably similar. Its arms appear relatively stouter, and Phillips[2] distinguishes it by the fewer rows of plates in its upper series of brachials (*i. e.* by the more rapid branching of the arms). It also shows interradials, of which our specimens give no sign.

2. Taxocrinus stultus, *Whidborne.* Plate XXXIV, figs. 1—3.

1896. Taxocrinus? stultus, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Stem rather stout, cylindrical, not perceptibly expanding near the cup. Columnars with convex or bead-shaped outer margins, arranged, at some distance from the body, in an alternating series of long and medium-sized, between very short, segments, but becoming uniform and increasingly short in the proximity of the cup. Edges crenulated, especially near the cup. Under basals (apparently) three, very narrow, flatly pentagonal, visible externally. Basals five, small, transverse, and pentagonal, except the one on the anal side, which appears to be considerably larger and higher than the rest, intruding between the radials and truncated on the top, and followed by a longitudinal row of two or three small anal plates. Radials large, squarish or inversely pentagonal, in contact, except, perhaps, at their upper corners and on the anal side. Primibrachs 5×3, similar in size and shape to the radials except the uppermost plate, which is pentagonal. Secundibrachs rather smaller but similar to the primibrachs, and in rows of five or six. Upper series of brachials indistinctly seen in the specimens, but possibly short and few, and inclined to curl inwards. Under side of arms perhaps rather convex, with a very small concave groove.

Size.—A specimen of the cup and arms (their extremities perhaps unseen) is 20 mm. high.

Localities.—In the Porter Collection is a specimen (obverse and reverse) from Pilton, and another from Poleshill. In the Barnstaple Athenæum is another from Roborough.

[1] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 205, pl. iii, fig. 40.

[2] 1841, Phillips, 'Pal. Foss.,' p. 30.

Remarks.—This little species appears to fall well within the limits of the genus *Taxocrinus* as restricted by Wachsmuth and Springer. It is distinguished from *T. macrodactylus* by various points, among others by the proximate columnars being much higher and being uniform in diameter. The arms also seem relatively much stouter.

Close examination has proved the short synopsis of the species which I originally gave to be incorrect; the plates in the best of the specimens are very difficult to distinguish, and it was only by tracing them out plate by plate that their true relationship, as seen in the opposite halves of the fossil, could be ascertained.

2. Order—CAMERATA, *Wachsmuth and Springer*, 1885.

I. *Family*—Rhodocrinidæ, *F. Römer*, 1855.

1. *Genus*—Rhodocrinus, *J. S. Miller*, 1821.

1. Rhodocrinus?, ? sp. Plate XXXI, figs. 3—3 *d.*

Size.—A distorted cup measures 25 mm. by 12 mm. in transverse sections, and the accompanying arm is 60 mm. long.

Localities.—In the Museum of Practical Geology is a specimen (with its reverse) from North Devon of a flattened dorsal cup with some expanded arms; and in the Woodwardian Museum from south-west of Sloly is the broken base of another cup, which may, from its somewhat similar ornamentation, possibly belong to the same species.

Remarks.—Though the first of these specimens is not in a condition to permit its identification, it appears distinct from any of the accompanying Crinoids. The dorsal cup is large, and was probably deeply conical or subglobose, and composed in large part of hexagonal plates arranged something in the style of *Actinocrinus;* but it is now so much flattened and cloaked by matrix that few of its plates can be seen, and their exact arrangement cannot be traced. The plates that are visible seem small and numerous, and they are marked with coarse nodules having a stellate arrangement. From the margins of the cup a number of very slender and long arms take their rise. Signs of only eight or ten of these arms remain, but it appears probable that there were originally twenty, of which ten were small and did not bifurcate, and ten were larger. These larger arms have more than five rather narrow uniserial plates before their first bifurcation, after which the plates become cuneate, and at last definitely biserial, and the arms do not appear to branch again. The greatest portion of these longer arms is clothed by exceedingly fine and elongate, close-set, hair-like pinnules, with ten or fifteen long segments, so that they have much the appearance of a feather from a bird's tail. These arms are totally different in general aspect from those of *Actinocrinus Porteri.*

Mr. Bather, who has kindly examined the specimen, expresses the arm-formula thus:

$$\overline{\text{I Br.}}\text{—II Br.—}\left\langle\begin{array}{l}\text{thick III Br.—IV B. (F.)—pinnules.}\\ \text{thin III Br. (F.)—? pinnules.}\end{array}\right.$$

To what genus this fossil belongs is most uncertain. There seem some slight grounds for supposing that it might belong to *Rhodocrinus*, and therefore with much hesitation I have placed it tentatively there.

II. *Family*—Batocrinidæ, *Wachsmuth and Springer*, 1897.

1. *Genus*—Megistocrinus, *Owen and Shumard*, 1852.

1. Megistocrinus ?, sp. Plate XXXVII, fig. 5.

Remarks.—In the Woodwardian Museum, from Barnstaple, is the imperfect cast of the dorsal cup of a Camarate Crinoid which measures about 10 mm. wide, and which appears to be distinguished from *Actinocrinus Porteri* by the much more uniform size of its plates.

In this specimen (taking a single ray) the lowest plate seen appears to be a radial, which, however, is almost destroyed; this is followed by a small hexagonal first primibrach, and this by a similar sized, polygonal, axillary primibrach. This, again, is followed by two pairs of hardly smaller secundibrachs, the first hexagonal, the second axillary; and between these are three or four small inter-axillary plates. The interambulacral plates in the adjoining area (which may be an anal area ?) are very numerous; there seem three in the second row, and four in the third and fourth rows.

It seems, as far as can be judged, sufficiently like a *Megistocrinus* to be placed tentatively in that genus.

III. *Family*—MELOCRINIDÆ, *Zittel*, 1880.

1. *Genus*—MARIOCRINUS, *Hall*, 1859.

To what genus the following species belongs seems very doubtful. Being monocyclic with four basals and *presumably* without an anal in the radial ring, it is however, excluded from *Melocrinus* by its uniserial arms, and their mode of branching.

The Silurian genus *Mariocrinus*[1] perhaps presents the least difficulty. According to Wachsmuth and Springer it differs from *Melocrinus* in having uniserial arm-plates. Some of its arms, however, are stated to be simple, whereas those of our fossils probably all fork once a long way up. The number of plates, moreover, which are contained in the cup in our species seems very much fewer.

1. MARIOCRINUS? MUNDUS, n. sp. Plate XXXIV, fig. 5? and Plate XXXVII, figs. 6, 7.

Description.—Stem round, very long, consisting of rather long, uniform, rather convex columnars in the lower parts, which become very short and more convex near the cup, the uppermost joint being apparently formed only halfway round. Margins of columnars very strongly crenulated. Dorsal cup elongate, vasiform. Basals four, about as long as their width. Radials five, very large, hexagonal or heptagonal, longer than wide, with flat upper margins. First primibrachs much smaller than the radials, pentagonal, axillary. Secundibrachs slightly smaller than the primibrachs, pentagonal, included within the cup, bearing two arms. Interambulacral plates (in one observed area), one resting on the shoulders of two radials, and about the same size as and at rather a lower level than the first primibrachs, hexagonal, bearing on its shoulders two much smaller interambulacrals of the second row. Anal side unobserved. Arms twenty ? uniserial, apparently short (about one and a half times the length of calix), tapering, composed of alternating wedge-shaped plates, bifurcating at about the fifteenth joint, and without any visible signs of pinnules.

Size.—A specimen with stem and arms measures about 110 mm., the cup being about 7 mm., and the arms 14 mm.

Localities.—A single specimen from Croyde Rocks is in my Collection; and in the Barnstaple Athenæum is a doubtful specimen from Braunton (Pl. XXXIV, fig. 5) showing a few plates of the cup and parts of the stem and arms, which possibly may belong to the same species.

[1] 1881, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1881, p. 288.

Remarks.—The Croyde specimen possesses the customary indistinctness of our fossils, for though both sides of the mould and the central cast are preserved, the cup is much distorted, and each side of it is obliterated. Hence its plates cannot be perfectly traced; and, particularly, it seems a little doubtful whether the first primibrachs are axillary, so as to produce twenty arms instead of ten; *i. e.* whether the following series of plates are second primibrachs or secundibrachs. The exposed face shows five arms, but their junction with the cup is obscure.

In the Athenæum specimen the stem is slight and round, and apparently bears a few fine cirrhi, and (some distance from the cup) every eighth columnar seems enlarged. In the cup a vertical row of five or six small polygonal plates may be traced, which may be a basal, a radial, and one or two primibrachs and secundibrachs, but there are too few plates shown to make their characters clear. The arms are comparatively much larger and more massive, uniserial, formed of rather long plates, clothed with rather sparse pinnules, and bifurcating some six or eight plates up. Its identity with the former specimen is very doubtful.

IV. *Family*—Actinocrinidæ, *F. Römer*, 1855.

1. *Genus*—Actinocrinus, *J. S. Miller*, 1821.

1. Actinocrinus Porteri, *Whidborne.* Plate V, fig. 21; Plate XXX, fig. 8; Plate XXXI, figs. 1, 1*a*, 2, 5; and Plate XXXII, fig. 1.

1896. Actinocrinus Porteri, *Whidborne.* Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Column long, round, with short alternating or doubly alternating segments. Larger columnars with a large prominent squared central band occupying more than half of their flat peripheries, and with about thirty-five rather stout submarginal radiations on their articulating surfaces. Central canal petaliform in section, dumb-bell-shaped between the sutures.

Calix large. Basals three (?), very narrow, hexagonal. Radials five, moderate in size, hexagonal. First primibrachs similar to the radials, but rather smaller. Second primibrachs rather smaller than the first, pentagonal. Secundibrachs 10 × 1, smaller than the primibrachs, pentagonal. Arms probably twenty, with short plates, uniserial for the first two or three plates (which are included in the cup), then biserial with alternating plates, branching at somewhat uneven heights from thirteen to twenty plates up, and again at still more uneven heights higher up.

Interradials (in one interradial area)—in the first row, one plate intercalated between, and of the same size as, the first primibrachs—in the second row two, smaller, and situated between the first and second primibrachs—in the third row three, situated on the level of the second primibrach—in the fourth row three which are very small. Anal area (Pl. V, fig. 21) with—in the first row, an anal plate equal to and intercalated between the radials—in the second row, three plates arching over the former, and more or less level with the first primibrachs (the two lateral of these being of the same size as the primibrachs, and the central smaller)—in the third row four (or five ?) smaller plates—in the fourth row five smaller plates rather irregularly placed, and above these several more small irregularly placed plates. (The only specimen showing the anal area is, however, too obscure to permit certainty as to the above numbers.)

Plates of the dome small and bearing central bosses, but in the condition of the specimens not individually decipherable. Arms thickly clothed with long and large, close-set tapering pinnules, having six or seven joints. Ornament of body-plates nodular-radiate.

Size.—A specimen of a portion of a dorsal cup is about 35 mm. across at the base of the arms.

Localities.—In the Museum of Practical Geology are two slabs containing portions of two very large specimens from Braunton, half a calix with stem from Barnstaple, another calix with arms from Barnstaple, and another specimen showing the arms and part of the dome, and another of a calix divided transversely from North Devon. In the Woodwardian Museum are two specimens of the dorsal cup, and two of the arms from Barnstaple. In the Porter Collection is a specimen of the dorsal cup, and two of portions of the arms from Pilton.

Remarks.—Although several of these fossils are much finer as specimens than are often found in the Pilton Beds, none of them show the entire cup, and therefore it is not easy to judge of the value of their individual plates without some uncertainty. The plates of the dorsal cup are ornamented by coarse radiating ridges, and the starting of the arms form clustered projections from the side of the cup, after the manner of typical forms of *Actinocrinus*, with which genus it appears to agree generally, unless it be in the mode of branching of its arms.

A curious case of deformity occurs in one of the specimens (Pl. XXXI, figs. 1, 1 *a*, 2). One of its arms, instead of simply bifurcating at the thirteenth joint, divides into three branches at once. These three new arms go off as nearly as possible at the same level; the regular biserial arrangement of the back of the arm is broken at the beginning of the division by several small plates, mostly pentagonal in shape, but it is at once resumed as soon as the division is completed.

Another specimen of a dorsal cup in the Porter Collection (Pl. V, fig. 21) is interesting as having had its dome covered by a *Capulus* (*Orthonychia*).

2. Actinocrinus ? Batheri, *Whidborne.* Plate XXXII, figs. 2—3*b*.

1896. Actinocrinus Batheri, *Whidborne.*[1] Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Dorsal cup rather shallow, conical, apparently considerably wider than high. Basals three, apparently wide and very short, with convex surfaces forming a kind of rim or bead round the base. Radials and first and second primibrachs very indistinctly seen, apparently small, subhexagonal, wider than high, and regularly decreasing in size. Secundibrachs very large, pentagonal, axillary. Arms twenty, uniserial for the first seven or eight joints, and then becoming biserial, clothed with strong, close, tapering pinnules. Interambulacral plates of the first row apparently large and hexagonal, and of succeeding rows much smaller and narrower. One (or two) interaxillary plates between each pair of secundibrachs. Dome apparently not quite as high as the cup, composed of very numerous plates, each bearing a very large globular boss. Surface of dorsal cup covered with extremely strong ridges, forming a coarse stellate pattern.

Size.—Height of dorsal cup about 7 mm., width about 13 mm.

Locality.—A specimen of the dorsal cup and arms, on two slabs obliquely divided, is in the Museum of Practical Geology from Braunton; and a doubtful specimen of the base of a cup is in the Woodwardian Museum from south-west of Sloly.

Remarks.—The very strong ornament, together with the poorly preserved surface of this fossil, which is in the condition of a mould, has rendered it quite impossible to trace more than a very few of the plates in the lower part of the cup. Those that can be traced appear on the whole to have the characters and arrangement of *Actinocrinus*, the basals being evidently very short, the radials and primibrachs probably rather wider than high. They all seem relatively small compared to the secundibrachs, which are large, convex, and smooth, and in this respect the fossil differs so remarkably from *A. Porteri* that there seems no doubt that it belongs to a distinct species, if not genus.

[1] By thus naming this species I had meant to express my gratitude to my friend Mr. F. A. Bather for some kind help in regard to it. I was unaware at the time that he preferred that species should not bear personal names.

V. *Family*—PLATYCRINIDÆ, *F. Römer*, 1855.

1. *Genus*—PLATYCRINUS, *J. S. Miller*, 1821.

1. PLATYCRINUS ? ANGULIFERUS, n. sp. Plate XXXVII, figs. 8—12.

Description.—Cup probably elongate. Basal disc nearly horizontal? Radials large, upright, suboblong, higher than wide, with a low excavation above, and ornamented by two or three central perpendicular ridges, from which four or five horizontal ridges start to the sides. Second primibrach axillary. Arms uniserial, with very low alternating cuneate plates (not quite reaching the sides), very long and moderately slender, sending out branches some distance up, and bearing close-set pinnules. Some small interradials on the shoulders of the radials.

Size.—Radials 8 or 10 mm. high.

Localities.—A crushed specimen from Saunton Hotel, consisting of parts of four radials with arms attached, is in Mr. Coomara Swamy's Collection; three detached radials from Top Orchard, Roborough, and Pilton are in the Porter Collection; and one from Ashhill Quarry and another from Croyde are in my Collection. A detached columnar of a *Platycrinus* from Vicarage Lane, Pilton, in the Barnstaple Athenæum, may perhaps belong to this species.

Remarks.—These specimens appear to be the remains of a fine species, the full characters of which cannot at present be ascertained. I have long been acquainted with the scattered plates, which are very similar in shape to those of *Platycrinus* or *Hexacrinus*, and are curiously ornamented with strong ridges which do not radiate, but form a succession of right angles on their surface. Recently Mr. Swamy has lent me a specimen showing part of the cup and arms, but these are unfortunately somewhat obscured by crushing. I have not observed any anal plate among the specimens, and though it is possible that one may have existed in the cup, it seems rather more probable that it was wanting. If it is a *Platycrinus* it is quite possible that the highly nodulate segment of a *Platycrinus* stem in the Barnstaple Athenæum may have belonged to it.

VI. *Family*—HEXACRINIDÆ, *Wachsmuth and Springer*, 1885.

1. *Genus*—ADELOCRINUS, *Phillips*, 1841.

So little appears to be known about the single species on which Phillips founded it, that the validity of this genus must remain for the present entirely in doubt. It has of late been sometimes treated as a synonym of *Platycrinus*.

The occurrence, however, of a small detached plate (Pl. XXX, fig. 2), suspiciously like the anal of *Hexacrinus*, makes it more likely that it was related to that genus. But its style of ornament so closely resembles that of *Arthracantha* as to suggest its identity with it. However, though the little tubercles which cover the body-plates are so elongate that they may be probably regarded as spines, I have been unable to trace their full length or their shape, and am not quite certain that they are moveable. Hence, while this view may ultimately be found correct, it certainly cannot as yet be asserted positively. It seems therefore best to retain for the present Phillips's existing name for whatever it may be worth, rather than to unite it with any genus from which it might again have to be separated.

1. Adelocrinus hystrix, *Phillips*. Plate XXX, figs. 1—7 *a*.

1841. Adelocrinus hystrix, *Phillips*. Pal. Foss., p. 30, pl. xvi, fig. 42 *a, b*.

Description.—Dorsal cup large, deep, apparently obconical, composed of large plates, which seem to be thin, covered with more or less numerous small elongate tubercles or spines, and so closely united that signs of the sutures are rarely discernible. Basal plates three, forming a shallow cone. Radials large, higher than wide, subpentagonal, with a small excavation above. Anal plate? narrow, subquadrate. No other plates of the calix decipherable except a few small polygonal plates (apparently of the dome), each of which bears a large rounded central tubercle. Arms stout, probably not very long, about ten in number, and not branching; biserial, composed of rather high joints, and clothed with long stout pinnules.

Size.—A specimen of the cup with closed arms (perhaps not fully shown) is about 40 mm long.

Localities.—In the Museum of Practical Geology are a dorsal cup (Phillips's type) from Brushford, a portion of another cup and some arms from Braunton, and two detached plates from Barnstaple. In the Barnstaple Athenæum are a cup with arms (mould and reverse) and a plate of the calix with some arms from Top Orchard, and portions of two other cups from Braunton. In the Porter Collection are portions of three cups and two detached plates from Pilton. Fragments of the dorsal cup do not appear to be rare.

Remarks.—Although several specimens have been found, we are unable to carry the description of this species very much further than where Phillips left it. Repeated examination of the specimens has only resulted in showing indistinct signs of the division of the lower part of the cup into three unequal plates; and the shape of the radials is only known from detached plates. The plates appear to have been very thin and very intimately united, consequently it is quite impossible to trace the divisions of the upper parts of the calix, which are, moreover, in many of the specimens wanting. Some of the arms are, however, occasionally clearly shown, and a few scattered plates of the dome are seen in one of the specimens.

The tubercles on the plates of the cup seem to vary very considerably in number and size. They appear to be conical, and higher than wide, and may be in the shape of small spines.

Affinities.—The basal disc is remarkably like that of *Arthracantha Ithacensis*, Williams,[1] as figured by Wachsmuth and Springer;[2] but, if it had spines, they were probably very much smaller and more like those of *A. punctobrachiata*, Hall, sp.[3] The ornament of *Hexacrinus interscapularis*, Phillips, sp.,[4] may also be compared.

The fossil doubtfully described by Römer[5] as *Ceriopora? patina* certainly presents much superficial resemblance in general shape to some of our specimens, though the ornament seems closer and more regular. Römer himself notes its likeness to a Crinoid.

3. Order—INADUNATA, *Wachsmuth and Springer*, 1885.

In the maze of this order it almost requires a necromancer to bring down a species to its rightful place amid the kaleidoscopic genera that appear, change, and vanish with the progress of science. With such obscure data as our Pilton fossils the results must necessarily be highly problematical.

I. *Family*—Poteriocrinidæ, *Austin*, 1850? (emend. *Wachsmuth and Springer*, 1886).

1. *Genus*—Poteriocrinus, *J. S. Miller*, 1821.

Wachsmuth and Springer,[6] finding difficulties in reference to Miller's type species *P. crassus*,[7] propose *P. notabilis*, Meek and Worthen, as "a new, or at

[1] 1883, H. S. Williams, 'Proceed. Amer. Philos. Soc.,' p. 85, plate.
[2] 1897, Wachsmuth and Springer, 'N. Amer. Crinoid. Camer.,' vol. ii, p. 749, pl. lxxvi, figs. 1 *a*—*c*.
[3] Ibid., p. 750, pl. lxxvi, figs. 2 *a*, *b*.
[4] 1895, Whidborne, 'Dev. Fauna,' vol. ii, p. 190, pl. xxi, figs. 1—4, and pl. xxii, figs. 1—2 *a*.
[5] 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. 1, p. 8, pl. ii, figs. 3 *a*, *b*.
[6] 1879, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1879, p. 327.
[7] 1821, J. S. Miller, 'Nat. Hist. Crinoid.,' p. 68, pl. xxiii, figs. 1—17.

least an additional type." The latter might perhaps have value as an explanatory species, but it is evident that to raise it to equal rank with *P. crassus*, Miller, may only make confusion worse confused. The true remedy would be a re-description of *P. crassus* from the original figured type (now in the Bristol Museum), and other carefully identified specimens of it from the same beds. As a matter of fact, it is very questionable whether Wachsmuth and Springer are even right in supposing that *P. notabilis* belongs to the same group of species. I have not been able as yet to examine closely the specimens in the Bristol Museum, but from what I am able to see of them I am inclined to think *P. crassus* may be found to have several rows of primibrachs in at least one of its arms, as stated by Austin,[1] and therefore that the primibrachs are variable in the genus, as stated by Sladen,[2] whereas *P. notabilis* (and therefore, according to Wachsmuth and Springer, the genus *Poteriocrinus*[3]) has one row only.

1. Poteriocrinus tensus, *Whidborne*. Plate XXXV, figs. 1—2; Plate XXXVIII, fig. 1.

1896. Poteriocrinus tensus, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Columnars very short, with smooth peripheries. Dorsal cup high, conical. Infra-basals five, large, pentagonal, as high as wide. Basals five, hexagonal ?, very high. Radials rather shorter than basals, inversely pentagonal, with excavated upper margins. First primibrachs sometimes axillary ? Arms very long, uniserial, bifurcating twice, composed of truncate cuneate plates. Pinnules rather few, slight, extremely elongate, with ten or twelve distant joints. Anal plates three. Ventral sac large, cylindrical, very long, with regular longitudinal undulations, and composed of about six rows of very numerous, subquadrate, slightly transverse plates with linear slits and lateral perforations.

Size.—A cup with portions of the arms is 80 mm. long.

Localities.—In the Woodwardian Museum is a specimen of the cup and arms, and another of a detached ventral sac from Barnstaple; in Miss Partridge's Collection a specimen of the cup and expanded arms from Saunton Hotel; and in the Porter Collection a ventral sac from Pilton.

Remarks.—Our specimens do not show the characters very clearly; but on the whole, taking the Woodwardian specimen as the type, the species seems to

[1] 1850? Austin, 'Mon. Rec. Foss. Crinoid.,' p. 71.

[2] 1877, Sladen, 'Proc. W. Rid. Yorks. Geol. Polyt. Soc.,' n. s., vol. i, p. (3).

[3] 1886, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1886, p. 158; but see 1897, Wachsmuth and Springer, 'N. Amer. Crinoid. Camer.,' vol. i, pp. 78, 154.

approach *P. crassus*, and is therefore probably a typical *Poteriocrinus*. That specimen is accompanied by three gutta-percha casts, which appear to have brought away portions of the cup as they were taken, so as to enable the plates to be counted, though in one their interior, and in the others their exterior, casts are seen. Part of its ventral sac is exposed. Two bifurcations may be traced in the arms, but whether the plates below the first of these are primibrachs or secundibrachs is not clear; the arms seem hardly sufficiently numerous for the latter. No pinnules are visible.

In Miss Partridge's fine fossil, on the other hand, no bifurcation of the arms is observable, and this must throw some doubt on its identity with the other specimen. The arms appear ten in number (eight are seen), and they bear remarkably long and slight distant pinnules, having ten or twelve distant joints.

2. Poteriocrinus Barumensis, *Whidborne*, sp. Plate XXXIV, fig. 6; and Plate XXXV, fig. 3.

1896. Cyathocrinus Barumensis, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 377.

Description.—Rather small. Stem cylindrical?, composed of short alternating columnars. Cup short, obconical. Infra-basals five, pentagonal, as high as wide. Basals small, hexagonal, as high as wide. Radials five, large, pentagonal, truncated above, as high as wide. Primibrachs five, large, pentagonal, as long or longer than the radials, axillary. Arms stout, very long, uniserial with truncated cuneate plates, and bearing very long close pinnules. Anal side unknown. Ventral sac large, long, composed of slightly transverse pieces with stellate marks.

Size.—A cup measures 7 mm. wide and 6 mm. high.

Localities.—There are two specimens (from Top Orchard Quarry and from Barnstaple) in the Woodwardian Museum. An indistinct specimen from Fremington is in the Porter Collection, and its reverse in Miss Partridge's Collection.

Remarks.—At first I supposed these fossils to be specimens of *P. tensus*, but further examination convinces me that they cannot be included in that species. The cup is much shorter and more globose, the basals smaller and primibrachs larger and single, and the columnars circular.

The stem in one of the specimens (Pl. XXXV, fig. 3) shows a curious deformity. Across one (and perhaps a second) longitudinal line the columnars are not continuous, but meet alternately, their line of junction being marked by a zigzag suture.

3. POTERIOCRINUS, sp. Plate XXXV, figs. 4—5 *a*, and Plate XXXVI, figs. 9, 9 *a*.

Description.—Large. Stem angular near dorsal cup. Columnars short, alternating. Proximal columnar curvilinear. Dorsal cup rather high, conical. Infrabasals five, pentagonal, wider than high. Basals five. Radials rather shorter than basals, with truncated upper sides. Primibrachs 5 × 2 or 3. Arms stout, uniserial, occasionally bifurcating, and composed of truncated cuneate plates, which in the lower parts (at least) bear stout short pinnules or armlets. Anal plates ? Ventral sac extremely large, cylindrical, elongated, with longitudinal undulations, and composed of exceedingly short transverse pieces with long linear slits.

Size.—A dorsal cup is about 12 mm. high. The sac of another specimen is 100 mm. high.

Localities.—In the Museum of Practical Geology is a specimen on two slabs as well as two detached ventral sacs from Braunton Down, and another ? from Braunton; in the Woodwardian Museum is a specimen from Barnstaple; and in the Porter Collection a ventral sac from Pilton.

Remarks.—I first supposed these might be large specimens of *Poteriocrinus tensus;* but, though the specimens are imperfect, they reveal several points of difference, *e.g.* the character of the ventral sac is very different, the arm-plates seem shorter, and the arms more rapidly branching. A pinnule or armlet very near the cup (Pl. XXXV, fig. 5 *a*) is noteworthy, as it has the appearance of bearing shorter pinnules on its side; its true character is therefore obscure.

2. *Genus*—SCAPHIOCRINUS, *Hall*, 1858.

S. dichotomus is the second of the two species described by Hall[1] in 1858; but Wachsmuth and Springer select it as the type of the genus as revised by them, because, they state, the first species belongs to the genus *Graphiocrinus*, de Koninck and le Hon, 1853.

1. SCAPHIOCRINUS ? PLUMIFER, n. sp. Plate XXXI, figs. 4—4 *c*; Plate XXXIII, fig. 1; Plate XXXVI, figs. 1, 1 *a*; and Plate XXXVIII, fig. 2.

Description.—Stem becoming acutely pentagonal near the base of the cup, composed of short columnars in a doubly alternating series, having convex peri-

[1] 1858, Hall, 'Report Geol. Surv. Iowa,' vol. i, pt. 2, p. 553, woodcut 72.

pheries. Dorsal cup basin-shaped, wider than high. Infra-basals five ? short. Basals five, almost regularly hexagonal in shape, as wide as high. Radials five, wider than high, pentagonal ? convex, and with wide horizontal upper margins. Surface of plates of the cup marked with strong (sometimes intermittent) ridges, radiating from the centres of the basals and other points. Primibrachs five, in from one to six rows, the first, the second, and the sixth primibrachs appearing to be axillary in different arms. Arms elongate, branching two or three times at rather regular distances so as to become about twenty-eight in all. Brachials rugose, uniserial, cuneate, bearing numerous slight, close-set, elongate pinnules of six or eight plates. Ventral sac probably (as seen in another specimen) long and narrow, and composed of small subhexagonal pieces marked with stellate ridges. Anal apparently situated on the horizontal top of a basal, and bearing on its shoulder a second anal, above which seem to be other interambulacral plates.

Size.—A cup with the greatest portion of the arms hitherto found measures about 60 mm. in length.

Localities.—In the Woodwardian Museum are six fine specimens of parts of the dorsal cup and arms from Barnstaple (on seven slabs); in the Barnstaple Athenæum a specimen of the extended head, and another (on two slabs) of the closed head from Braunton; in the Museum of Practical Geology a specimen from Braunton, and in Mr. Coomara Swamy's Collection one from the Pilton Beds.

Remarks.—It appears to me that these specimens give evidence of a well-marked species, though in spite of the excellence of several of the specimens it seems impossible to be certain about some of its most important characters.

The elaborate ornamentation of the dorsal cup, and the ridges or rugosities on the larger arm-plates, are of some assistance in identifying the specimens; but the plates of the cup, and especially the arrangement of the anals, are not well shown in any of the specimens, none of which enable us to trace the plates all round. One of the Woodwardian specimens shows short stout armlets of three segments upon the secundibrachs, which seem, however, only modifications of the pinnules of the higher branches.

I have found very great difficulty in locating this species in any of the genera allowed by Wachsmuth and Springer. While the ornate surface of its body-plates would approach their definition of their restricted *Poteriocrinus*, the shape of the dorsal cup is quite different, as also is the arrangement of the primibrachs. While perhaps not quite falling within the limits of their emended definition of *Scaphiocrinus*, Hall, it certainly bears sufficient likeness to several species referred by them to that genus to be imagined congeneric.

2. Scaphiocrinus transcisus, n. sp. Plate XXXVIII, fig. 3.

Description.—Column at the base of the cup pentagonal, with very short columnars. Dorsal cup conical, rather short, apparently consisting of five rather large infra-basals, five large subhexagonal basals, five rather short radials, and three anal plates, all very strongly ornamented by large, smooth, rounded ridges, which radiate from the centres of the plates. Primibrachs 5 × 2 (at least in one ray), short. Arms uniserial, with cuneate plates, bifurcating again a few plates up. Ventral sac exceedingly large and heavy, composed of rather large and high pieces.

Size.—Height of dorsal cup about 25 mm.

Localities.—A fragmentary portion of a calix and of the ventral sac from Barnstaple is in the Woodwardian Museum; and another similar specimen from Pilton is in the Porter Collection.

Remarks.—These specimens are too imperfect for anything like a full specific description. They appear most nearly to resemble *S. plumifer*, and I am not certain whether they may prove to be more than a variety of it. As far, however, as can be seen at present they seem to differ from it by their very much larger size, and their much less elaborate ornamentation. The ventral sac is exceedingly wide and massive. The individual plates are ornamented with five or six large bars or costæ radiating from their centres, without tubercles, in a way very like some of the plates of *Poteriocrinus crassus*, figured by J. S. Miller.

3. Scaphiocrinus ? inordinatus, n. sp. Plate XXXIV, fig. 7 ?; Plate XXXV, fig. 6, 6 *a*; Plate XXXVIII, fig. 4.

Description.—Stem pentagonal near the cup. Columnars short, alternating, with a central raised and perhaps nodulated band round their peripheries. Dorsal cup probably bowl-shaped and rather shallow. Infra-basals indistinctly seen, probably five, short. Basals five, small, polygonal. Radials five, large, convex, truncated above. Primibrachs large, convex, the first (at least in four of the rays) quadrate, the second pentagonal and axillary. Anal plates—one in the first row, large, elongate, apparently squeezed in between the basals, but prolonged above them, bearing in the second row a large plate resting on its upper margin, and a third above that. Surface coarsely rugose. Arms composed of elongate quadrate plates, and bearing very long pinnules.

Size.—A flattened cup is about 7 mm. wide.

Localities.—In my Collection is a flattened specimen from Upcott Arch (on the two faces of a slab divided horizontally). As far as can be seen, a specimen (on the two faces of a slab divided longitudinally) from Barnstaple in the Woodwardian Museum belongs to the same species; as perhaps does also a fine but obscure specimen (divided longitudinally) from Poleshill, in the Porter Collection, and a specimen from Braunton in the Museum of Practical Geology.

Remarks.—I have drawn up the above description from the specimen from Upcott Arch. While the Woodwardian specimen from its corrugated surface and its general appearance seems probably identical, its plates are not sufficiently clear to make this certain. Its cup is of a low vasiform shape, the large radials bending outwards and being convex, so that a section across them would be petaloid. In most of the rays the second primibrach is axillary, but in one (the right anterior ?) the first primibrach seems axillary, or at least it is shorter than the corresponding pairs, and no suture can be traced across it. Its arms appear to be ten in number, and clothed with strong pinnules.

To what genus this species (with the Upcott Arch specimen for its type) may belong is a perplexing question. It appears to me clear that the first anal is included in the basal ring, and is level with the basals; but, according to Wachsmuth and Springer, this arrangement exists in none of the *Inadunata*, though Bather[1] has since proved it to occur in *Thenariocrinus* and one or two other genera, to neither of which, however, our species in other respects approximates. This position of the azygous plate would probably be a character of generic importance, but our specimens are not sufficiently good and indubitable to form the type of a new genus. The only course, therefore, is to leave them for the present in *Scaphiocrinus,* and await the evidence of further finds.

4. Scaphiocrinus, sp. Plate XXXIV, fig. 8.

Description.—Stem circular, with very unequal alternating columnars which have convex peripheries. Dorsal cup very shallow, bowl-shaped. Infra-basals pentagonal, very short. Basals about as high as wide. Radials large. First primibrachs very large and long, axillary. Arms large and very long, composed of rather short cuneate plates, bifurcating at about the sixth plate, and clothed with large and stout pinnules. Anal side unknown.

Size.—A cup is about 4 mm. wide.

Localities.—In the Museum of Practical Geology is one specimen from Barnstaple and one from Braunton Down; in the Woodwardian Museum one (on two slabs) from Barnstaple; in the Porter Collection one from Poleshill; and in my Collection one from Top Orchard.

[1] 1890, Bather, 'Ann. Mag. Nat. Hist.,' ser. vi, vol. vi, p. 222.

2. SCAPHIOCRINUS TRANSCISUS, n. sp. Plate XXXVIII, fig. 3.

Description.—Column at the base of the cup pentagonal, with very short columnars. Dorsal cup conical, rather short, apparently consisting of five rather large infra-basals, five large subhexagonal basals, five rather short radials, and three anal plates, all very strongly ornamented by large, smooth, rounded ridges, which radiate from the centres of the plates. Primibrachs 5 × 2 (at least in one ray), short. Arms uniserial, with cuneate plates, bifurcating again a few plates up. Ventral sac exceedingly large and heavy, composed of rather large and high pieces.

Size.—Height of dorsal cup about 25 mm.

Localities.—A fragmentary portion of a calix and of the ventral sac from Barnstaple is in the Woodwardian Museum; and another similar specimen from Pilton is in the Porter Collection.

Remarks.—These specimens are too imperfect for anything like a full specific description. They appear most nearly to resemble *S. plumifer*, and I am not certain whether they may prove to be more than a variety of it. As far, however, as can be seen at present they seem to differ from it by their very much larger size, and their much less elaborate ornamentation. The ventral sac is exceedingly wide and massive. The individual plates are ornamented with five or six large bars or costæ radiating from their centres, without tubercles, in a way very like some of the plates of *Poteriocrinus crassus*, figured by J. S. Miller.

3. SCAPHIOCRINUS ? INORDINATUS, n. sp. Plate XXXIV, fig. 7 ?; Plate XXXV, fig. 6, 6 *a*; Plate XXXVIII, fig. 4.

Description.—Stem pentagonal near the cup. Columnars short, alternating, with a central raised and perhaps nodulated band round their peripheries. Dorsal cup probably bowl-shaped and rather shallow. Infra-basals indistinctly seen, probably five, short. Basals five, small, polygonal. Radials five, large, convex, truncated above. Primibrachs large, convex, the first (at least in four of the rays) quadrate, the second pentagonal and axillary. Anal plates—one in the first row, large, elongate, apparently squeezed in between the basals, but prolonged above them, bearing in the second row a large plate resting on its upper margin, and a third above that. Surface coarsely rugose. Arms composed of elongate quadrate plates, and bearing very long pinnules.

Size.—A flattened cup is about 7 mm. wide.

Localities.—In my Collection is a flattened specimen from Upcott Arch (on the two faces of a slab divided horizontally). As far as can be seen, a specimen (on the two faces of a slab divided longitudinally) from Barnstaple in the Woodwardian Museum belongs to the same species; as perhaps does also a fine but obscure specimen (divided longitudinally) from Poleshill, in the Porter Collection, and a specimen from Braunton in the Museum of Practical Geology.

Remarks.—I have drawn up the above description from the specimen from Upcott Arch. While the Woodwardian specimen from its corrugated surface and its general appearance seems probably identical, its plates are not sufficiently clear to make this certain. Its cup is of a low vasiform shape, the large radials bending outwards and being convex, so that a section across them would be petaloid. In most of the rays the second primibrach is axillary, but in one (the right anterior ?) the first primibrach seems axillary, or at least it is shorter than the corresponding pairs, and no suture can be traced across it. Its arms appear to be ten in number, and clothed with strong pinnules.

To what genus this species (with the Upcott Arch specimen for its type) may belong is a perplexing question. It appears to me clear that the first anal is included in the basal ring, and is level with the basals; but, according to Wachsmuth and Springer, this arrangement exists in none of the *Inadunata*, though Bather[1] has since proved it to occur in *Thenariocrinus* and one or two other genera, to neither of which, however, our species in other respects approximates. This position of the azygous plate would probably be a character of generic importance, but our specimens are not sufficiently good and indubitable to form the type of a new genus. The only course, therefore, is to leave them for the present in *Scaphiocrinus*, and await the evidence of further finds.

4. Scaphiocrinus, sp. Plate XXXIV, fig. 8.

Description.—Stem circular, with very unequal alternating columnars which have convex peripheries. Dorsal cup very shallow, bowl-shaped. Infra-basals pentagonal, very short. Basals about as high as wide. Radials large. First primibrachs very large and long, axillary. Arms large and very long, composed of rather short cuneate plates, bifurcating at about the sixth plate, and clothed with large and stout pinnules. Anal side unknown.

Size.—A cup is about 4 mm. wide.

Localities.—In the Museum of Practical Geology is one specimen from Barnstaple and one from Braunton Down; in the Woodwardian Museum one (on two slabs) from Barnstaple; in the Porter Collection one from Poleshill; and in my Collection one from Top Orchard.

[1] 1890, Bather, 'Ann. Mag. Nat. Hist.,' ser. vi, vol. vi, p. 222.

Remarks.—All these specimens are imperfect and indistinct. They seem to agree as far as can be made out, but whether they belong to a new form or to one of the accompanying species is uncertain.

5. SCAPHIOCRINUS? SALEBROSUS, n. sp. Plate XXXVII, fig. 13.

Description.—Stem pentagonal, composed near the cup of short alternate columnars with a raised central band round their peripheries. Dorsal cup rather shallow, bowl-shaped (nearly hemispherical), composed of tumid plates. Infra-basals very indistinctly seen. Basals large, convex, apparently hexagonal. Radials convex, pentagonal, truncated above, and with a linear articulating ridge. Azygous plate pentagonal, situated on the shoulders of two basals, and bearing an anal piece on its left shoulder, and another on its truncated summit. First primibrach in some of the arms axillary? Arms stout, uniserial, bifurcating (in one instance six plates up), composed of somewhat cuneate plates; (arm-furrows wide, with ligamental fossæ?). Pinnules strong, with rather short plates. Ventral sac probably large, and covered by ridged, polygonal plates. Surface of body and arm-plates covered with a minute irregularly corrugated ornament.

Size.—A dorsal cup measures about 6 mm. high and 9 mm. wide.

Localities.—A specimen from Pilton is in the Porter Collection; another from Barnstaple in the Woodwardian Museum; a third from Upcott in the Barnstaple Athenæum.

Remarks.—Of these specimens the first is exposed longitudinally, the second horizontally, while the third is only a most obscure and doubtful basal part of a cup. They seem sufficient to show the distinctness of the species, but not to give a clear conception of its characters. The bowl-shaped cup with tumid plates covered with a minute ornament gives distinguishing characters. The ventral sac is not itself seen, but the occurrence of numerous peculiar plates indicates something of its size and character. It seems to differ from *Poteriocrinus Barumensis* by having larger basals and smaller infra-basals and by the greater tumidity of its plates.

It appears to come very near to the characters given by Wachsmuth and Springer[1] for *Cromyocrinus*, a genus which they first unite with and then separate from *Eupachycrinus*, Meek and Worthen.[2] It may be compared with *C. globosus*, Worthen, sp.,[3] and *C. papillatus*, Worthen, sp.[4]

[1] 1879, Wachsmuth and Springer, 'Proc. Nat. Sci. Philad.,' 1879, p. 356.

[2] 1886, ibid., 1886, p. 170.

[3] 1873, Meek and Worthen, 'Geol. Surv. Illin.,' vol. v, p. 557, pl. xxi, fig. 12.

[4] 1883, Worthen, ibid., vol. vii, p. 315, pl. xxix, fig. 17.

3. *Genus*—Scytalocrinus, *Wachsmuth* and *Springer*, 1886.

Sladen[1] founded the genus *Dactylocrinus* for the *Poteriocrinus tenuis* of Austin[2] (not Miller[3]); and the species *S. stadiodactylus* described below, which is very similar to that species, seems quite agreeable to his definition. Wachsmuth and Springer, however, stating that his name had been preoccupied by Quenstedt in 1876 for another form, merge Sladen's genus into their own *Scytalocrinus*,[4] to which they refer a large number of American fossils. How far our species is congeneric with some or all of these may be doubtful, though in many points it corresponds. It differs from most if not all of them in the very great length and quadrate shape of its arm-joints, and this feature was made by Sladen one of the important characters of his genus. Wachsmuth and Springer explain this away by saying that it simply betokened a young animal. In our case, however, their remark hardly appears applicable; several of our specimens show the arms, and these are of very great length, and seem to be of sufficiently mature character.

1. Scytalocrinus stadiodactylus, *Whidborne*, sp. Plate XXXVI, figs. 2—6, 8, and Plate XXXVII, fig. 14.

1886. Poteriocrinus stadiodactylus, *Whidborne*. Proc. Geol. Assoc., vol. xiv, p. 377.

1886. — Batheri, ibid., p. 377.

Description.—Stem apparently long and slender, composed of moderately high, equal or nearly equal columnars. Dorsal cup conical or slightly obconical, moderately deep. Infra-basals five, small, slightly higher than wide, pentagonal. Basals five, apparently large, higher than wide, hexagonal. Radials five ? moderately short, truncate above. Primibrachs 5×2. Arms ten, very long and slender, composed of very long, narrow, subquadrate plates, and sending out occasionally long slight armlets or pinnules. Anal side with a pentagonal azygous plate, resting on the shoulders of two basals, and bearing an anal piece on its left shoulder level with the radials, and another hexagonal anal on its summit; the last two supporting further similar plates, which appear to clothe the lower parts

[1] 1877, Sladen, 'Proc. W. Rid. Yorks. Geol. and Polyt. Soc.,' n. s., vol. i, p. (4), pl. x, fig. 2.

[2] 1850? Austin, 'Monog. Rec. and Foss. Crinoid.,' p. 83, pl. x, figs. 5 *a*, *b*.

[3] 1821, J. S. Miller, 'Nat. Hist. Crinoid.,' p. 71, pl. xxii, fig. 2, and pl. xxiv, figs. 1—25.

[4] 1879, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1879, p. 339; and 1886, ibid., 1886, pp. 157, 161.

of the greatly elongated ventral sac, which in its higher parts is covered by slightly transverse quadrate plates, and swells out into a slightly clavate form.

Size.—A calix is 3 mm. high; another 6 mm. high. The arm of a similarly sized specimen appears to be more than 50 mm. long.

Localities.—In the Barnstaple Athenæum are one specimen from Braunton and two from Roborough; in the Woodwardian Museum are five (on four slabs) from Barnstaple; and in the Porter Collection two from Pilton.

Remarks.—The great slightness and elongation of its arm-plates and the length and mode of branching of the arms easily distinguish this form from the accompanying Crinoids. The arms do not appear to exceed ten, and are composed of alternately long and shorter quadrate plates, only the longer of which appear to bear long and relatively strong pinnules, which, therefore, do not produce the usual plumose aspect. The arms do not seem straight, but slightly waved or zigzagged, the pinnules starting from the outer angles thus formed. Possibly the pinnules themselves sometimes have a slightly waving shape, and hence they may be of rather doubtful nature, and possibly have to be reckoned as armlets, but I have not been able to recognise any branching in them.

The anal side of the cup is seen in a small specimen (Pl. XXXVI, figs. 2, 2 *a*, which I should regard as the type) which retains the arms; but there it is rather distorted by accident. This specimen also shows the ventral sac, which is seen to rise from the anal plates of the cup for some distance as a narrow tube covered with elongate hexagonal plates, and then to swell out into an elongate inflated shape, when it is covered by short quadrate pieces in probably ten or twelve rows. How high it extends cannot be seen. The height of the cup being about 4 mm., the neck of the sac is 10 mm. long, and the inflated part more than 10 mm.; while the width of the neck is 1 mm., and of the inflated part 3 mm.

The arm-plates are sometimes three times as long as their width.

Two specimens (Pl. XXXVI, figs. 6, 8) were regarded by me in 1896 as a distinct species, which I named *Poteriocrinus Batheri*. They seemed to differ from the type by the greater size and length of their basals, shorter columnars, and some other points. Further examination makes me very doubtful whether any of the supposed distinctions hold good, or may not have been really caused by the imperfect preservation of our specimens—the appearance of the column especially being due to decay, and the portion of an arm (fig. 7) on the same slab as fig. 6 evidently belonging to another animal of a different species. They must therefore, I think, be united with the present species.

Affinities.—*Sc. loreus*, Sladen, sp.[1] (= *Poteriocrinus tenuis*, Austin), is very similar, and seems evidently congeneric, but its dorsal cup is more elongate and

[1] 1877, Sladen, 'Proc. W. Rid. Yorks. Geol. and Polyt. Soc.,' n. s., vol. i, p. (5), pl. x, fig. 2.

conical, its arm-plates seem all equal, and it appears to differ in having only one row of primibrachs.

Sc. Vanhornei, Worthen,[1] is also very like, both as to its dorsal cup and its ventral sac, but its arm-plates are much shorter and more cuneate. Its second primibrach is axillary.

2. Scytalocrinus arachnoideus, n. sp. Plate XXXVIII, figs. 5, 6.

Description.—Stem round, with alternate very long and moderate columnars (near the cup), which have gently convex peripheries. Dorsal cup small, apparently semi-globose (bowl-shaped). Infra-basals elongate, pentagonal? longer than wide. Basals subhexagonal, equal to the infra-basals in height but broader. Radials pentagonal, about the same size as basals, convex laterally, and with horizontal upper margins. First primibrachs large, square; second primibrachs pentagonal, axillary. Arms very long, simple, not perceptibly tapering, composed of equal plates, which are rather higher than wide, have almost horizontal sutures, and bear very long pinnules with numerous joints. Azygous plate very similar to the radials, bearing apparently another very small anal on its left shoulder, and a third on its truncated upper margin; these being followed by numerous rows of subhexagonal pieces forming a long narrow neck to the sac, which is longer than the height of the cup, the sac then expanding and forming a long reticulate bag four or five times the height of the cup.

Size.—Height of a cup 5 mm., length of ventral sac about 40 mm.

Localities.—There are three specimens from Barnstaple in the Woodwardian Museum.

Remarks.—These specimens appear to have very much the same characters as *Sc. stadiodactylus*, but to differ distinctly from it in the structure of their arms, which are much stouter, and composed of comparatively short equal joints. The ventral sac seems also very similar. The defective state of our specimens leaves of course many of the characters indistinct and doubtful, but as their size does not seem to exceed that of the former species, they could hardly be supposed to be its adult condition, and must therefore, I think, be regarded as a new form.

[1] 1875, Worthen, 'Geol. Surv. Illin.,' vol. vi, p. 517, pl. xxxi, figs. 2, 3.

4. *Genus*—Cœliocrinus, *White*, 1863.

1. Cœliocrinus, n. sp. Plate XXXVIII, fig. 7.

Description.—Dorsal cup unseen. Arms stout, slowly diminishing in size, bifurcating at nearly level distances, the ramifications occurring only on the two outer arms of the rays, and the branches being given off toward the inner side of the ray, and remaining single throughout. Arm-plates extremely short, uniserial, cuneate. Pinnules large and long. About five plates between the first divarication seen and the second; about seven between the second and third; and about eleven between the third and fourth. Anal sac long.

Size.—A specimen with parts of the arms is 22 mm. long.

Localities.—A single defective specimen from Barnstaple is in the Woodwardian Museum.

Remarks.—This specimen being a mass of arms with only indistinct indications of the dorsal cup is insufficient for full determination, but at the same time is distinctly different from any other Pilton Crinoid.

As far as can be seen, it has great resemblance to such forms as *Zeacrinus cariniferus*, Worthen,[1] and *Z. lyra*, Meek and Worthen,[2] which Wachsmuth and Springer refer to *Cœliocrinus*,[3] a genus with a "balloon-shaped" dorsal sac, and for one of the species of which they somewhat rapaciously claim[4] the well-known *Echinosphærites tesselatus*, Phillips, sp.,[5] regardless of its structure! A small portion of the ventral sac, seen in our specimen, proves it to have been large and possibly wide, but its shape is unknown, so that it is not certain whether our species belongs to this or some kindred genus. The cuneate plates of the arms, however, appear, according to Wachsmuth and Springer, to separate it from *Zeacrinus*, and from such species as *Zeacrinus ramosus*, Hall,[6] or *Scaphiocrinus subæqualis*, Wachsmuth and Springer,[7] which, after having placed in a new genus *Pachylocrinus*, they afterwards referred to *Woodocrinus*, de Koninck,[8] from the type form of which, *W. macrodactylus*, these species certainly have a very different aspect, though they may be more like *W. expansus*, de Koninck.[9]

[1] 1873, Meek and Worthen, 'Geol. Surv. Illin.,' vol. v, p. 535, pl. xx, fig. 4.

[2] Ibid., p. 432, pl. i, fig. 11.

[3] 1879, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1879, p. 354.

[4] 1886, ibid., p. 168.

[5] 1841, Phillips, 'Pal. Foss.,' p. 135, pl. lix, figs. 49xx *a*, *b*.

[6] 1858, Hall, 'Report Geol. Surv. Iowa,' vol. i, pt. 2, p. 548, pl. ix, fig. 3.

[7] 1873, Meek and Worthen, 'Geol. Surv. Illin.,' vol. v, p. 494, pl. xv, fig. 6 (this figure, however, has cuneate plates); and 1879, Wachsmuth and Springer, 'Proc. Acad. Nat. Sci. Philad.,' 1879, p. 339.

[8] 1854, de Koninck et le Hon, 'Recherches Crinoid. Terr. Carb. Belg.,' p. 212, pl. viii, figs. 1 *a*—*e*.

[9] 1858, de Koninck, 'The Geologist,' vol. i, p. 13, pl. ii, fig. 1.

PLATE XXII.

PRODUCTUS INTERRUPTUS, *Sowerby* (?). (Page 172.)

FIG.

1. Ventral valve, lying obliquely in the matrix, showing the ribs and the interrupting grooves and ridges in the posterior parts, × 3. Pilton. Porter Collection.
2. Dorsal? valve, somewhat worn, showing the transverse ridges over the whole surface, × 2. Fremington. Porter Collection.
3. Portion of a crushed specimen, showing ornament, × 8. Pilton. Porter Collection.

CHONETES HARDRENSIS, *Phillips*, sp. (Page 177.)

4. Cast of dorsal valve, showing the areas of the dorsal and ventral valves, and the divaricating ribs, × 3. Saunton Hotel. My Collection.

CHONETES MARGARITACEA, *Whidborne.* (Page 179.)

5. Ventral valve, showing the shape and the simple ribs, × 3. 5 *a*. Portion of surface, showing the shape of the ribs and the transverse ornament, × 10. Roborough. Porter Collection.
6. Another specimen, much crushed, showing two of the hinge-spines, × 3. Braunton. Museum of Practical Geology.

CHONETES ILLINOISENSIS, *Worthen* (?). (Page 179.)

7. Dorsal valve, showing the crowded divaricating and slightly waved striæ and the slight geniculation, × 3. Fremington (?). Porter Collection.
8. Ventral valve, much crushed, showing one of the long oblique hinge-spines, × 3. Fremington (?). Porter Collection.

CRANIELLA INSECURA, n. sp. (Page 180.)

9. Cast of dorsal valve, showing the apex, the casts of the muscle-scars, and the ornament assumed from the organism to which the other valve was attached, × 2. Pilton Beds. Barnstaple Athenæum.

CRANIA? RICTA, n. sp. (Page 182.)

10. Ventral valve, showing the divaricator, the occlusor, and the ventral adjuster (?) muscle-scars, × 3. 10 *a*. Portion, showing the minutely tuberculated inner surface, × 10. Pilton. Porter Collection.

DISCINA NITIDA, *Phillips*, sp. (Page 183.)

11. Upper valve, which is a cast in the central part, but retains the surface near the margins, the front part of which is covered by matrix, × $\frac{3}{2}$. 11 *a*. Lateral view, × $\frac{3}{2}$. Saunton Hotel. Miss Partridge's Collection.
12. Lower valve, × $\frac{3}{2}$. West Angle Bay, Pembrokeshire. Museum of Practical Geology.

LINGULA SQUAMIFORMIS, *Phillips.* (Page 183.)

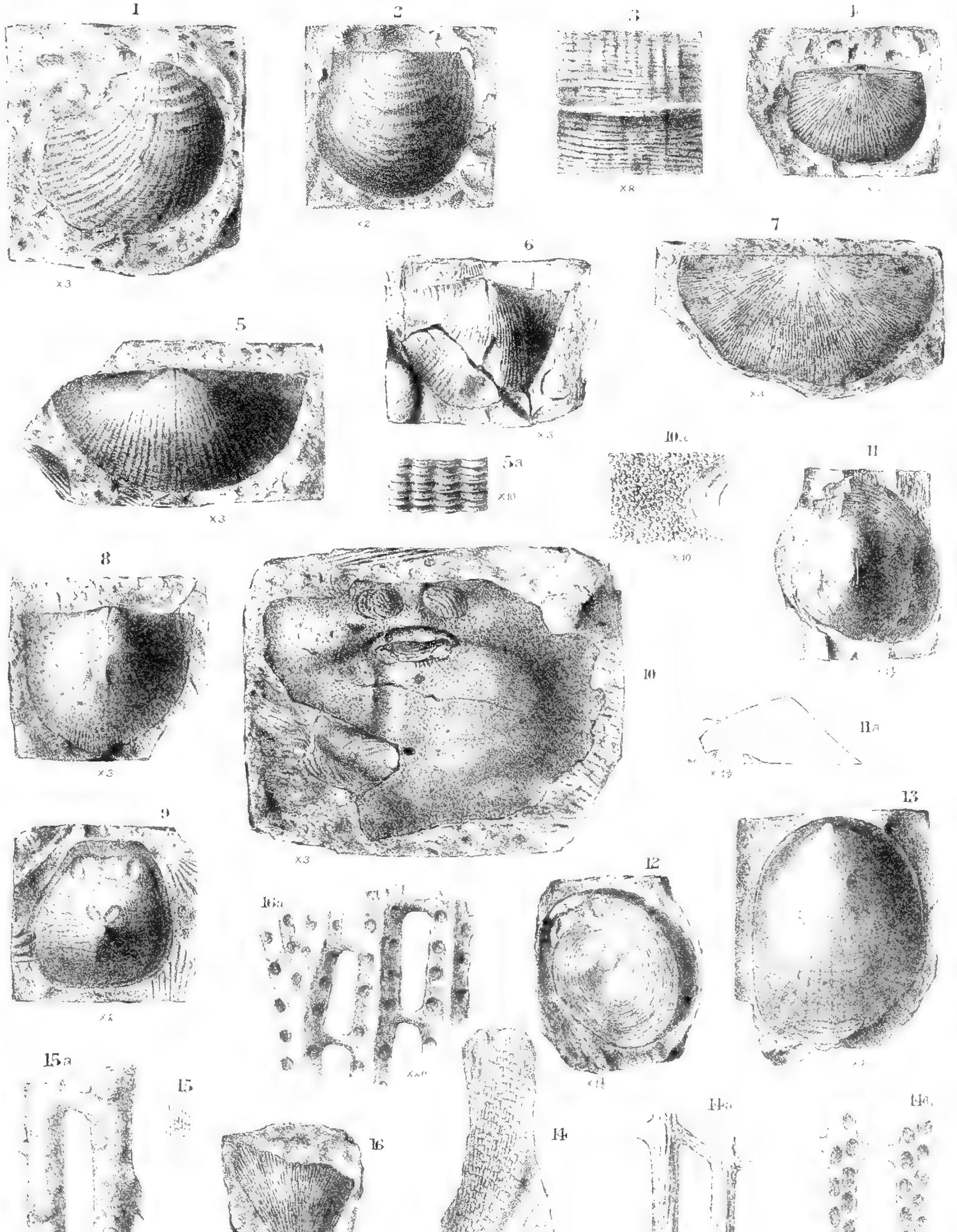
13. Dorsal valve, showing the radiations on the surface, × 2. Saunton Hotel. Miss Partridge's Collection.

FENESTELLA PLEBEIA, *M'Coy.* (Page 185.)

14. Part of a large frond. 14 *a*. A fenestrule, showing the non-poriferous surface, × 20. 14 *b*. A fenestrule, which is a natural section, showing five or six cells between the dissepiments, × 20. Snapper Quarry. Hamling Collection.
15. Fragment of a frond. 15 *a*. Portion, showing a nodulated surface, and the section of some cells, × 20. Ironpost. My Collection.

FENESTELLA? UMBROSA, n. sp. (Page 186.)

16. Wax impression of the natural cast of a frond. 16 *a*. A portion of the surface showing the blunt central keel, the shape of the fenestrules, and three or four cell-mouths to a fenestrule, × 20. Roborough. Barnstaple Athenæum.


1
2
3
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x3
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7
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11
8
10
x3
11a
9
x3
13
12
16a
15a
15
16
14
14a
14b

PLATE XXIII.

FENESTELLA PLEBEIA, *M'Coy*. (Page 185.)

FIG.

1. Fragmentary specimen. 1 *a*. Portion, showing the striated non-poriferous side, and the section with four or six cells to a fenestrule (slightly restored), × 20. Pilton Beds. Porter Collection.

FENESTELLA ? UMBROSA, n. sp. (Page 186.)

2. Fragmentary specimen in the condition of a cast, probably belonging to this species, but with very small fenestrules. 2 *a*. Portion, showing two cells to a fenestrule, × 20. Roborough. Porter Collection.

3. Fragmentary specimen of the radical portion of a frond. 3 *a*. Portion, showing the keeled and striated non-poriferous side, which sometimes appears to have two cells to a fenestrule, × 20. Poleshill. Porter Collection.

FENESTELLA POLYPORATA, *Phillips*. (Page 188.)

4. Fragmentary specimen of the poriferous face. 4 *a*. Portion, showing six cells to a fenestrule, the median keel, and the elevated cell-mouths, × 20. Pilton Beds. Hamling Collection.

5. Fragmentary specimen of the radical portion of a frond. 5 *a*. Portion, showing the mode of branching, the cells, the cell-mouths, and the median keel, × 20. Pilton. Porter Collection.

PENNIRETIPORA BIPINNATA, *Phillips*, sp. (Page 190.)

6. Portion of a large cast, showing mouths of cells. 6 *a*. Portion, showing two cells on the central stem between each two of the branches, × 20. Poleshill. Porter Collection.

7. Slab with several specimens retaining surface. 7 *a*. Portion of a frond, showing the central keels and the cell-mouths, × 20. Barnstaple. Woodwardian Museum.

8. Specimen, showing the mode of branching. Pilton. Porter Collection.

PENNIRETIPORA VIRGATA, n. sp. (Page 191.)

9. Fragmentary specimen. 9 *a*. Portion, showing the numerous cells between the subsidiary branches, × 20. Croyde Bay. My Collection.

STREBLOTRYPA GREGORII, *Whidborne*. (Page 192.)

10. Portion of a zoarium. 10 *a*. Portion of surface, showing the acute undulating ridges, the mouths of the zoœcia and the mesopores, × 20. Pilton Beds. Hamling Collection.

RHABDOMESON ? GRACILE, *Phillips*, sp. (Page 194.)

11. Portion of a zoarium. 11 *a*. Portion of surface, showing cell-mouths, × 20. Barnstaple. Woodwardian Museum (on a slab from which Sowerby's figure in 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liii, fig. 17, was taken).

12. Portion of a zoarium. 12 *a*. Portion of surface, showing cell-mouths and acanthopores, × 20. Ironpost. My Collection.

13. Portion of the zoarium of a variety with larger cell-mouths. 13 *a*. Portion of surface, showing the long, oval cell-mouths and pores, × 20. East Anstey. My Collection.

14. Cast of a zoarium, probably belonging to this species. 14 *a*. Portion, showing the form of the cells, × 20. Pilton. Porter Collection.

15. Portion of the natural section of a zoarium, probably belonging to this species. 15 *a*. Portion, showing the shape of the cells and the central axis, × 20. Pilton. Porter Collection.

LEIOCLEMA ? DISTANS, *Whidborne*, sp. (Page 196.)

16. Portion of a zoarium. 16 *a*. Portion, showing the small, distant, oval cell-mouths and the scattered mesopores, × 20. Laticosta Cave, Baggy. Hamling Collection.

FISTULIPORA ? sp. (Page 197.)

17. Specimen of a free zoarium. 17 *a*. Portion, showing the cells, × 15. Pilton. Porter Collection.

FISTULIPORA (?), sp. (Page 198.)

18. Specimen encrusting a coral, × 2. Frankmarsh. Barnstaple Athenæum.

19. Wax cast of the portion of another specimen, encrusting a crinoid stem, × 20. Barnstaple. Woodwardian Museum.

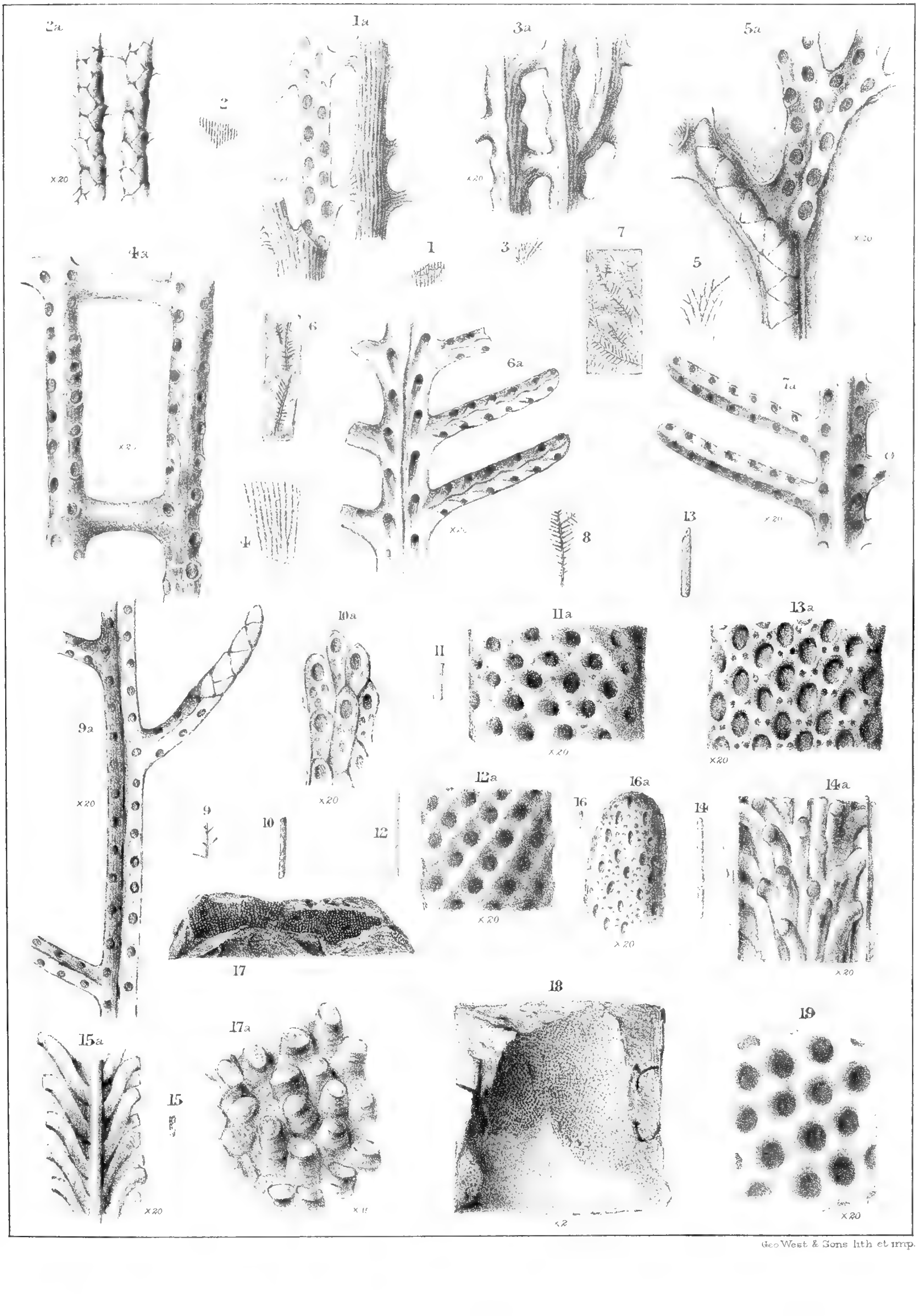

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PLATE XXIV.

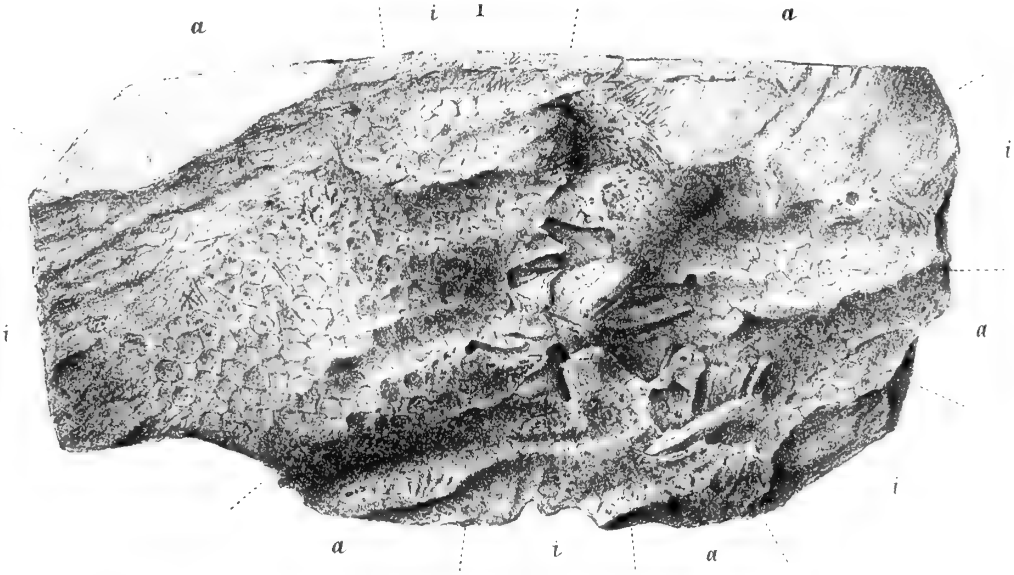
Lepidesthes ? devonicans, *Whidborne.* (Page 200.)

Fig.

1. One side of the mould of a nearly perfect but flattened and compressed specimen, in which the remains of the lantern are seen, and the ten areas may be roughly traced, nat. size. Pilton Beds, North Devon. Museum of Practical Geology.
2. Portion of the opposite face of the same specimen, showing numerous spines and interambulacral and ambulacral plates, × 2. Pilton Beds, North Devon. Museum of Practical Geology.

PLATE XXIV.

1



2

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PLATE XXV.

PROTOCIDARIS ACUARIA, n. sp. (Page 203.)

FIG.

1. Mould of a portion of a crushed test, showing numerous interambulacral plates and spines, × 2. 1 *a*. Portion of the same, showing a tubercle and parts of two spines, × 25. 1 *b*. Portion of the same, showing several plates and large and small spines, × 5. East of Barnstaple. Museum of Practical Geology.
2. Another specimen, probably belonging to the same test, showing remains of the lantern-apparatus, nat. size. 2 *a*. Portion of one of the bones of the lantern, × 10. East of Barnstaple. Museum of Practical Geology.

LEPIDESTHES ? DEVONICANS, *Whidborne*. (Page 200.)

3 *a*. Wax cast of some interambulacral plates from the test figured on Pl. XXIV, showing their shape and ornamentation, × 5. 3 *b*. Wax cast of some ambulacral plates, × 5. 3 *c*. Portion of an interambulacral plate, showing a tubercle, × 25. 3 *d*. Portion of a spine, × 25. 3 *e*. Another spine, × 10. 3 *f*. An ambulacral plate, showing its thickness, × 10. Pilton Beds, North Devon. Museum of Practical Geology.

PLATE XXV

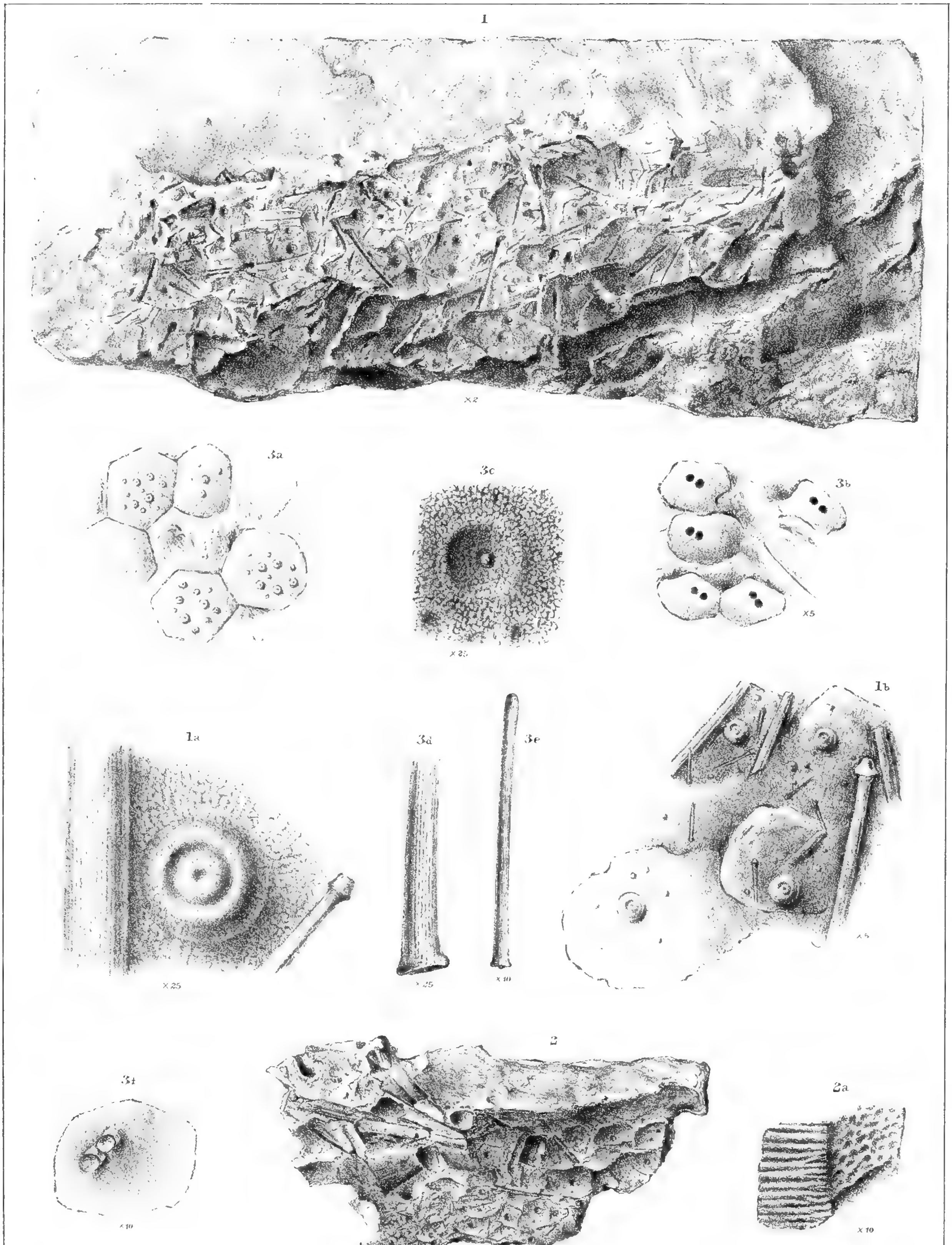

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PLATE XXVI.

PALÆASTER LONGIMANUS, *Whidborne.* (Page 204.)

FIG.

1. Mould of the upper surface of a specimen, × 3. 1 *a.* Wax impression of a portion of the same, showing the arrangement of the plates, × 5. Park, near Braunton. Museum of Practical Geology.
2. Mould of the under surface of the same animal, × 3. Park, near Braunton. Museum of Practical Geology.
3. Mould of the under surface of another specimen, showing the length of the arms, × 3. 3 *a.* Wax impression, showing the mouth, × 5. 3 *b.* Wax impression of an arm, which has been twisted so as to show its upper side, × 8. Baggy Point. Museum of Practical Geology.
4. Wax impression from another specimen, showing the mouth and parts of the arms, × 6. Pilton. Porter Collection.

PROTASTER GRANIFER, *Whidborne*, sp. (Page 207.)

5. Mould of the lower surface, × $\frac{3}{2}$. 5 *a.* Wax impression from a portion of one of the arms showing (indistinctly) the arrangement of the plates, × 3. Pilton Beds, North Devon. Museum of Practical Geology.
6. Mould of the upper surface of the same animal, × $\frac{3}{2}$. 6 *a.* Wax impression of a portion of the surface, × 15. Pilton Beds, North Devon. Museum of Practical Geology.

PLATE XXVI

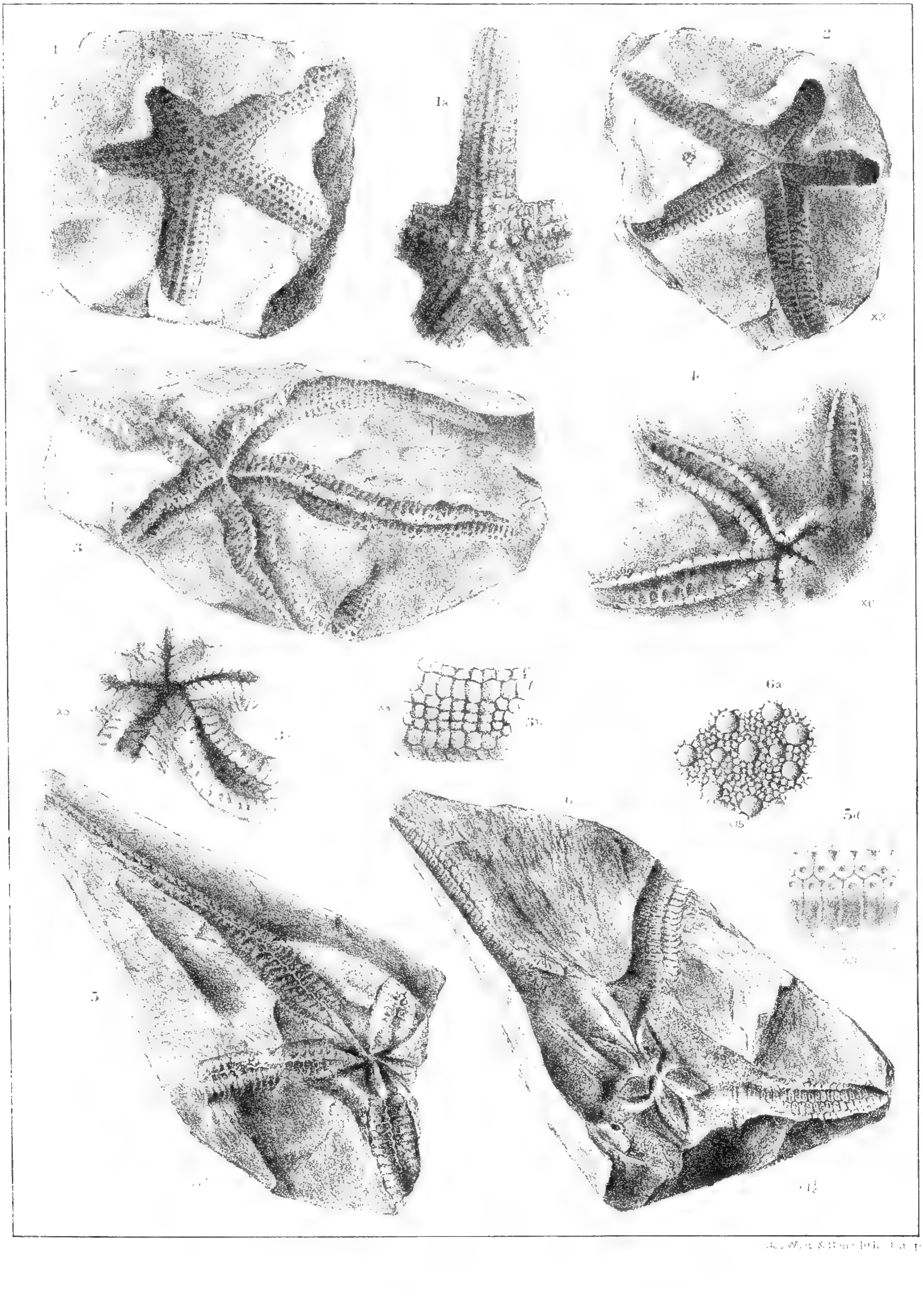

PLATE XXVII.

PROTASTER? (DREPANASTER) SCABROSUS, *Whidborne*, var. (Page 208.)

FIG.

1. Under surface of an indistinct specimen, × 2. 1 *a*. Wax impression of a portion of one of the arms, × 4. Top Orchard Quarry. Hamling Collection.
2. Upper surface of the same animal, × 2. 2 *a*. Wax impression of a portion of one of the arms, × 4. 2 *b*, Side view of the same, × 2. 2 *c*. Wax impression of a portion of the surface, × 10. Top Orchard Quarry, Hamling Collection.
3. Another specimen in a very poor state of preservation, × 3. Fremington. Porter Collection.

EUGASTER? PERARMATUS, *Whidborne*, sp. (Page 209.)

4. Wax impression from the mould of the lower side of an arm, × $\frac{7}{2}$. Poleshill. Porter Collection.
5. Wax impression from the mould of portions of the upper sides of three arms, × 2. Poleshill. Porter Collection.
6. A confused group of arms from another animal. 6 *a*. Wax impression of one of the arms, × 4. Braunton Down. Museum of Practical Geology.

PLATE XXVII.

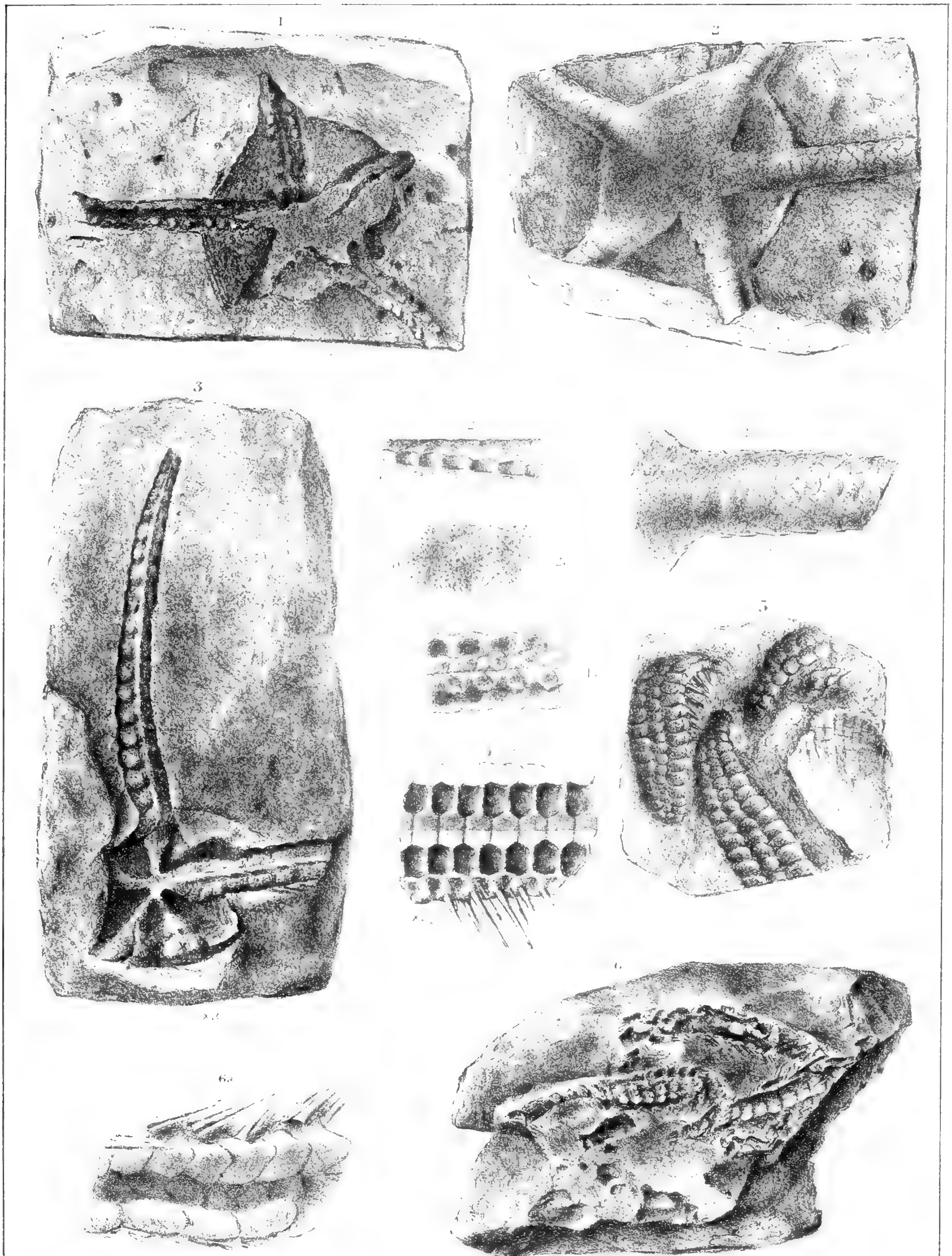

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PLATE XXVIII.

PROTASTER? (DREPANASTER) SCABROSUS, *Whidborne*, var. (Page 208.)

FIG.

1. Under side of a specimen, × 3. 1 *a*. Wax impression, showing the oral arrangement, × 5. 1 *b*. Wax impression of a portion of the arms, × 7. Croyde. Museum of Practical Geology.
2. Under side of another specimen, × 3. 2 *a*. Wax impression of a portion of one of the arms, × 10. 2 *b*. A small portion of the surface of the same, × 70. Croyde. Museum of Practical Geology.

OPHIURELLA? GREGARIA, *Whidborne*, sp. (Page 210.)

3. Wax impression of a portion of the mould of a specimen, × 5. (The longest portion of arm here shown is only three fifths of its full length.) Braunton Down. Museum of Practical Geology.

PLATE XXVIII

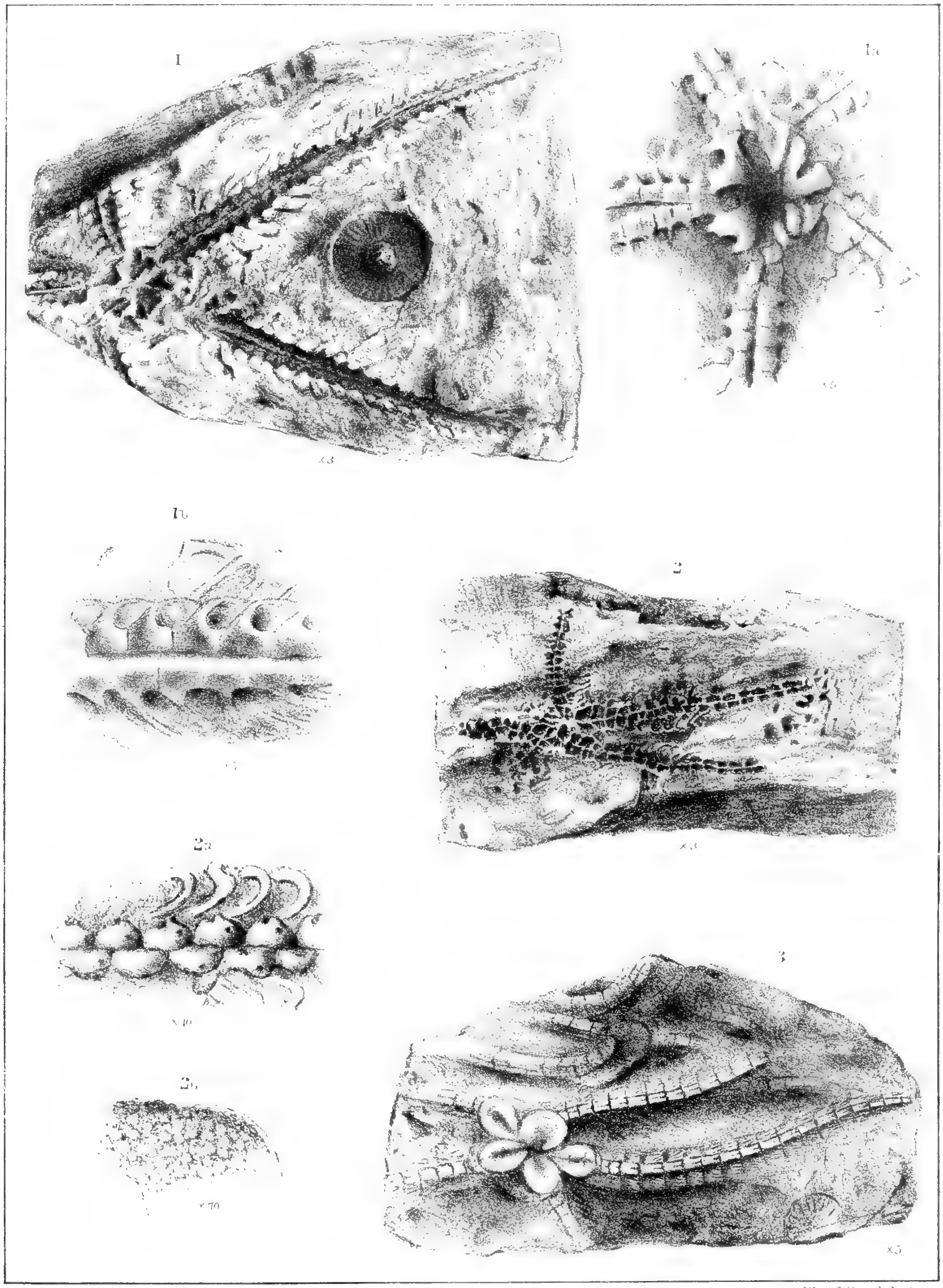

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PLATE XXIX.

PROTASTER ? (DREPANASTER) SCABROSUS, *Whidborne*. (Page 208.)

FIG.

1. Specimen showing the small plates of the dorsal surface of the disc and portions of the arms, and the lateral spines, × 5. 1 *a*, 1 *b*. Wax impressions of two portions of the arms, × 10. Croyde Bay. Barnstaple Athenæum.
2. Another specimen, showing the lower side of an animal, × 3. 2 *a*. Wax impression of a portion of one of the arms, × 10. Braunton Down. Museum of Practical Geology.

PALÆASTER LONGIMANUS, *Whidborne*. (Page 204.)

3. Wax impression from the mould of the upper surface of a small specimen, the arms of which are really longer than here visible, × 4. Top Orchard Quarry. My Collection.

CODONASTER CONICUS, n. sp. (Page 214.)

4. Small specimen, showing the sutures, × 6. 4 *a*. Upper view showing the disc, the surface of which is partly destroyed, × 12. Top Orchard Quarry. Woodwardian Museum.

PENTREMITIDEA PHILLIPSII, n. sp. (Page 212.)

5. Mould of a specimen, showing two ambulacra and an interradius, × 10. 5 *a*. Wax impression of a portion of one of the ambulacra, showing the food-grooves and the plates, × 20. Wrafton Lane. My Collection.
6. Cast of a radial plate with an ambulacra, × 3. Ashford Strand. Barnstaple Athenæum.

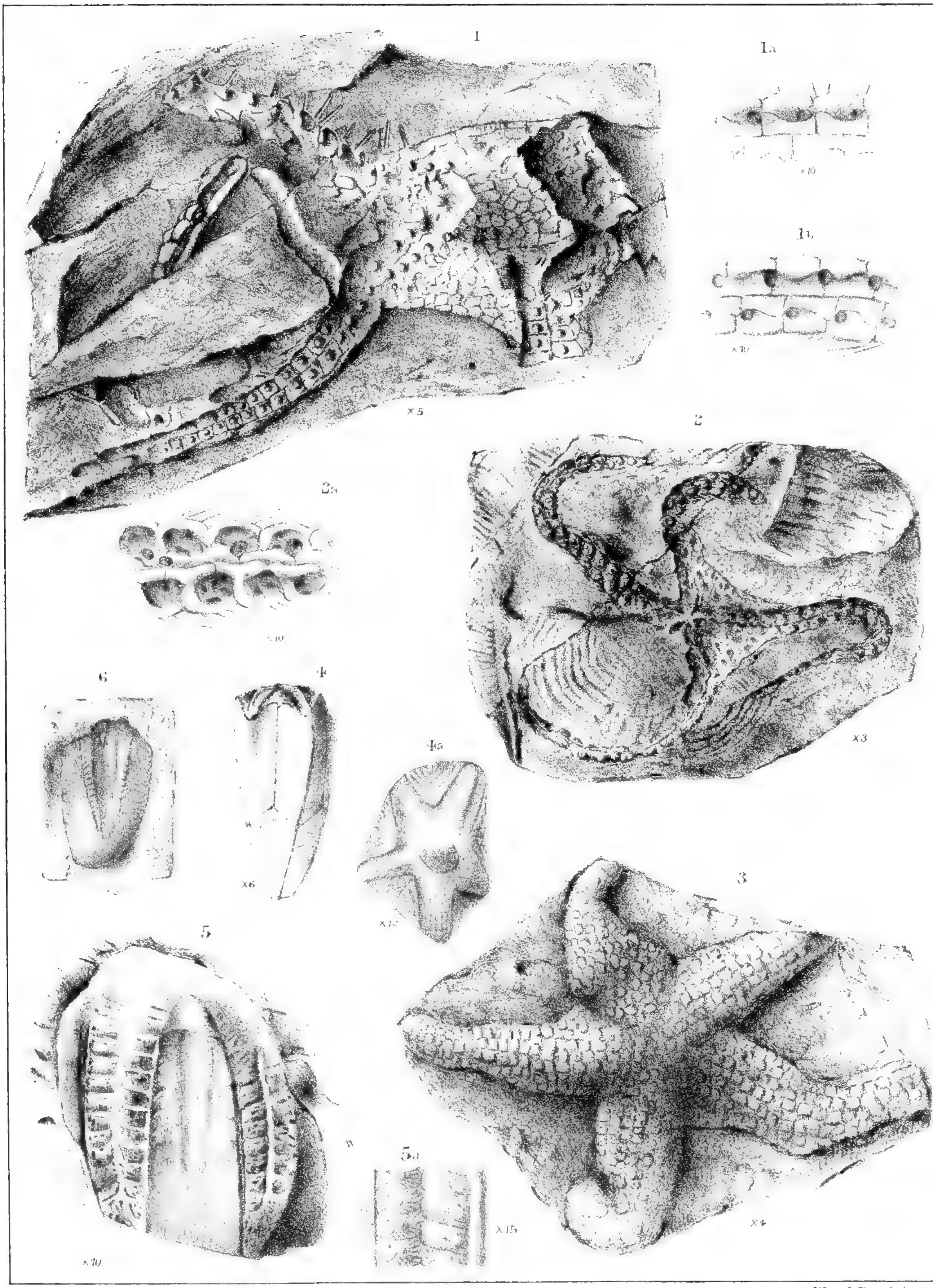

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PLATE XXX.

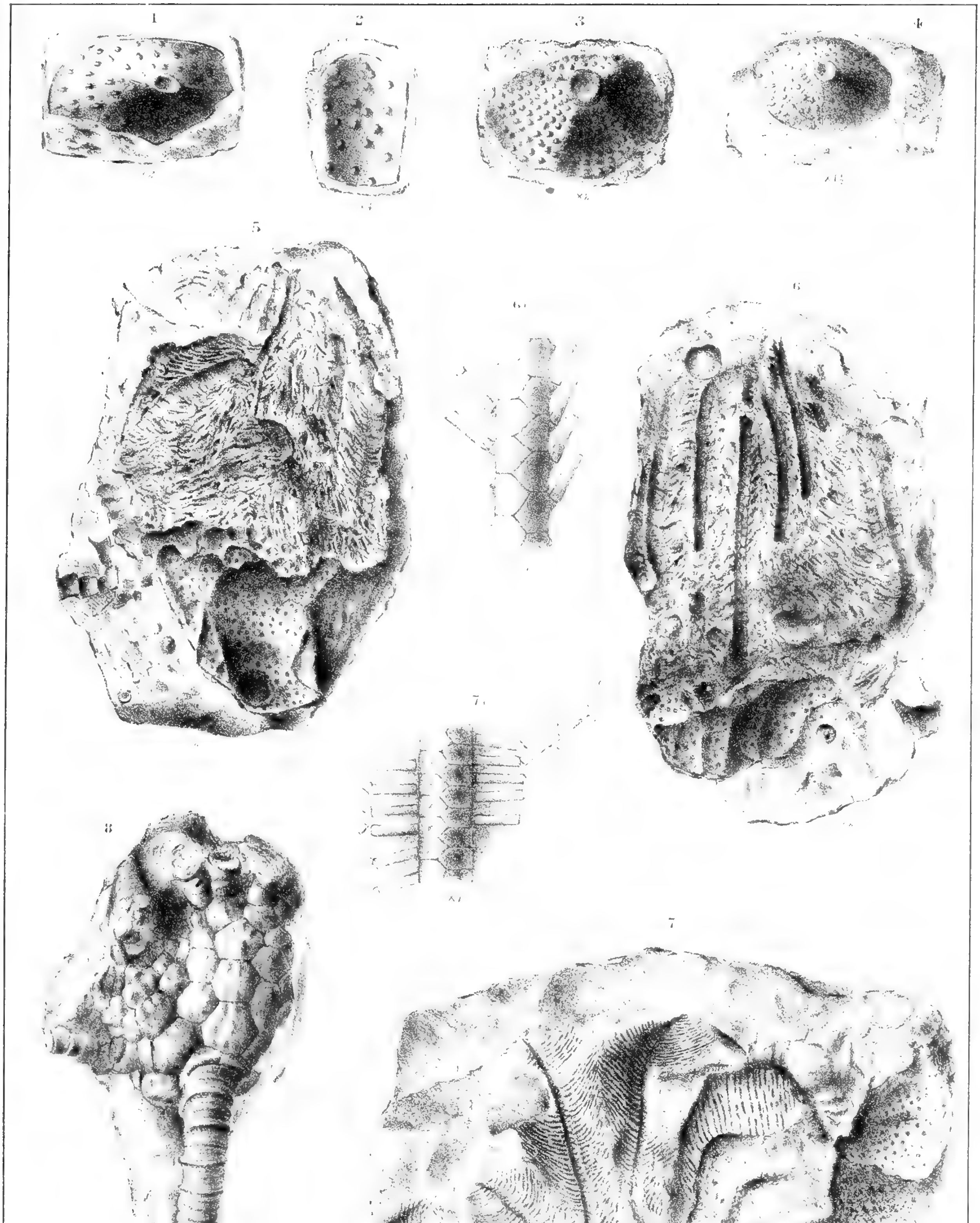
ADELOCRINUS HYSTRIX, *Phillips*. (Page 224.)

FIG.

1. Basal view of the wax impression of a mould of part of a dorsal cup, × 2. Pilton. Porter Collection.
2. A single concave plate of another cup (possibly an anal plate?), × 4. Pilton. Porter Collection.
3. Wax impression of part of another cup, having larger and more numerous tubercles, and being quadrate in horizontal section, × 2. Bradford. Barnstaple Athenæum.
4. Wax impression from Phillips's type specimen, having few and small tubercles, × $\frac{3}{2}$. Brushford. Museum of Practical Geology.
5. Specimen of a calix with arms attached, × 2. Top Orchard. Barnstaple Athenæum.
6. The other side of the same animal, showing the arms, × 2. 6 *a*. Wax impression of a portion of one of the arms, showing the plates and pinnules, × 7. Top Orchard. Barnstaple Athenæum.
7. Specimen, showing parts of five arms with their pinnules *in situ*, and part of the calix of the same or another animal, × $\frac{3}{2}$. 7 *a*. Wax impression of one of the arms, × 7. Braunton. Museum of Practical Geology.

ACTINOCRINUS PORTERI, *Whidborne*. (Page 220.)

8. Gutta-percha cast of a specimen, × 2. Barnstaple. Woodwardian Museum.



Geo West & Sons lith et imp

PLATE XXXI.

ACTINOCRINUS PORTERI, *Whidborne*. (Page 220.)

FIG.

1. Mould of part of a calix with arms and pinnules, nat. size. 1 *a*, wax cast of a portion of one of the arms, showing a curious triple branching, × 2. North Devon. Museum of Practical Geology.
2. Mould of the opposite side of the same animal as fig. 1, showing part of the dome. North Devon. Museum of Practical Geology.

RHODOCRINUS? sp. (Page 217.)

3. Specimen showing a defective dorsal cup with armlets and long arms clothed with fine pinnules, nat. size. 3 *a*, a plate of the cup, × 7. 3 *b*, a portion of an arm, showing the arrangement of the plates, × 10. 3 *c*, impression of the inner surface of one of the pinnules, × 25. 3 *d*, portion of the outer surface of one of the arms, × 5. North Devon. Museum of Practical Geology.

SCAPHIOCRINUS? PLUMIFER, n. sp. (Page 228.)

4. Gutta-percha cast of a specimen, nat. size. 4 *a*, anal side of the dorsal cup, × 6. 4 *b*, one of the arms, × 5. 4 *c*, impression of one of the pinnules, × 25. Barnstaple. Woodwardian Museum.

ACTINOCRINUS PORTERI, *Whidborne*. (Page 220.)

5. Part of the dorsal cup and arms of a large specimen, nat. size. Braunton. Museum of Practical Geology.

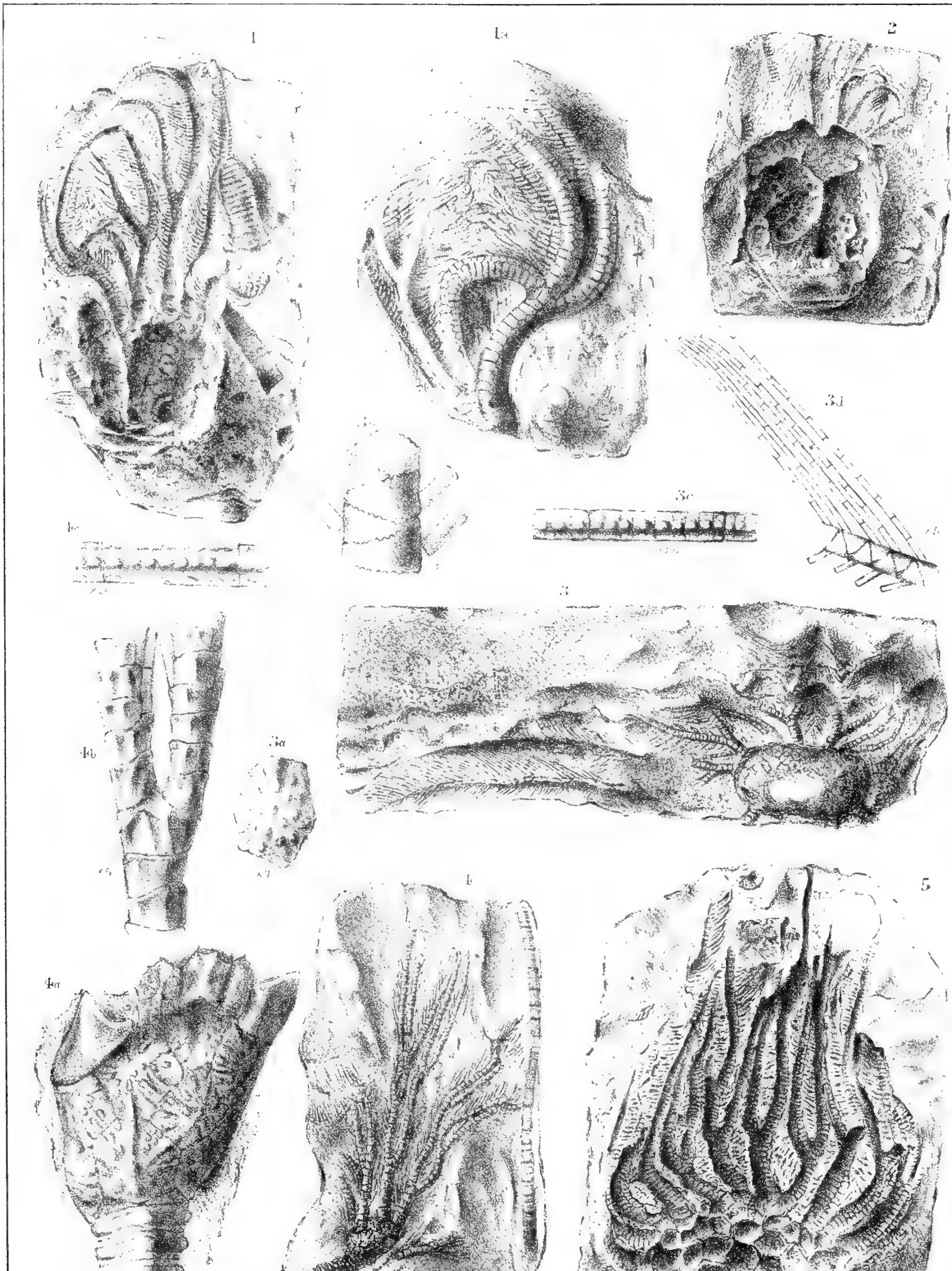


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PLATE XXXII.

ACTINOCRINUS PORTERI, *Whidborne*. (Page 220.)

FIG.

1. Specimen, containing the opposite side of the dorsal cup figured on Pl. XXXI, fig. 5, together with the stems of several other individuals. Braunton. Museum of Practical Geology.

ACTINOCRINUS ? BATHERI, *Whidborne*. (Page 222.)

2. Mould of the dome and inner side of the arms, $\times \frac{3}{2}$. 2 *a*, wax cast of part of the dome, showing some of the plates, $\times$ 3. 2 *b*, three plates, $\times$ 10. Braunton. Museum of Practical Geology.
3. Mould of the dorsal cup of the same individual, $\times \frac{3}{2}$. 3 *a*, wax cast of the dorsal cup, slightly restored, $\times$ 3. 3 *b*, lateral view, $\times$ 3. Braunton. Museum of Practical Geology.

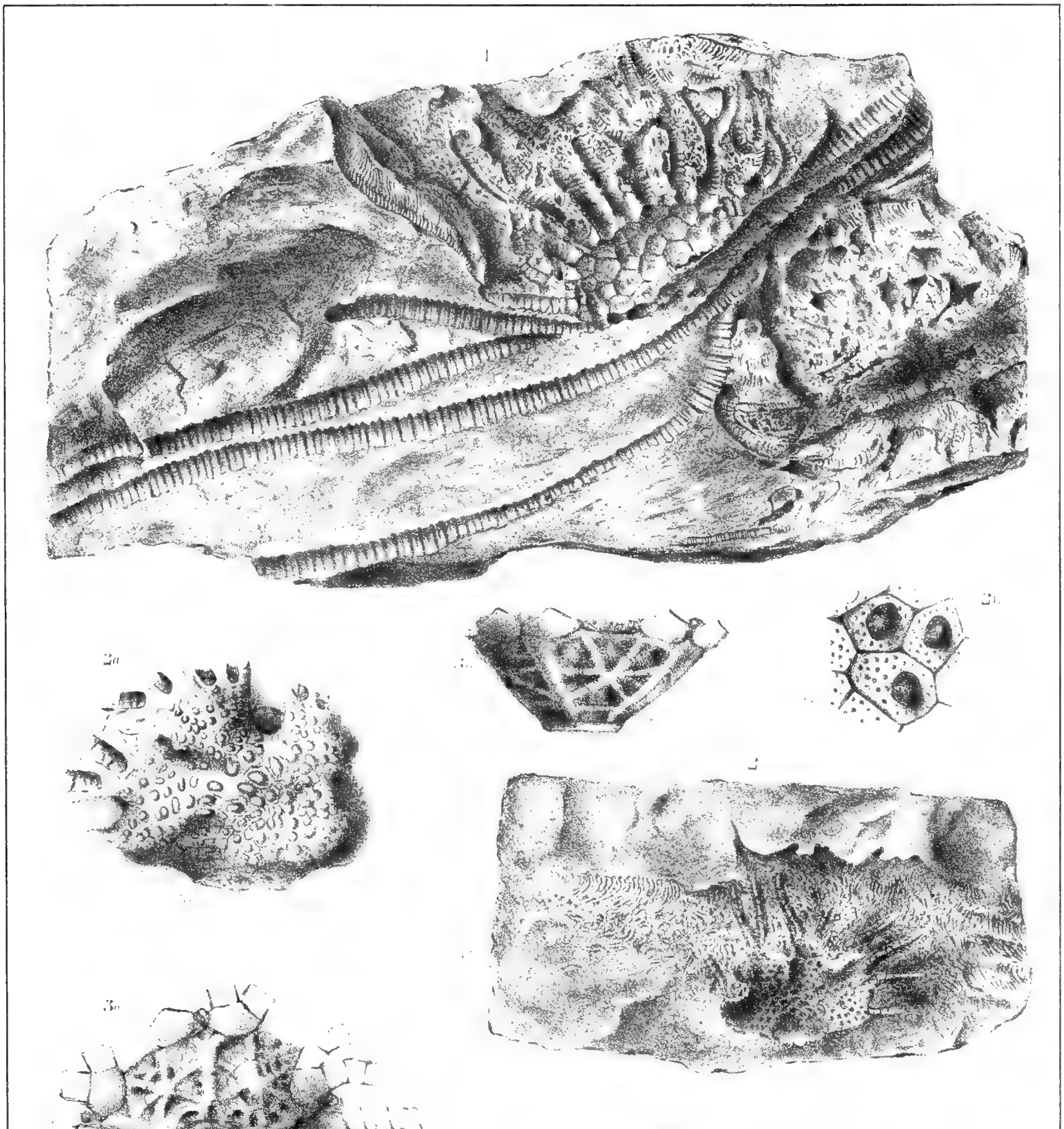

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PLATE XXXIII.

SCAPHIOCRINUS? PLUMIFER, n. sp. (Page 228.)

FIG.

1. Gutta-percha cast of a large specimen, in which the plates of the dorsal cup are broken away, × 2. Barnstaple. Woodwardian Museum.

TAXOCRINUS MACRODACTYLUS, *Phillips*. (Page 215.)

2. The only remaining specimen of Phillips's types of this species known, nat. size. Pilton. Museum of Practical Geology.
3. Another specimen, showing the bifurcations of the arms, × $\frac{3}{2}$. 3 *a*, wax cast of the inner side of one of the arms, × 3. North Devon. Museum of Practical Geology.
4. Another specimen, being a cast in the upper part and a mould in the lower, nat. size. 4 *a*, wax cast of the top of the stem and lower part of the dorsal cup, restored above the dotted line from the arms seen in the specimen, × 2. North Devon. Museum of Practical Geology.

PLATE XXXIII

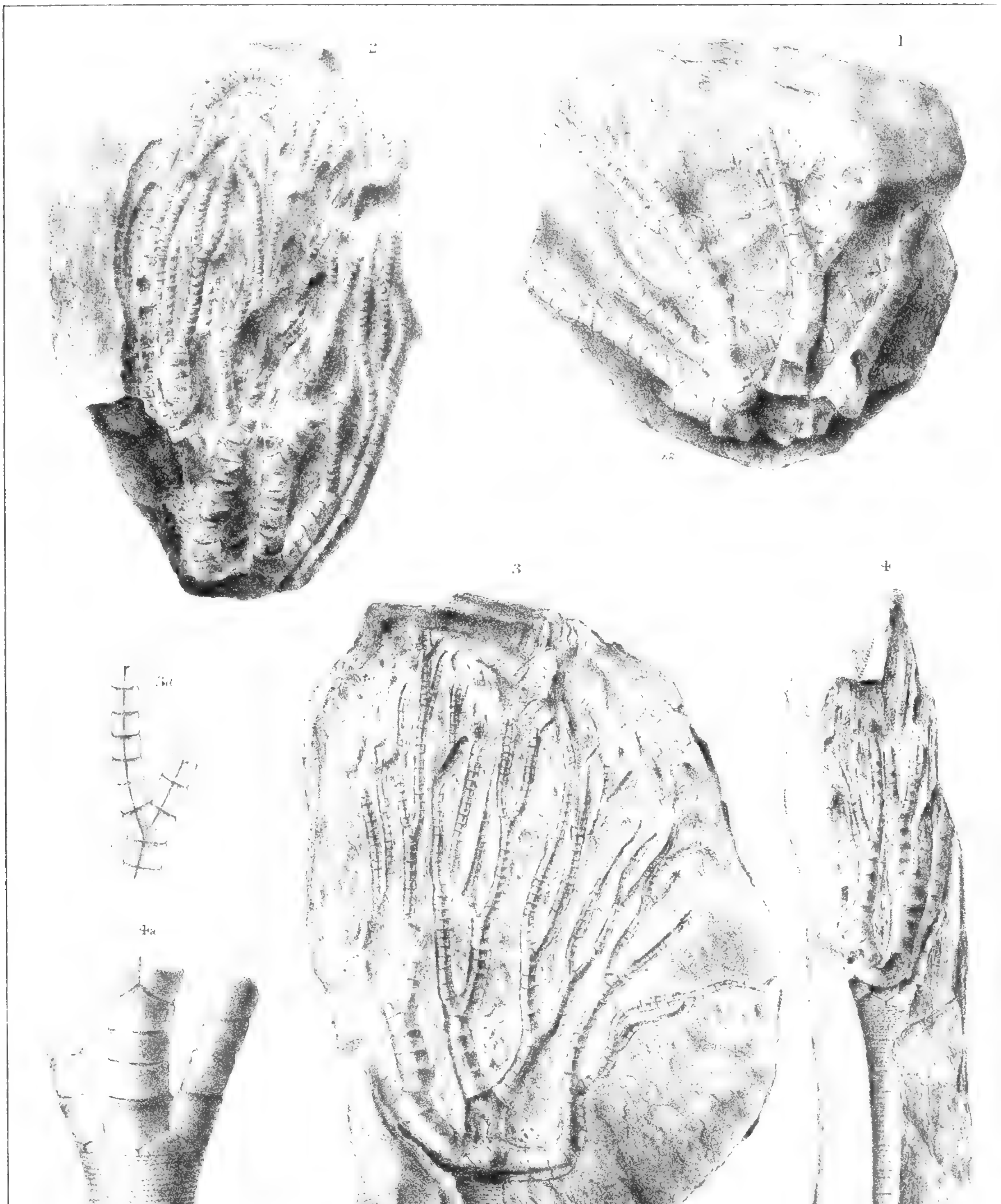

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PLATE XXXIV.

Taxocrinus stultus, *Whidborne.* (Page 216.)

Fig.

1. Wax cast of a specimen, showing the top of the stem, the dorsal cup, and the beginnings of the arms, one of which has three primibrachs and five and six secundibrachs respectively, × 3. (*The little plates seen between the arms have been drawn too regularly, and are probably not pinnules, but scattered plates from the infolded extremities of the arms.*) Pilton. Porter Collection.
2. Mould of the opposite side of the same individual, × 2. 2 *a*, wax cast, showing anal plates, × 3. Pilton. Porter Collection.
3. Another specimen, showing the character of the stem, × 2. Pilton. Porter Collection.

Sp. indet.

4. Terminal portion of an arm with stout short pinnules, × 4. 4 *a*, portion, × 10. Pilton. Porter Collection.

Mariocrinus ? sp. (Page 219.)

5. Doubtful specimen, showing the arms and a few plates of the dorsal cup, × 2. Braunton. Barnstaple Athenæum.

Poteriocrinus Barumensis, *Whidborne.* (Page 227.)

6. Gutta-percha cast of a specimen showing the plates of the dorsal cup, the first primibrachs axillary, and nine secundibrachs in one of the arms, × 2. Barnstaple. Woodwardian Museum.

Scaphiocrinus ? inordinatus ? n. sp. (Page 230.)

7. Mould of a specimen, very doubtfully referred to this species, × $\frac{3}{2}$. Braunton. Museum of Practical Geology.

Scaphiocrinus ? sp. (Page 231.)

8. Mould of a specimen, showing the very shallow dorsal cup and the large primibrachs, × $\frac{3}{2}$. 8 *a*, portion of an arm, showing the pinnules, × 5. Braunton. Museum of Practical Geology.

PLATE XXXIV

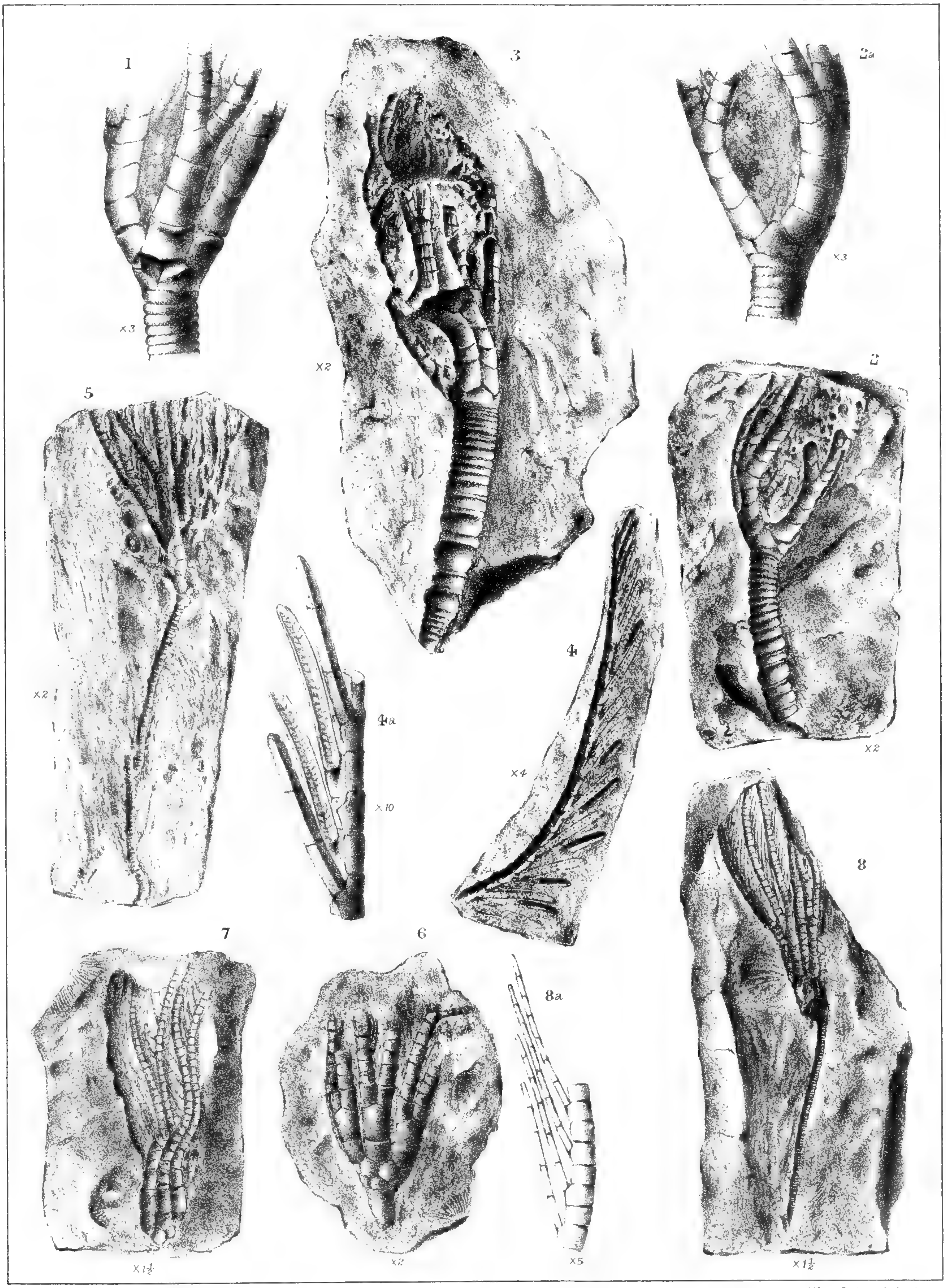

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PLATE XXXV.

POTERIOCRINUS TENSUS, *Whidborne.* (Page 226.)

FIG.

1. Gutta-percha cast of a specimen, showing the dorsal cup (much injured), the branching of the arms, and fragments of the anal tube, × 2. (*The plates between the cup and the first bifurcations of the arms have been restored in this figure, and perhaps incorrectly.*) 1 *a*, portion of one of the arms, × 5. Barnstaple. Woodwardian Museum.
2. Another gutta-percha cast, taken subsequently from the same specimen, showing the opposite side of the dorsal cup, × 2. Barnstaple. Woodwardian Museum.

POTERIOCRINUS BARUMENSIS, *Whidborne.* (Page 227.)

3. Specimen, showing the plates of the dorsal cup and the arms, and having a curious deformity in the stem, × 2. Top Orchard Quarry. Woodwardian Museum.

POTERIOCRINUS, sp. (Page 228.)

4. A large detached ventral sac, nat. size. Braunton. Museum of Practical Geology.
5. Specimen, showing one arm, part of the ventral sac, and some plates of the dorsal cup, nat. size. 5 *a*, portion of the arm, showing an armlet which appears to bear pinnules, × 5. Barnstaple. Woodwardian Museum.

SCAPHIOCRINUS ? INORDINATUS, n. sp. (Page 230.)

6. Specimen, showing the dorsal cup and arms, × 2. 6 *a*, portion of one of the arms, showing the pinnules, × 7. Barnstaple. Woodwardian Museum.

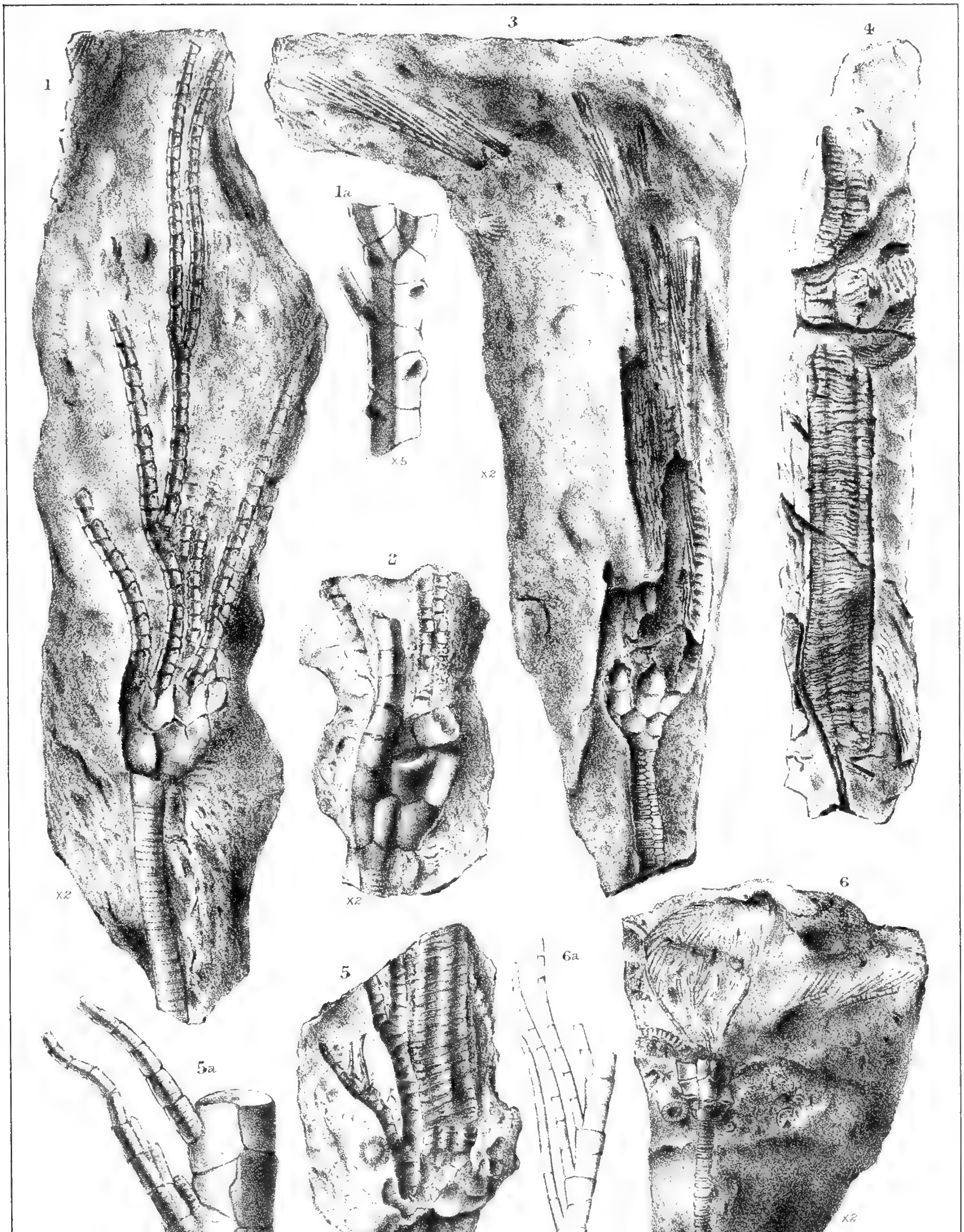

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PLATE XXXVI.

SCAPHIOCRINUS ? PLUMIFER, n. sp. (Page 228.)

FIG.

1. Mould of a specimen in rough preservation, × $\frac{3}{2}$. 1 *a*, wax cast of the dorsal cup, showing the plates, the surface-ornamentation of which appears to have been obliterated, × 3. Braunton. Museum of Practical Geology.

SCYTALOCRINUS ? STADIODACTYLUS, *Whidborne*, sp. (Page 233.)

2. Wax cast of a specimen, showing the anal side of the dorsal cup and the ventral sac, nat. size (see Pl. XXXVII, fig. 14). 2 *a*, dorsal cup, × 4. Braunton. Barnstaple Athenæum.
3. Specimen in which the dorsal cup is obliterated, but the expanded arms and pinnules are seen, × 2. 3 *a*, gutta-percha cast of the central parts, × 4. Barnstaple. Woodwardian Museum.
4. Wax cast of a specimen, showing the anal side of the dorsal cup and the beginning of the ventral sac, the plates of the stem being obliterated, × 3. Pilton. Porter Collection.
5. Wax cast of part of a dorsal cup with closed arms, × 4. Roborough. Barnstaple Athenæum.
6. Mould, showing the plates of the dorsal cup, the first and second primibrachs and the beginning of the arms, × 2. Pilton. Porter Collection.
8. Mould of a smaller specimen, × 3. Roborough. Barnstaple Athenæum.

SP. INDET.

7. Terminal portion of an arm, × 2. 7 *a*, portion showing the pinnules, × 6. Pilton. Porter Collection.

POTERIOCRINUS, sp. (Page 228.)

9. Mould of a defective dorsal cup, with portions of two arms and the upper part of the stem, nat. size. 9 *a*, portion of one of the arms, showing the pinnules, × 3. Braunton Down. Museum of Practical Geology.

PLATE XXXVI

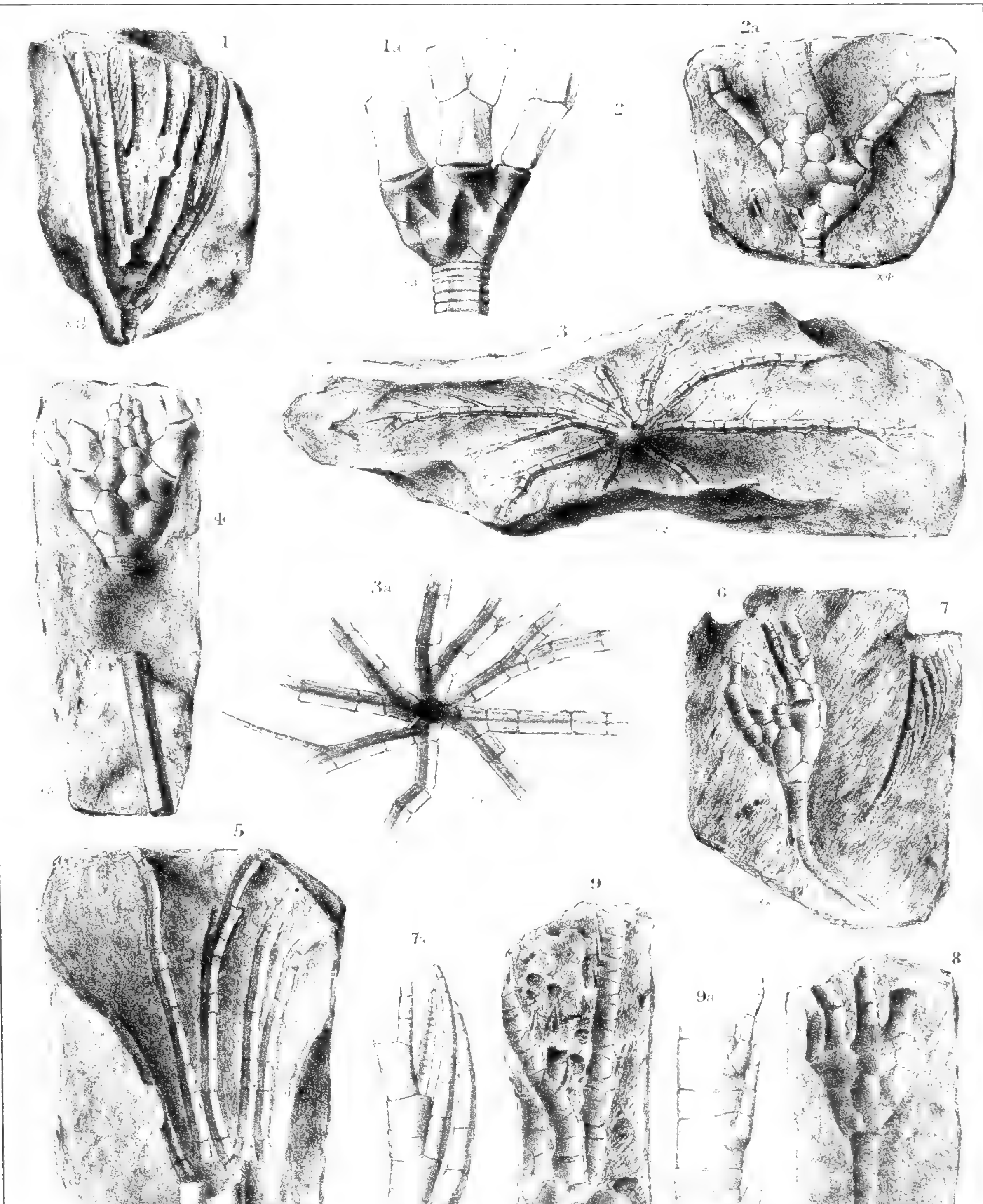

PLATE XXXVII.

Cornulites devonianus, *Whidborne.* (Page 198.)

Fig.

1. Small specimen, × 8. Pilton. Porter Collection.
2. Small recurved specimen, × 8. Roborough. Porter Collection.
3. Larger specimen with irregular annulations, × 2. Pilton. Porter Collection.

Medusaster parvus, n. sp. (Page 205.)

4. Mould of a specimen, showing the disc, the buccal plates, and the sixteen arms, × 9. North-east of Harford Landkey. Hamling Collection.

Megistocrinus? sp. (Page 218.)

5. Cast of a dorsal cup, showing primibrachs, secundibrachs, interradials, and interambulacrals, × 6. Barnstaple. Woodwardian Museum.

Mariocrinus? mundus, n. sp. (Page 219.)

6. Specimen, showing the mould of the stem and the dorsal cup, and the cast of the arms, × 3. Croyde Rocks. My Collection.
7. Mould of the other side of the same dorsal cup, × 3. Croyde Rocks. My Collection.

Platycrinus? anguliferus, n. sp. (Page 223.)

8. Mould of a specimen, showing two radials, some smaller plates, and the beginnings of the arms, × 2. Saunton Hotel. Mr. Coomara Swamy's Collection.
9. Detached radial, × 3. Roborough. Porter Collection.
10. Wax cast of a radial with stronger ornamentation, × 3. Pilton. Porter Collection.
11. Wax cast of another radial, × 3. Roborough. Porter Collection.
12. Mould of a detached columnar, probably belonging to this species, × 3. Vicarage Lane, Pilton. Barnstaple Athenæum.

Scaphiocrinus? salebrosus, n. sp. (Page 232.)

13. Mould of a dorsal cup, showing the tumid plates, × 2. Pilton. Porter Collection.

Scytalocrinus stadiodactylus, *Whidborne*, sp. (Page 233.)

14. The same specimen as figured on Pl. XXXVI, fig. 2, showing the dorsal cup, the ventral sac, and the arms, × 2. Braunton. Barnstaple Athenæum.

(*Figures* 2, 3, 9, 10, *and* 11 *have by accident been placed on the Plate upside down.*)

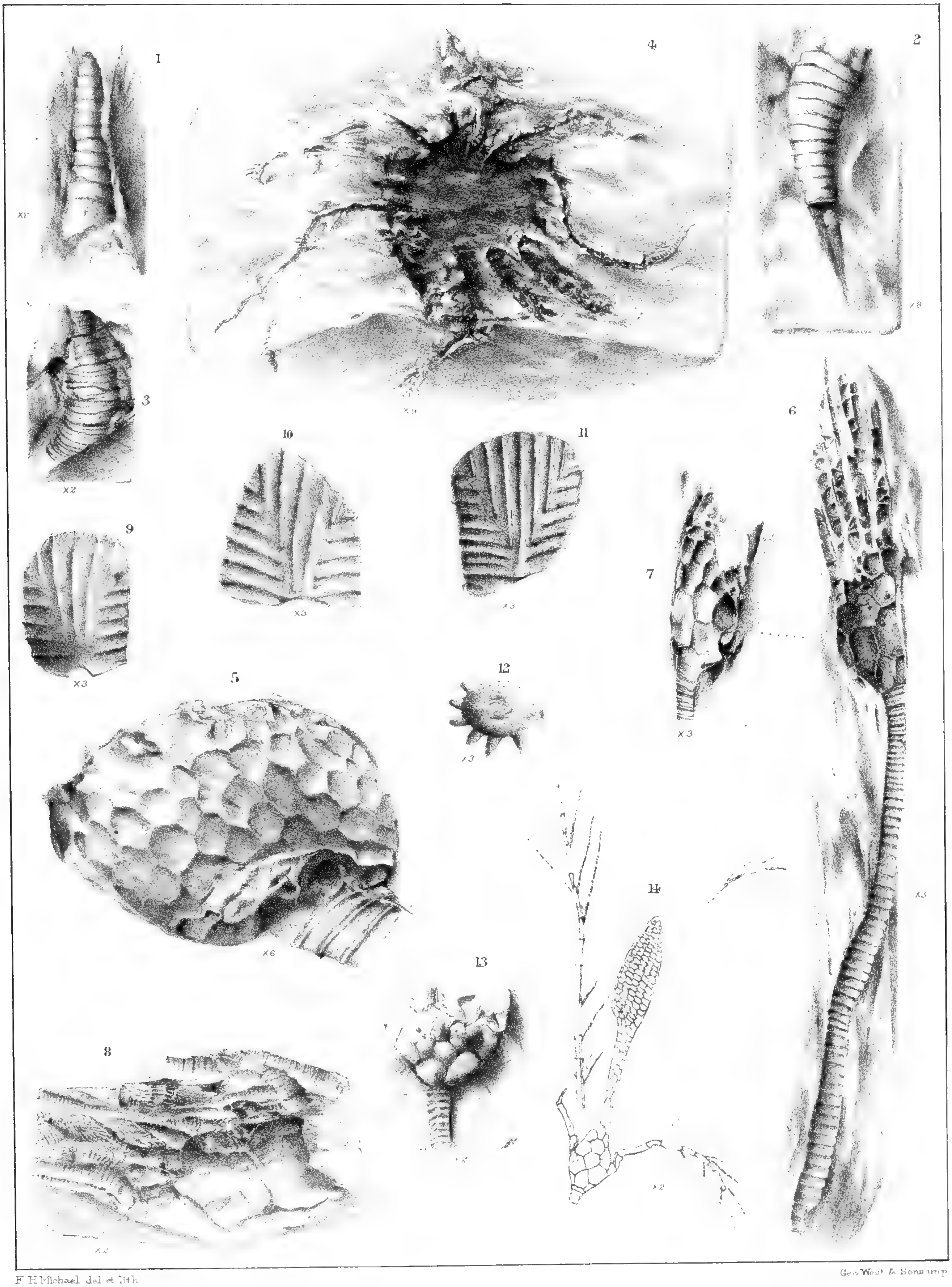

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PLATE XXXVIII.

POTERIOCRINUS TENSUS, *Whidborne*. (Page 226.)

FIG.

1. Specimen, showing the cast of the dorsal cup, the expanded arms (in which no bifurcations are visible), and the exceedingly long slight pinnules, × 2. Saunton Hotel. Partridge Collection.

SCAPHIOCRINUS ? PLUMIFER, n. sp. (Page 228.)

2. Gutta-percha cast of a specimen showing the dorsal cup and the closed arms, × 2. Barnstaple. Woodwardian Museum.

SCAPHIOCRINUS TRANSCISUS, n. sp. (Page 230.)

3. Wax cast of a specimen, showing some plates of the anal side of the dorsal cup and the beginning of the ventral sac, nat. size. Poleshill. Porter Collection.

SCAPHIOCRINUS ? INORDINATUS, n. sp. (Page 230.)

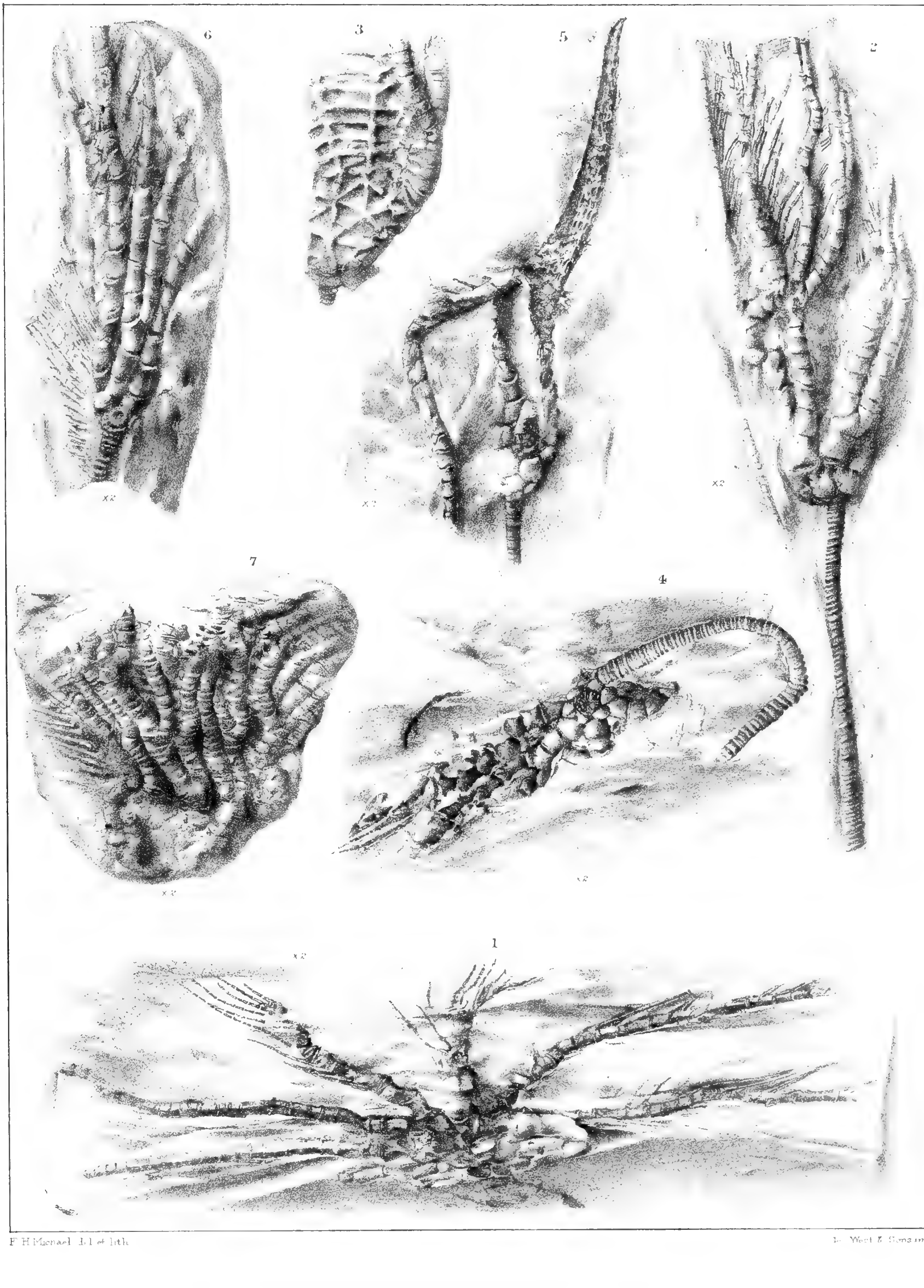
4. Cast of a flattened specimen, showing the arrangement of the plates of the dorsal cup, including the anal plate in the basal ring, and (in four of the arms) the two primibrachs, × 2. Upcott Arch. My Collection.

SCYTALOCRINUS ARACHNOIDEUS, n. sp. (Page 235.)

5. Gutta-percha cast of a specimen, showing the upper part of the stem, the plates of the dorsal cup, the ventral sac, and part of the arms, × 2. Barnstaple. Woodwardian Museum.
6. Gutta-percha cast of another specimen, showing the arms, × 2. Barnstaple. Woodwardian Museum.

CŒLIOCRINUS ? n. sp. (Page 236.)

7. Gutta-percha cast of a specimen, showing the mode of branching of the arms, their short cuneate plates, and the pinnules, × 2. Barnstaple. Woodwardian Museum.



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