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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;

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

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§ I. CATALOGUE OF WORKS

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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.

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

* 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.

† This Vol. is marked on the outside 1855.

‡ This Vol. is marked on the outside 1856.

CATALOGUE OF WORKS—Continued.

Vol. XII.	Issued for the Year 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.
„ XVI.	„ 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.
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CATALOGUE OF WORKS—Continued.

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

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CATALOGUE OF WORKS—Continued.

Vol. XII.	Issued for the Year 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.
„ XVI.	„ 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.

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CATALOGUE OF WORKS—Continued.

Vol. XXII.*	Issued for the Year 1868	Supplement to the Fossil Corals, Part II, No. 1, Cretaceous, by Dr. Duncan, 9 plates. The Fossil Merostomata, Part II, Pterygotus, by Mr. H. Woodward, 6 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 3, Silurian, by Mr. Davidson, 15 plates. The Belemnitidæ, Part IV, Liassic and Oolitic Belemnites, by Prof. Phillips, 7 plates. The Reptilia of the Kimmeridge Clay, No. 3, by Prof. Owen, 4 plates. The Pleistocene Mammalia, Part III, Felis spelæa, concluded, with F. lynx, by Messrs. W. Boyd Dawkins and W. A. Sanford, 6 plates.
„ XXIII.*	„ 1869	Supplement to the Fossil Corals, Part II, No. 2, Cretaceous, by Dr. Duncan, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part III, by Dr. Wright, 10 plates. The Belemnitidæ, Part V, Oxford Clay, &c., Belemnites, by Prof. Phillips, 9 plates. The Fishes of the Old Red Sandstone, Part I (concluded), by Messrs. J. Powrie and E. Ray Lankester, 9 plates. The Reptilia of the Liassic Formations, Part II, by Prof. Owen, 4 plates. The Crag Cetacea, No. 1, by Prof. Owen, 5 plates.
„ XXIV.*	„ 1870	The Flora of the Carboniferous Strata, Part II, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part IV, by Dr. Wright, 10 plates. The Fossil Brachiopoda, Vol. III, Part VII, No. 4, Silurian, by Mr. Davidson, 13 plates. The Eocene Mollusca, Part IV, No. 3, Bivalves, by Mr. S. V. Wood, 5 plates. The Fossil Mammalia of the Mesozoic Formations, by Prof. Owen, 4 plates.
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„ XXVII.*	„ 1873	The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part I (Tertiary and Cretaceous), by Mr. Davidson, 8 plates. Supplement to the Crag Mollusca, Part II (Bivalves), by Mr. S. V. Wood, 5 plates. Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen, 2 plates. Supplement to the Reptilia of the Wealden (Hylæochampsa) No. VI, by Prof. Owen. The Fossil Reptilia of the Mesozoic Formations, Part I, by Prof. Owen, 2 plates.
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„ XXIX.*	„ 1875	The Flora of the Carboniferous Strata, Part IV, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part VII, by Dr. Wright, 10 plates. The Fossil Trigoniæ, No. III, by Dr. Lycett, 8 plates. The Fossil Reptilia of the Mesozoic Formations, Part II, by Prof. Owen, 20 plates.
„ XXX.*	„ 1876	The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady, 12 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 1 (Jurassic and Triassic), by Mr. Davidson, 8 plates. Supplement to the Reptilia of the Wealden (Poikilopleuron and Chondrosteosaurus), No. VII, by Prof. Owen, 6 plates.

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CATALOGUE OF WORKS—Continued.

Vol. XXXI.*	Issued for the Year 1877	Supplement to the Eocene Mollusca (Bivalves), by Mr. S. V. Wood, 2 plates. The Fossil Trigoniæ, No. IV, by Dr. Lycett, 13 plates. The Eocene Mollusca (Univalves), Part IV, by Mr. S. V. Wood, 1 plate. The Carboniferous Ganoid Fishes, Part I (Palæoniscidæ), by Dr. Traquair, 7 plates. The Fossil Reptilia of the Mesozoic Formations, Part III, by Prof. Owen, 2 plates. The Fossil Elephants (E. antiquus), Part I, by Prof. Leith Adams, 5 plates.
" XXXII.*	" 1878	The Fossil Echinodermata, Cretaceous, Vol. I, Part VIII, by Dr. Wright, 8 plates. Index and Title Page to the Fossil Echinodermata, Oolitic, Vol. I (Echinoidea), by Dr. Wright. The Fossil Merostomata, Part V (Neolimulus, &c.), by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 2 (Jurassic and Triassic), by Mr. Davidson, 13 plates. The Lias Ammonites, Part I, by Dr. Wright, 8 plates. The Sirenoid and Crossopterygian Ganoids, Part I, by Prof. Miall, 6 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Petrosuchus, and Suchosaurus), No. VIII, by Prof. Owen, 6 plates. The Pleistocene Mammalia, Part A (Preliminary Treatise), by Prof. Boyd Dawkins.
" XXXIII.*	" 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.

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CATALOGUE OF WORKS—Continued.

Vol. XXXIX.*	Issued for the Year 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.
„ XLII.*	„ 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.

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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 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.)

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* 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.)

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.)

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 Volume 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 Volume 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 Eocene Flora, by Mr. J. S. Gardner.
The Fossil Sponges, by Dr. G. J. Hinde.
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady.†
The Jurassic Gasteropoda, by Mr. W. H. Hudleston.
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 Sirenoid and Crossopterygian Ganoids, by Professor Miall.
The Fishes of the Carboniferous Formation, by Prof. 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 in course of PREPARATION :*—

The Fossil Cycadeæ, by Mr. W. Carruthers.
The Graptolites, by Prof. Lapworth.
The Carboniferous Entomostraca, Part II (Leperditiadæ), by Prof. T. Rupert Jones.
The Wealden, Purbeck, and Jurassic Entomostraca, by Prof. T. R. Jones.
The Purbeck Mollusca, by Mr. R. Etheridge.
The Rhætic Mollusca, by Mr. R. Etheridge.
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.

† Will be finished by Prof. T. Rupert Jones.

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

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

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

§ IV. SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* NOVEMBER, 1892): *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 Spec described 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	1887, 1888	188	9	337	50
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady, *in course of completion*	1865	1866	78	4	211	43
The Carboniferous and Permian Foraminifera, by Mr. H. B. Brady, COMPLETE.........................	1876	1876	166	12	266	62
The Stromatoporoids, by Prof. Alleyne Nicholson, COMPLETE	1885, 1888, 1890, 1892	1886, 1889, 1891, 1892	237	29	415	44
The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime, COMPLETE (*k*)	1849, 1851, 1852, 1853, 1854	1850, 1851, 1852, 1853, 1855	406	72	800	319*g*
Supplement to the Tertiary, Cretaceous, Oolitic, and Liassic Corals, by Prof. Duncan, COMPLETE	1865, 1866, 1867, 1868, 1869, 1872, 1890	1866, 1867, 1868, 1869, 1870, 1872, 1891	232	49	797	149
The Polyzoa of the Crag, by Mr. G. Busk, COMPLETE	1857	1859	145	22	641	122
The Tertiary Echinodermata, by Prof. Forbes, COMPLETE	1852	1852	39	4	144	44
The Oolitic Echinodermata, by Dr. Wright. Vol. I, COMPLETE (*l*)	1855, 1856, 1857, 1858, 1878	1857, 1858, 1859, 1861, 1878	491	43	724	120*h*
„ „ Vol. II, COMPLETE	1861, 1864, 1880	1863, 1866, 1880	207	22	232	35
The Cretaceous Echinodermata, by Dr. Wright. Vol. I, COMPLETE..	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882	1864, 1868, 1870, 1871, 1872, 1874, 1875, 1878, 1881, 1882	390	87	1119	113
„ „ by Mr. W. Percy Sladen. Vol. II, *in course of completion*	1890	1891	28	8	71	9
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)	1889	1890	78	4	258	46
The Carboniferous Entomostraca, by Prof. Rupert Jones and Messrs. J. W. Kirkby and Prof. G. S. Brady. Part I, COMPLETE..	1874, 1884	1874, 1884	95	7	374	81
The Fossil Estheriæ, by Prof. Rupert Jones, COMPLETE	1860	1863	139	5	158	19*i*
		CARRIED FORWARD...	4187	531	9073	1701

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* NOVEMBER, 1892)—*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...	4187	531	9073	1701
The Palæozoic Phyllopoda, by Prof. Rupert Jones and Dr. H. Woodward, *in course of completion*	1887, 1892	1888, 1892	124	17	226	72
The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter, COMPLETE	1862, 1863, 1864, 1866, 1883	1864, 1865, 1866, 1867, 1883	224	31	703	114
The Carboniferous Trilobites, by Dr. H. Woodward, COMPLETE	1883, 1884	1883, 1884	86	10	148	31
The Malacostracous Crustacea (comprising those of the London Clay, Gault, and Greensands), by Prof. T. Bell, *in course of completion*	1856, 1860	1858, 1863	88	22	215	50
The Fossil Brachiopoda, Vol. I. The Tertiary, Cretaceous, Oolitic, and Liassic Brachiopoda, by Mr. T. Davidson, COMPLETE	1850, 1852, 1853, 1854	1851, 1852, 1853, 1855	409	42	1855	160
,, ,, Vol. II. The Permian and Carboniferous Brachiopoda, COMPLETE	1856*d*, 1857, 1858, 1859, 1860	1858, 1859, 1861, 1861, 1863	331	59	1909	157
,, ,, Vol. III. The Devonian and Silurian Brachiopoda, COMPLETE	1862, 1863, 1865, 1866, 1868, 1870	1864, 1865, 1866, 1867, 1869, 1871	528	70	2766	321
,, ,, Vol. IV. Supplements, Tertiary to Carboniferous, COMPLETE	1873, 1876, 1878, 1880, 1881, 1882	1874, 1876, 1878, 1880, 1881, 1882	383	42	1664	215
,, ,, Vol. V. Supplements, Devonian and Silurian, COMPLETE	1882, 1883, 1884	1882, 1883, 1884	476	21	1135	116
,, ,, Vol. VI. Bibliography, COMPLETE	1885	1886	163	—	—	—
The Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1872, 1874, 1875, 1877, 1879	1872, 1874, 1875, 1877, 1879	246	41	446	115
Supplement to the Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1881, 1883	1881, 1883	19	4	53	9*h*
The Mollusca of the Crag, by Mr. S. V. Wood:—						
Vol. I. (Univalves), COMPLETE	1847, 1855*b*	1848, 1857	216	21	581	244
Vol. II. (Bivalves), COMPLETE	1850, 1853, 1855, 1858*c*	1851, 1853, 1857, 1861	344	31	691	253
Supplements to the Crag Mollusca, No. I and II, by Mr. S. V. Wood, COMPLETE	1871, 1873, 1879	1872, 1874, 1879	322	18	517	232
,, ,, No. III ,, COMPLETE	1882	1882	24	1	29	13
The Eocene Mollusca, Cephalopoda and Univalves, by Mr. F. E. Edwards, continued by Mr. S. V. Wood. Vol. I, COMPLETE	1848, 1852, 1854, 1855, 1858, 1877	1849, 1852, 1855, 1857, 1861, 1877	361	34	625	275
The Eocene Mollusca, Bivalves, by Mr. S. V. Wood. Vol. I, COMPLETE	1859, 1862, 1870	1861, 1864, 1871	182	25	531	194
Supplement to the Eocene Mollusca, by Mr. S. V. Wood (Bivalves). Vol. I, COMPLETE	1877	1877	24	2	66	30
The 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
The Jurassic Gasteropoda, by Mr. W. H. Hudleston, *in course of completion*	1886, 1887, 1888, 1889, 1891, 1892	1887, 1888, 1889, 1890, 1892, 1892	316	26	835	257
The Inferior Oolite Ammonites, by Mr. S. S. Buckman, *in course of completion*	1886, 1887, 1888, 1889, 1890, 1891, 1892	1887, 1888, 1889, 1890, 1891, 1892, 1892	344	77	832	120
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...	10311	1261	26809	5399

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* NOVEMBER, 1892)—*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...	10311	1261	26809	5399
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 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	1892, 1892	88	10	204	55
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 and E. Ray Lankester, *in course of completion*	1867, 1869	1868, 1870	62	14	195	21
The Reptilia of the London Clay [and of the Bracklesham and other Tertiary Beds], by Profs. Owen and Bell, Vol. I, COMPLETE ‡	1848, 1849, 1856*f*	1849, 1850, 1859	150	58	304	39
,, ,, Vol. II, Part I, by Prof. Owen, COMPLETE	1880	1880	4	2	4	1
The Reptilia of the Cretaceous Formations, by Prof. Owen, COMPLETE‡	1851, 1857, 1858, 1862	1851, 1859, 1861, 1864	184	59	519	26
The Reptilia of the Wealden and Purbeck Formations (with Supplements 1, 2, 3), by Prof. Owen, COMPLETE ‡	1853, 1854, 1855, 1856, 1857, 1858, 1862	1853, 1855, 1857, 1858, 1859, 1861, 1864	155	62	251	17
The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), COMPLETE	1871, 1873, 1876, 1878, 1879, 1888*n*	1872, 1874, 1876, 1878, 1879, 1889	85	21	175	15
The Reptilia of the Kimmeridge Clay Formation, by Prof. Owen, COMPLETE	1859, 1860, 1868, 1888*n*	1861, 1863, 1869, 1889	16	6	23	4
The Reptilia of the Liassic Formations, by Prof. Owen, COMPLETE	1859,‖ 1860,‖ 1863, 1869, 1881*n*	1861, 1863, 1865, 1870, 1881	174	50	276	20
The Reptilia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1873, 1875, 1877, 1888*n*	1874, 1875, 1877	101	24	165	17
The Red Crag Cetacea, by Prof. Owen, COMPLETE	1869, 1888*n*	1870, 1889	42	5	43	9
The Fossil Elephants, by Prof. Leith Adams, COMPLETE	1877, 1879, 1881*n*	1877, 1879, 1881	265	28	216	3
The Pleistocene Mammalia, by Messrs. W. Boyd Dawkins and W. A. Sanford, *in course of completion*	1864, 1867, 1868, 1871, 1878, 1886	1866, 1868, 1869, 1872, 1878, 1887	333	39	340	12
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1870	1871	115	4	247	30
		TOTAL............	13005	1780	32112	6171

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—1892) *of the* Palæontographical Society.

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

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

STRATIGRAPHICAL TABLE *exhibiting the* BRITISH FOSSILS *already figured and described in the* ANNUAL VOLUMES (1847—1892) *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	1850, 1861, 1868, 1869, 1886, 1887, 1888, 1889 1890, 1891, 1892	...	(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	......	......	1877		
Devonian	...	1862, 1863, 1881, 1882, 1884	1890, 1891, 1892	1889	1867 1869		
Silurian............	...	1865, 1866, 1868, 1870, 1881, 1882, 1883					
Cambrian							

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

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A MONOGRAPH

OF THE

BRITISH STROMATOPOROIDS.

BY

H. ALLEYNE NICHOLSON, M.D., D.Sc., Ph.D., F.G.S.,
REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF ABERDEEN.

PART IV.

TABLE OF CONTENTS, DESCRIPTION OF SPECIES, SUPPLEMENT, APPENDIX, INDEX, AND GENERAL TITLE-PAGE, WITH DIRECTIONS FOR BINDING.

Pages 203—234; Plates XXVI—XXIX.

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THE BRITISH STROMATOPOROIDS.

DIRECTIONS TO THE BINDER.

The Monograph on the British Stromatoporoids will be found in the Volumes of the Palæontographical Society for the years 1885, 1888, 1890, and 1892.

Cancel the Title-pages to the Parts I, II, III, and IV issued in the Volumes of the Palæontographical Society for the years 1885, 1888, 1890, and 1892; *cancel* also the Table of Contents in the Volume for the year 1885; *substitute* the accompanying General Title-page and Table of Contents now provided, and place the sheets and Plates in the order indicated below.

ORDER OF BINDING AND DATES OF PUBLICATION.

PAGES	PLATES	ISSUED IN VOL. FOR YEAR	PUBLISHED
Title-page	—	1892	November, 1892
Table of Contents	—	,,	,,
i—iii	—	1885	January, 1886
1—130	I—XI	,,	,,
131—158	XII—XIX	1888	March, 1889
159—202	XX—XXV	1890	April, 1891
203—234	XXVI—XXIX	1892	November, 1892

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TABLE OF CONTENTS.

vermiculate ridges. Parts of the surface may be covered by a thin calcareous membrane, which is perforated by scattered circular apertures (Plate IV, fig. 6).

As regards its internal structure, the skeleton-fibre is minutely porous, or is penetrated by delicate canaliculi (Plate I, figs. 4 and 5); while the general cœnosteal tissue is of the incompletely reticulated type. Vertical sections (Plate I, fig. 5, and Plate VII, fig. 6) show well-developed "concentric laminæ," each of which commonly exhibits a median clear line. The apparent "laminæ" of vertical sections (Plate XXVI, fig. 1 *b*) represent the regularly developed connecting processes of the radial pillars; the latter structures being short and usually discontinuous, being commonly confined to the interlaminar space in which they originate. From eight to ten concentric laminæ occupy the space of 2 mm. measured vertically. Imperfect zoöidal tubes, with remote tabulæ, are sometimes recognisable, but, in general, vertical sections do not clearly exhibit the presence of such structures in a definite form. In tangential sections (Plate I, fig. 15; Plate XXVI, fig. 1 *a*) the perforated tubercles of the successive laminæ are abundantly seen, each in the form of a more or less complete ring, enclosing a central space. Occasionally the intervals between the cut ends of the radial pillars are crossed by delicate partitions, indicating the presence of astrorhizal tabulæ or "interlaminar septa."

Obs.—Having now fully examined my available material, I have come to the conclusion that the Devonian rocks of North America contain two allied but nevertheless really distinct species of *Stromatoporella*, which up till now I have included under the single name of *S. granulata.* One of these—the true *S. granulata*—occurs in the Hamilton formation, and I have supplemented the figures of its microscopic structure with a drawing of an actual specimen (Plate XXVI, fig. 1). The other form in question occurs in the Corniferous Limestone of Canada; and I shall briefly describe it under the name of *S. Selwynii*, Nich. Neither of these forms can be positively asserted to occur in the Devonian rocks of either Britain or Germany, though from both of these regions I have examples of closely related if not identical types.

As regards its general characters, *S. granulata*, Nich., as here restricted, is distinguished by its laminar cœnosteum, its non-parasitic habit, and its epithecate under surface. The upper surface always exhibits well-marked astrorhizal prominences or "mamelons" (Plate XXVI, fig. 1), and is always studded with numerous tubercles, of which the larger have apertures at their apices.[1]

[1] In the heading to this description of *S. granulata*, fig. 14 of Plate I is inadvertently quoted as illustrating the surface-characters of the species. In the explanation to Plate I this same illustration is likewise ascribed to *S. granulata.* This figure, however, really belongs to the form which I now name *S. Selwynii*, which in surface-characters closely resembles *S. granulata.* Fig. 6 of Plate IV is illustrative of the surface of the true *S. granulata.*

As regards its microscopic structure, the most marked feature in *S. granulata* is the presence in tangential sections (Plate I, fig. 15, and Plate XXVI, fig. 1 *a*) of more or less numerous, complete or incomplete, rings, enclosing each a central space. These represent the perforated tubercles of the successive laminæ, as seen when transversely divided. The same feature characterises corresponding sections of *S. Selwynii*, Nich., also; but the latter species is sufficiently separated from the present form by its comparatively coarse structure.

From *S. eifeliensis*, Nich., the present species is distinguished by its non-parasitic habit of growth, by the much more limited development of the astrorhizæ, by the presence of "mamelons" or astrorhizal prominences, and by the possession of the perforated tubercles alluded to above.

The form which I shall here describe under the name of *S. solitaria* is nearly related to *S. granulata*, as shown by its similar mode of growth, its possession of "mamelons," and the general likeness of the minute structure of the skeleton in the two. It also exhibits in tangential sections (Plate XXVII, fig. 6) appearances very similar to those which are above referred to as characterising corresponding sections of *S. granulata*. At the same time *S. solitaria* is sufficiently proved to be distinct from *S. granulata* by its decidedly coarser structure, and also by the much more complete development of "astrorhizal cylinders," while its skeleton resembles that of *S. eifeliensis* in being tubulated rather than simply porous.

From *S. socialis*, Nich., the most abundant of the British species of *Stromatoporella*, the present species is distinguished by its generally thicker skeleton-fibre, and more lax structure, as well as by the characteristic perforated tubercles previously referred to. Lastly, *S. damnoniensis*, Nich., is adequately separated from *S. granulata* by its much coarser skeleton-fibre, as well as by the limited development of its astrorhizal system.

I have not so far met with any example of *Stromatoporella granulata* in the "Caunopora-state." Indeed, one of the difficulties in arriving at absolutely clear and satisfactory conclusions as to the so-called "Caunoporæ" is that "Caunopora tubes" are so commonly present in certain Stromatoporoids, while there are a few forms—apparently of very similar structure and habit—in which such tubes are seemingly never present.

Distribution.—Not uncommon in the Devonian rocks (Hamilton formation) of Ontario. As above stated, no undoubted British or German examples of this species have been recognised as yet; but the microscopic structure of some of the *Stromatoporellæ* which abound in the pebbles of Devonian Limestone in the Triassic conglomerates of South Devon strongly reminds us of this species.

2. STROMATOPORELLA SELWYNII, n. sp. Pl. I, fig. 14, and Pl. XXVI, figs. 2—4.

The cœnosteum in this species is massive or laminar, and apparently attains a considerable size. The mode of attachment, in the only case observed, is by the greater portion of the under surface. The laminæ are gently undulated, but there are no distinct astrorhizal eminences or "mamelons," nor are "astrorhizal cylinders" developed. The surface is studded with numerous tubercles, of different sizes, the smaller ones being imperforate, while the larger ones are blunt, and have their apices pierced by round apertures (Plate XXVI, fig. 2). Astrorhizæ are apparently wanting, or may be incompletely developed; but they do not constitute a marked feature in the specimens examined.

As regards microscopic structure the skeleton-fibre is thick, and is seen in sections to be minutely porous. Tangential sections (Plate XXVI, fig. 3) show the cut ends of the radial pillars, together with a larger or smaller number of complete or incomplete rings, the latter representing sections of the hollow tubercles which are developed on each successive lamina. Vertical sections (Plate XXVI, fig. 4) show very well-defined concentric laminæ, of which about six occupy the space of 2 mm. measured vertically. The radial pillars are well developed, but are, as a rule, confined each to its own interlaminar space. Imperfect zoöidal tubes are occasionally recognisable, but are never conspicuous.

Obs.—This form, as shown by the characters of the skeleton, is closely related to *S. granulata*, Nich., and I had previously regarded it as merely a variety of the latter. I am, however, now satisfied that it may be fairly considered as a good species, and I have much pleasure in naming it after the distinguished Director of the Geological Survey of Canada.

Stromatoporella Selwynii is separated from *S. granulata* by the fact that the laminæ of the cœnosteum are simply undulated, and the astrorhizæ are imperfectly developed, the surface therefore never exhibiting the characteristic rounded or conical "mamelons" of the latter species. As regards internal characters, *S. Selwynii* is further separated from *S. granulata* by its markedly coarser structure, as will be at once seen from a comparison of corresponding sections of the two forms in question drawn to the same scale (compare figs. 1 *a* and 1 *b* of Plate XXVI with figs. 3 and 4 of the same plate). From other related species of the genus *Stromatoporella*, *S. Selwynii* is separated by characters essentially the same as those distinctive of *S. granulata*, as pointed out in the observations made with regard to the latter form.

Distribution.—Not uncommon in the Corniferous Limestone of Port Colborne, Ontario. *S. Selwynii* has not yet been certainly recognised in Britain, though some specimens from the Devonian pebbles in the Triassic conglomerates of Devonshire yield sections in some respects resembling those of the present species.

3. Stromatoporella socialis, n. sp. Pl. XXVI, figs. 5—7.

This species is only known to me from the pebbles of Devonian Limestone in the Triassic conglomerates of South Devon, and the characters of its surface and its mode of growth are therefore imperfectly or not at all known. It appears, however, to have been in general either laminar or massive in form, and it certainly was not of an encrusting habit. The laminæ of the cœnosteum are always more or less extensively undulated, and sections show conclusively that "astrorhizal cylinders" were usually more or less largely developed. The astrorhizæ, namely, are not only well marked and of large size, but they are superimposed in vertical rows in successive laminæ, each series having a wall-less axial canal round which the laminæ are concentrically wrapped (Plate XXVI, fig. 5). The interspaces between the astrorhizal cylinders are occupied by undulating laminæ, in the same manner as in *Actinostroma verrucosum*, Goldf. We may, therefore, assume that the surface, when observed, will be found to be more or less extensively covered with prominent conical eminences or "mamelons," at the apex of each of which the central canal of a series of astrorhizæ will open.

The skeleton-fibre was doubtless porous, but in all the specimens examined the intimate structure of the fibre has been so obscured by secondary crystallisation that this point cannot be definitely ascertained.

Tangential sections (Plate XXVI, figs. 5 and 6) show the cut ends of the radial pillars united into a reticulation, which, though imperfect, is more complete than is usual in the genus *Stromatoporella*. Where such sections traverse an astrorhizal cylinder (as in Plate XXVI, fig. 5), then, of course, the laminæ are seen as cut vertically or obliquely. Tangential sections do not exhibit the incomplete or complete rings so characteristic of corresponding sections of *Stromatoporella granulata* or *S. Selwynii*, and we may therefore conclude that the surface did not possess the perforated tubercles of the species just mentioned.

Vertical sections (Plate XXVI, fig. 7) show well-defined concentric laminæ and short radial pillars, the latter confined to their respective interlaminar spaces, or not even extending completely across these. Definite zoöidal tubes cannot be detected. Nine or ten laminæ occupy the space of 2 mm. measured vertically.

Obs.—This is by far the commonest species of *Stromatoporella* in the Devonian rocks of Britain; and its microscopic characters enable us to separate it definitely from the other species of the genus. From *S. granulata*, Nich., it is distinguished by its total want of perforated tubercles, and the more complete development of astrorhizal cylinders, pointing to a more massive habit of growth. From *S. Selwynii*, Nich., it is separated not only by the characters just mentioned, but also by the much finer structure of the skeleton. In the general structure of the skeleton, and more especially in the possession of astrorhizal cylinders, *S. socialis* more nearly resembles *S. solitaria*, Nich., than it does either of the species just alluded to; but its skeletal tissue is much finer and closer, while the latter has perforated tubercles. From *S. damnoniensis*, Nich., lastly, the present species is at once distinguished by the much greater delicacy of its skeleton. There are no other species of the genus known to me with which *S. socialis* could well be confounded.

The great majority of the specimens of *Stromatoporella socialis* occur in the "Caunopora-state" (Plate XXVI, fig. 6), the "Caunopora-tubes" showing well marked infundibuliform tabulæ and, occasionally, radiating spines or "septa." A few specimens appear to be free from "Caunopora-tubes" (Plate XXVI, fig. 5).

Distribution.—Very abundant in the pebbles of Devonian Limestone in the Triassic conglomerates of South Devon. It occurs also in the Devonian Limestone of Dartington and at Bishopsteignton. An apparently identical form, with a laminar cœnosteum, occurs in the Middle Devonian of the Eifel.

4. STROMATOPORELLA DAMNONIENSIS, *Nicholson*. Pl. XXVII, figs. 8 and 9.

STROMATOPORELLA DAMNONIENSIS, *Nicholson*. Ann. and Mag. Nat. Hist., ser. 5, vol. xvii, p. 237, pl. viii, figs. 3 and 4, 1886.

The external characters of this species are imperfectly known; but the cœnosteum appears to be in general massive, and more or less hemispherical in shape, with an epithecate under surface. The upper surface is not known completely, but seems to have been generally gently undulated.

The concentric laminæ of the cœnosteum are gently undulated, and the astrorhizæ are arranged in vertical systems, each of which is built up round a wall-less axial canal; so that "mamelons" were almost certainly present. At the same time the astrorhizæ are comparatively small and remote. "Astrorhizal tabulæ" are present in the horizontal astrorhizal canals.

The skeleton-fibre is exceedingly thick, and is minutely tubulated. About six laminæ and five interlaminar spaces occupy the space of 2 mm. measured vertically, the laminæ and intervening spaces being of about equal width as seen in vertical sections (Plate XXVII, fig. 9). The radial pillars are confined to their respective interlaminar spaces. Irregular tabulate zoöidal tubes, usually extending from one interlaminar space to the next above only, may be present. Tangential sections (Plate XXVII, fig. 8) show an irregular and imperfect reticulation, the more complete tracts of which (where the section is most completely coincident with the plane of a concentric lamina) exhibit the rounded apertures of the irregularly divided zoöidal tubes.

Obs.—This species is most nearly related to *S. solitaria*, Nich., from which it is distinguished more particularly by the markedly greater thickness of the skeleton-fibre, and the greater density of the cœnosteal network thence resulting. The astrorhizal system is also not so highly developed in *S. damnoniensis* as it is in *S. solitaria*. From *S. eifeliensis*, Nich., the present species is distinguished by its wholly different mode of growth, by the much more rudimentary condition of the astrorhizal system, and by the more solid character of the skeleton-fibre. There are no other species of the genus *Stromatoporella*, as yet described, with which *S. damnoniensis* could well be confounded.

The external characters of *S. damnoniensis* are imperfectly known, as all the British examples hitherto recognised have been derived from the Triassic conglomerates of Devonshire, and the few German specimens which I have collected are in a state of poor preservation.

Distribution.—Rare in the pebbles of Devonian Limestone in the Triassic conglomerates of Teignmouth. Also in the Middle Devonian Limestones of Sötenich, in the Eifel.

5. Stromatoporella eifeliensis, *Nicholson*. Pl. IV, fig. 2; Pl. VII, fig. 3 (*non* fig. 4); Pl. XI, figs. 1 and 2; Pl. XXVII, figs. 1—3.

Stromatoporella eifeliensis, *Nicholson*. Mon. Brit. Strom., part 1, 1886 (named and figured, but not described).

— — — (pars). Ann. and Mag. Nat. Hist., ser. 5, vol. xvii, p. 235, pl. viii, fig. 5 (*non* figs. 6 and 7), 1866.

The cœnosteum in this species is encrusting and parasitic, and is attached by the whole of the lower surface to some foreign body, the thickness of the crust varying from one millimètre up to $1\frac{1}{2}$ centimètres. The laminæ are straight or gently curved, and the surface is therefore smooth and destitute of "mamelons." The astrorhizæ are exceedingly well developed, greatly ramified (Plate XXVII, fig. 1, and Plate IV, fig. 2), and often of remarkably large size, their centres being commonly 2 to 3 centimètres apart. The astrorhizal canals are often furnished with transverse partitions or "astrorhizal tabulæ;" but the astrorhizal systems are not superimposed in vertical groups.

As regards its minute structure, the skeleton-fibre is thick, and is seen in well-preserved examples to be traversed by minute inosculating microscopic tubuli (Plate XI, figs. 1 and 2, and Plate XXVII, figs. 2 and 3). Vertical sections (Plate XXVII, fig. 3) show thick and very distinct concentric laminæ, of which about six occupy the space of 2 mm. measured vertically. Owing to the thickness of the laminæ, the interlaminar spaces are comparatively narrow, and the correspondingly thick radial pillars usually run from lamina to lamina, but do not extend beyond the interlaminar space within which each originates. Definite zoöidal tubes are not recognisable. The interlaminar spaces are occasionally traversed by a few irregular, curved, calcareous partitions ("interlaminar septa"), but these are never numerous, and may be wanting. Tangential sections (Plate XXVII, fig. 2) show that the skeleton is more completely reticulate than is usual in the genus *Stromatoporella*. The cut ends of the radial pillars are so far confluent as to give rise to a coarse network, which is traversed by the branches of the astrorhizal canals, and is perforated by rounded or oval apertures representing sections of short zoöidal tubes.

S. eifeliensis, as above defined, has not as yet been recognised in the "Caunopora-state."

Obs.—A careful examination of a very large series of specimens has now satisfied me that in my former description of the species ('Ann. Nat. Hist.,' ser. 5, vol. xvii, p. 235) I embraced two distinct though related types, which differ from one other both in habit and in minute structure.

One of these forms, to which I shall restrict the name of *S. eifeliensis*, is invariably parasitic, and forms thin crusts attached by the whole of the lower surface to foreign organisms, such as *Heliolites porosa*, Goldf., or, still more commonly, *Rhaphidopora stromatoporoides*, Roem. The other form, which I shall describe immediately under the name of *S. solitaria*, possesses a laminar cœnosteum with an epithecate under surface, and is non-parasitic, being attached by a limited point only.

The surface of *S. eifeliensis* is smooth, and is destitute of "mamelons" (Plate XXVII, fig. 1); while it is characterised by the extraordinary development of the astrorhizal gutters, which are typically so extremely branched as to permit of the free inosculation of adjoining systems. The general aspect of the surface in well-preserved specimens thus closely reminds us of that of *Stromatopora discoidea*, Lonsd. The astrorhizæ (Plate IV, fig. 2) are, moreover, usually of large size, and their centres are widely remote. On the other hand, in *S. solitaria* the astrorhizæ are circumscribed and comparatively small, while they are arranged in vertically superimposed systems. Each of these systems, further, becomes surrounded in *S. solitaria* by an "astrorhizal cylinder," similar to what is seen in *Actinostroma verrucosum*, Goldf. Hence the surface exhibits conspicuous conical prominences or "mamelons" (Plate XXVII, fig. 4).

Again, as regards the minute structure of the cœnosteum, though the concentric laminæ have much about the same closeness in the two species, these structures are much more delicate in *S. solitaria* than they are in *S. eifeliensis*, the interlaminar spaces of the former thus becoming comparatively much wider and more open (compare figs. 3 and 7, Plate XXVII).

Lastly, the skeletal tissue is much less completely reticulated in *S. solitaria* than it is in *S. eifeliensis*, while there exist perforated tubercles of the same character as those seen in *S. granulata*, Nich.

As above restricted, *S. eifeliensis* becomes an exceedingly natural and well-defined species of *Stromatoporella;* and the only other form of the genus with which it could be confounded is *S. arachnoidea*, Nich., which occurs associated with it. This latter species ('Ann. Nat. Hist.,' ser. 5, vol. xvii, p. 237, pl. viii, figs. 1 and 2) is, however, distinguished from *S. eifeliensis* not only by its non-parasitic habit, but also by the extraordinary development of the "interlaminar septa," which give to both tangential and vertical sections of the cœnosteum an altogether unique and characteristic appearance.

Distribution.—*S. eifeliensis* occurs abundantly in the Middle Devonian of Gerolstein, in the Eifel. I have not certainly identified the species as occurring in the corresponding rocks in Britain, the form which I doubtfully referred to this species ('Mon. Brit. Strom.,' pl. ii, figs. 9 and 10) being rather referable to the type which I now call *S. solitaria*.

6. Stromatoporella solitaria, n. sp. Pl. VII, fig. 4, and Pl. XXVII, figs. 4—7; (?) also Pl. II, figs. 9 and 10.

Stromatoporella eifeliensis, *Nicholson*.	Mon. Brit. Strom., pt. 1, pl. vii, fig. 4 (figure only); and woodcut, fig. 7, 1886.
— — —	(pars). Ann. Nat. Hist., ser. 5, vol. xvii, pl. viii, figs. 5 and 7 (not fig. 6), 1886.

The cœnosteum in this species is of considerable size, laminar in form, with a basal epitheca, attached at one point only, not parasitic. The thickness of the cœnosteum is from two to nearly three centimètres. The surface (Plate XXVII, fig. 4) exhibits prominent conical eminences or "mamelons," the centres of which are from one to one and a half centimètres apart; and is covered with small but well-marked tubercles, some of which appear to be perforated at their apices. The "mamelons" are formed by the upward bending of the skeletal laminæ in such a way as to form "astrorhizal cylinders," each of which encloses a vertical wall-less canal forming the axis of a series of superimposed astrorhizæ (woodcut, fig. 28). The opening of this axial canal is placed at the summit of a mamelon, and the radiating canals diverge from this. The astrorhizæ are, however, small and circumscribed, and they do not become confluent by the anastomosis of the terminal twigs of adjoining systems.

FIG. 28.

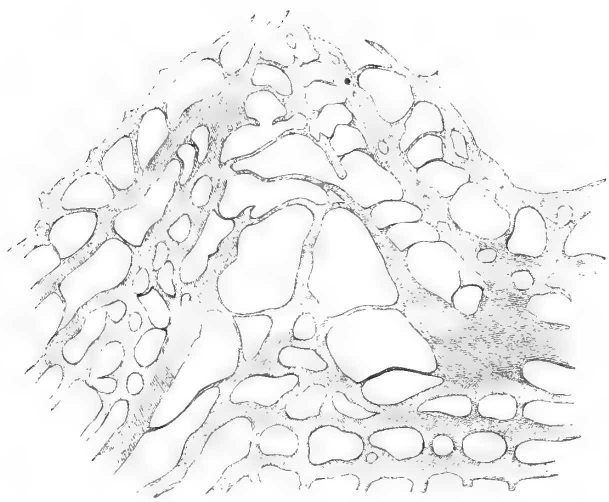


FIG. 28.—Vertical section through part of an astrorhizal cylinder of *Stromatoporella solitaria*, Nich., enlarged twelve times. Middle Devonian, Gerolstein, Eifel. (This is fig. 7, p. 56, where it is figured as belonging to *S. eifeliensis*, Nich.)

As regards internal structure, the skeleton-fibre is moderately thick, and is minutely porous, or even delicately canaliculated, though it does not exhibit the marked tubulated structure of typical examples of *S. eifeliensis*. Tangential sections exhibit different appearances according as the section traverses an interspace between two mamelons, or cuts across one of these eminences. In the first case (Plate XXVII, fig. 6) the cut ends of the radial pillars are seen, separate or more or less confluent, and often showing central clear spots which correspond with those seen in similar sections in *S. granulata*, Nich., and *S. Selwynii*, Nich., and which indicate the presence of perforated surface-tubercles. On the other hand, if the section traverses a mamelon (Plate XXVII, fig. 5), we see in the centre the aperture of a transversely divided axial astrorhizal canal, surrounded by concentrically disposed laminæ with their uniting pillars.

Vertical sections (Plate XXVII, fig. 7) show well-marked concentric laminæ, of which about six occupy the space of 2 mm. measured vertically. The radial pillars are stout, and are confined to the interlaminar spaces in which each originates. "Interlaminar septa" are often present in fairly large numbers, and have the form of delicate curved calcareous partitions intersecting the interlaminar spaces obliquely. If a vertical section traverses a mamelon (woodcut, fig. 28), the axial and radial canals of the astrorhizal system belonging thereto are seen to be crossed by irregular calcareous partitions or "astrorhizal tabulæ."

Specimens of *S. solitaria* are commonly found in the "Caunopora-state," but show no phenomena of special interest.

Obs.—As previously pointed out, I am now satisfied that I formerly included two distinct types under the name of *Stromatoporella eifeliensis;* and I now propose the name of *S. solitaria* for those specimens which agree with the specific description above given. In various respects, and particularly as regards minute structure, *S. solitaria* agrees with *S. eifeliensis;* while the difficulty of separating the one from the other is enhanced by the fact that specimens of the two are very commonly associated with one another. Nevertheless, both as regards microscopic structure and macroscopic characters, there are sufficient distinctive features to warrant the separation of the two forms as distinct species.

Thus while the cœnosteum of *S. eifeliensis* has the form of a crust parasitically attached to foreign bodies by the whole of the lower surface, that of *S. solitaria* is laminar, is furnished with an inferior epithecal membrane, and is attached by one point only. The astrorhizæ of *S. eifeliensis* are extraordinarily developed, and anastomose freely with one another, but they are not arranged in superimposed systems, and neither "astrorhizal cylinders" nor surface-eminences are developed. On the other hand, the astrorhizæ of *S. solitaria* are comparatively small, and are circumscribed; but they are vertically superimposed, and usually form the centres of well-defined "astrorhizal cylinders," while they open on prominent surface-projections or "mamelons" (Plate XXVII, fig. 4).

As regards minute structure, again, the skeleton-fibre of *S. solitaria* is not so finely tubulated as it is in *S. eifeliensis*, and is at the same time much more delicate. The result of this latter character is that the cœnosteal network of *S. solitaria* becomes conspicuously more lax and open than is the case in *S. eifeliensis* (compare figs. 2 and 3 with figs. 6 and 7 of Plate XXVII). Lastly, *S. solitaria* shows in tangential sections the same perforated tubercles as are characteristic of corresponding sections of *S. granulata* or *S. Selwynii.*

Leaving *S. eifeliensis* out of consideration, the species which *S. solitaria* most nearly resembles is *S. Selwynii*, Nich. From this form, however, the present species is separated by the comparatively greater delicacy of the skeletal framework, the much more extensive development of the astrorhizal system, and the presence of "mamelons." There is no other species of *Stromatoporella* which *S. solitaria* resembles with such closeness in internal structure as to demand a detailed comparison.

Distribution.—*S. solitaria* is not uncommon in the Middle Devonian Limestones of the Auberg, at Gerolstein in the Eifel. It is very difficult to identify this form among the species of *Stromatoporella* which occur in the pebbles of Devonian Limestone in the Triassic conglomerates of Devonshire, since such derived specimens necessarily exhibit no surface-characters. I am disposed, however, to think that the sections figured by me in Plate II, figs. 9 and 10, and doubtfully referred to *S. eifeliensis*, really belong to the present species.

7. Stromatoporella curiosa, *Barg.* sp. Pl. XXVIII, figs. 1—3.

Stromatopora polymorpha, *Goldfuss.* Petref. Germ., pl. lxiv, figs. 8 *a*, 8 *c*, and 8 *d* (cæt. excl.), 1826.
— curiosa, *Bargatzky.* Die Stromatoporen des Rheinischen Devons, p. 55, 1881.
Stromatoporella curiosa, *Nicholson.* Ann. and Mag. Nat. Hist., ser. v, vol. xviii, p. 8, pl. i, figs. 1—3, 1886.

Cœnosteum incrusting, thin, attached by the whole of the inferior surface to some foreign body, and usually developing externally numerous irregular pointed eminences, at the extremities of which the astrorhizæ open. Surface usually covered with minute rounded tubercles, the apices of which may be perforated, and also exhibiting branched astrorhizal canals; in other cases part or the whole of the surface may be covered by a thin calcareous membrane, which exhibits few or no apertures of any kind. As regards internal structure, the skeleton-fibre is minutely porous, and the skeletal tissue is of the imperfectly reticulate type. The concentric laminæ are thick and well marked, often with a median clear line in each (as seen in vertical section), and they are placed from $\frac{1}{4}$ to $\frac{1}{3}$ millimètre apart. The transversely divided ends of the radial pillars can be more or less extensively recognised as distinct structures in tangential sections. The astrorhizæ are furnished with vertical axial canals, and astrorhizal tabulæ may be sparingly present. Definite zoöidal tubes are not recognisable.

Obs.—This is a typical example of an incrusting and parasitic Stromatoporoid. It envelops Rugose Corals or other organisms, and forms crusts varying in thickness from less than a millimètre up to 5 or 6 millimètres One of its most characteristic and conspicuous external features is the fact that the exterior is more or less extensively covered with pointed conical eminences (Plate XXVIII, fig. 1), which may be imperforate, or which may terminate in an aperture corresponding with the centre of one of the astrorhizal systems. These eminences or "mamelons" may be comparatively large, sometimes more than a centimètre in height, in which case they are comparatively few in number. More usually they are smaller, perhaps 2 or 3 millimètres in height, and in this case they are numerous. When well developed, each of these pointed eminences consists of concentrically laminated tissue traversed centrally by the axial canal of an astrorhizal system, and having the external opening of the same at its apex, while the astrorhizal twigs run down its sides externally.

The surface presents curious and very puzzling variations in different examples, or in different regions of the same specimen. Sometimes the whole, or a part only, of the surface is covered with minute rounded or elongated tubercles, which sometimes coalesce into vermiculate ridges, and which may have their apices perforated with minute circular apertures. This seems to be the normal condition of the surface. In many specimens, however, this granulated surface is extensively or completely concealed from view by the development of a delicate smooth calcareous pellicle or membrane. This external membrane may pass unbrokenly over the mamelons as well as over the general surface; but commonly the apices of the mamelons show a few small apertures or the single larger opening of an astrorhizal canal. In this latter case the appearances presented remind one of the general surface of *Distichopora* at points where ampullæ are developed.

As regards internal structure, the general appearances presented by tangential and vertical sections (Plate XXVIII, figs. 2 and 3) are very similar to those of corresponding sections of *Stromatoporella eifeliensis*, Nich., and need not be more minutely discussed here. The present species is distinguished from *S. eifeliensis*, as from the other related species of *Stromatoporella*, by its uniformly incrusting habit, the development of pointed mamelons, and the characters of its surface. On the other hand, there is a close general resemblance between *Stromatoporella curiosa*, Barg., and the form which Hall and Whitfield described from the Devonian rocks of Iowa under the name of *Cœnostroma incrustans* ('Twenty-third Ann. Rep. of the State Cabinet,' p. 227, pl. ix, fig. 3, 1873). This latter, as I have shown elsewhere ('Ann. Nat. Hist.,' ser. 6, vol. vii, p. 310, 1891) is really identical with the fossil which I described from the Hamilton rocks of Ontario under the name of *Stromatopora nulliporoides* ('Second Report on the Palæontology of Ontario,' p. 78, 1875), this title thus falling to be abandoned. I have now examined an authentic example of *Cœnostroma incrustans*, H. and W., and find it to be a species of *Stromatoporella*, very nearly related to *S. curiosa*, Barg., in general characters and in minute structure. Upon the whole, however, the American and Canadian type may fairly rank as a distinct species, since it not only shows the superficial distinction that its mamelons are closer set, more regular, and more pointed than they are in *S. curiosa* (see Plate III, fig. 6), but the general skeletal tissue, as shown in thin sections, is decidedly more close and dense.

Distribution.—This species is of common occurrence in the Middle Devonian Limestones of Büchel (in the Paffrath district), and occurs also in the Eifel. As regards Britain, I possess two examples of an incrusting Stromatoporoid, collected by the late Mr. Champernowne in the Middle Devonian Limestones of Pit Park Quarry, Dartington, which show all the general characters of the present species. Unfortunately the internal structure of these specimens is imperfectly preserved, and though I have no reason to doubt the correctness of my determination, I have preferred to take the description of the species from specimens collected in Germany, and the specimens figured are also German.

Genus 4.—Hermatostroma, *Nicholson*, 1886.

(General Introduction, p. 105.)

1. Hermatostroma Schlüteri, *Nicholson*. Pl. III, figs. 1 and 2; Pl. XXVIII, figs. 12 and 13; and woodcuts, figs. 1, 16, 29, 30, 31, and 32.

Hermatostroma Schlüteri, *Nicholson*. Mon. Brit. Strom., General Introduction, p. 105, 1886 (figured but not described).

The cœnosteum in this species is massive, and readily splits into thick concentric strata of the nature of "latilaminæ." The true surface is not known, but the supposed upper surfaces of the laminæ are covered with broad and comparatively low, rounded elevations of variable size, which are formed by gentle bendings of the concentric layers (Plate XXVIII, fig. 12). These elevations are about 3—4 mm. in diameter, two of them usually occupying a space of about 1 cm., and they do not constitute proper "mamelons," since they do not carry the apertures of the astrorhizæ at their summits. Astrorhizæ, in fact, appear to be wanting.

As regards its minute structure, the skeleton-fibre is very thick, and is furnished with an axial canal, which may give off secondary prolongations, but it is not minutely porous. Vertical sections (Plate III, fig. 2) show exceedingly strong "continuous" radial pillars, which traverse many successive interlaminar spaces without a break, and are connected at definite intervals by short and stout connecting processes, which give rise to very regular "concentric laminæ." As the connecting processes are rectangular to the pillars, vertical sections show a characteristic trellis-like appearance, the interlaminar spaces being broken up into rectangular meshes. The radial pillars are traversed by very large axial canals, and prolongations of these canals extend into the horizontal connecting processes. Six or fewer pillars, and a like number of concentric laminæ, occupy a space of 2 mm., measured respectively in the transverse or vertical direction.

Tangential sections (Plate III, fig. 1) show the broad round or oval ends of the transversely divided radial pillars, with the dark infilling of the cut axial canals of the pillars. Where the section corresponds with the plane of a concentric lamina, the cut ends of the pillars are seen to be united into a loose network, with rounded or oval meshes representing sections of zoöidal tubes.

Tangential sections also commonly show large oval or rounded apertures (woodcut, fig. 16 *a*), which are bounded by thin but definite walls, and are placed at distances of from 3 to 12 or 15 mm. apart. The apertures in question are cross-sections of short, wide, flexuous tubes, which pierce the skeletal network at right angles to the surface, are bounded by thin proper walls, and are crossed by occasional horizontal "tabulæ" (woodcut, fig. 16 *b*). Tubes of this kind seem to be very generally developed in variable numbers, and they open sometimes on the convex, but more usually on the concave surfaces of the laminæ (woodcut, fig. 29). The nature of these tubes is quite problematical, and it is not clear that they are

Fig. 29.

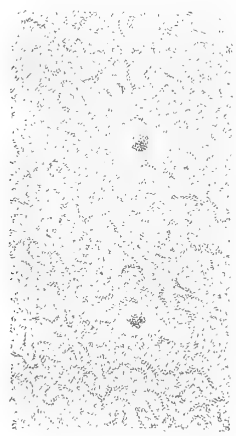


Fig. 29.—Under (?) surface of part of a lamina of *Hermatostroma Schlüteri*, Nich., enlarged, showing the apertures of two of the large thin-walled tubes which traverse the cœnosteum of this species at irregular intervals.

not adventitious structures. If they really belong to the Stromatoporoid in which they are found, they may perhaps be connected with the function of reproduction.

Obs.—All the examples of this species which I possess are fragments of a single very large specimen, the complete form of which was, unfortunately, not accurately noted before it was broken up. All the fragments are made up of gently curved concentric layers, and are, therefore, more or less convex on one side and concave on the other. If we are to judge from analogy, the *convex* sides of such fragments ought to represent the *upper* surfaces of the mass, and this view is supported by the fact that these sides (Plate XXVIII, fig. 12) are covered with rounded eminences resembling the "mamelons" of the Stromatoporoids generally. It is, however, possible that the mass was really basin-shaped, and that the *concave* sides are really the successive upper surfaces. This view is supported by the fact that the wide, scattered, and thin-walled tubes above spoken of as perforating the cœnosteum—whatever their true nature may be—generally open by prominent apertures on the *concave* sides of the laminæ.

In the possession of definite and "continuous" radial pillars *Hermatostroma Schlüteri* entirely resembles a true *Actinostroma*, but differs from the species of this genus in the fact that the connecting processes of the pillars do not give rise to an angular or "hexactinellid" network. On the contrary, the cœnosteal meshes are oval or round; and the aspect of tangential sections, so far as this point is concerned, resembles that of similar sections of *Stromatopora* or *Stromatoporella*. From these latter genera the present form is distinguished not only by the complete development of the radial pillars as distinct structures, but also by the fact that the skeleton-fibre is apparently not of the minutely "porous" type. The other two general features distinctive of *Hermatostroma Schlüteri* are the apparent absence of astrorhizæ, and the imperfect development of zoöidal tubes as recognisable structures. The zoöidal tubes are, in fact, in general represented by nothing more than the pores which pierce the successive "laminæ" of the skeleton.

The most remarkable features in the skeleton of *Hermatostroma Schlüteri* are connected with the tubulated condition of the skeleton-fibre. Vertical sections (woodcut, fig. 30) show that each radial pillar is traversed by a wide axial canal, which sends out horizontal prolongations into the successive laminæ formed by the connecting processes. The entire canal-system is more or less completely injected with some opaque material, apparently an iron oxide, and the extensions of the radial canals into the laminæ can thus easily be followed, the crossing nodes of the two sets of canals being generally more or less dilated. The laminar canals also send off irregular secondary tubes, but it is uncertain whether or not these open directly into the interlaminar spaces. On the other hand, an examination of the surfaces of the concentric laminæ, as exposed by fractures, renders it certain that the axial canals of the radial pillars open by circular apertures both superiorly and inferiorly (Plate XXVIII, fig. 13). Tangential sections (woodcut, fig. 31) show that the large dark masses representing the infiltrated axial canals of the radial pillars are connected with one another by more delicate dark threads representing the canals of the connecting processes. Moreover the main axial canals are commonly seen to give off subordinate and irregular prolongations, which may form a loose network in the substance of the fibre, and which seem in some cases to actually reach the surface of the fibre itself, so as to open into the interlaminar spaces.

Fig. 30.

Fig. 30.—Part of a vertical section of *Hermatostroma Schlüteri*, Nich., enlarged about 24 times.

Fig. 31.

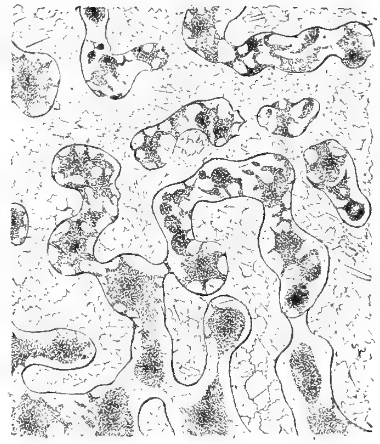


Fig. 31.—Part of a tangential section of the same, similarly enlarged.

It follows from what has been above said that, though the skeleton-fibre of *Hermatostroma Schlüteri* is not "porous," in the sense in which this term is used in connection with the cœnosteal fibre of *Stromatopora*, it is nevertheless traversed by tubes which, in point of fact, are chiefly remarkable for their exceptional size and regular distribution. It has further to be borne in mind that the only known example of this species has undergone considerable change in fossilisation, and that the apparent absence of minute pores in the skeleton-fibre may be simply the result of mineralisation. This view is rendered the more probable since the *Hermatostroma episcopale* of the British Devonians—to be described immediately—has, if rightly placed in this genus, a skeleton-fibre which is both porous and tubulated.

The generic diagnosis of *Hermatostroma* given in the earlier portion of this work (p. 105) must be, therefore, so far amended as to admit that the skeleton-fibre is, in some cases at any rate, porous as well as canaliculated. A further amendment has been necessitated by the examination of *H. episcopale*, since this species possesses well-marked astrorhizæ.

I had formerly placed the genus *Hermatostroma* in the immediate neighbourhood of *Idiostroma* chiefly on account of its possession of a skeleton which is essentially reticulate, but which at the same time possesses exceedingly well-developed radial pillars. Upon the whole, however, I am now rather disposed to consider *Hermatostroma* as really one of the same series of generic types as *Stromatopora*, *Stromatoporella*, and *Parallelopora*. The essential distinctions between the members of this series, on the view here expressed, may be summarised as follows:

1. *Stromatopora.*—Skeleton-fibre minutely porous; radial pillars and their connecting processes more or less indistinguishably fused to form a reticulate skeleton.

2. *Stromatoporella.*—The skeleton-fibre minutely porous; the skeleton network incompletely reticulate, and the radial pillars more or less clearly recognisable as distinct structures.

3. *Parallelopora.* — Skeleton-fibre porous and minutely canaliculated; the skeleton incompletely reticulate, and the radial pillars more or less clearly recognisable, but never traversed by large axial canals.

4. *Hermatostroma.*—Skeleton-fibre with large and conspicuous canaliculi, and sometimes also minutely porous; the skeleton reticulate, but showing exceedingly well developed, "continuous" radial pillars, which are traversed by large axial canals.

From *Hermatostroma episcopale*, Nich., the only other species of the genus at present known to me, the present form is at once distinguished by the greater coarseness of the skeleton-fibre, the absence of astrorhizæ, and the extraordinary development of the canal-system of the radial pillars.

Distribution.—Rare in the Middle Devonian Limestones of Hebborn in the Paffrath district. The species has not been recognised in Britain.

2. Hermatostroma episcopale, n. sp. Pl. XXVIII, figs. 4—11.

? Stromatopora concentrica, *Phillips.* Pal. Foss. of Cornwall, &c., p. 18, pl. x, figs. 28 *a*, 28 *b*, 1841.

The cœnosteum in this species is massive, not composed of definite latilaminæ, and apparently attached at one point only; but its mode of growth is not perfectly known. It may, however, be inferred from the structure of the skeleton that the surface was elevated into prominent astrorhizal eminences—"mamelons," and at the same time covered with well-defined tubercles, the latter being probably perforated at their apices.

The laminæ are undulated, and well-defined "astrorhizal cylinders" are developed round the astrorhizal systems (Plate XXVIII, fig. 4). The astrorhizæ, though of small size, are usually well developed, their centres being from 7 to 10 mm. apart. They are arranged in vertically superimposed systems, each system having an axial wall-less canal, which doubtless opened on the surface at the apex of a mamelon.

As regards the internal structure, the skeleton-fibre is of moderate thickness, and is minutely porous, the pores being often unrecognisable, or being infiltrated with some foreign material, and appearing therefore as so many dark dots (Plate XXVIII, fig. 10). Tangential sections (Plate XXVIII, figs. 5, 7, and 8) show the cut ends of the radial pillars, sometimes more or less distinct, sometimes completely confluent, according as the plane of the section corresponds with an interlaminar space or intersects a concentric lamina. Definite zoöidal tubes cannot be clearly distinguished, and are represented essentially by mere perforations in the concentric laminæ. Tangential sections further show the transversely divided astrorhizal cylinders (Plate XXVIII, figs. 4 and 5).

Vertical sections (Plate XXVIII, figs. 6, 9, and 11) show well-marked, often undulated, concentric laminæ, and very distinct radial pillars of the "continuous type"—*i. e.* pillars which are continued for longer or shorter distances across successive interlaminar spaces. About six concentric laminæ occupy a space of 2 mm. measured vertically, and about six or seven radial pillars occupy the same space measured transversely.

In well-preserved examples both vertical and tangential sections show that the radial pillars are occupied by large axial canals, which send off delicate prolongations into the periodically produced horizontal connecting processes, which unite adjoining pillars at corresponding levels, and thus give origin to the "concentric laminæ." Both the vertical and the horizontal canals are usually infiltrated with some dark and opaque material, and in this condition they are readily recognised in both vertical and tangential sections (Plate XXVIII, figs. 6, 8, and 11). In badly preserved specimens the canals of the skeleton-fibre may be imperfectly infiltrated, and may therefore be recognisable with difficulty (Plate XXVIII, figs. 7 and 9). In some cases the canals cannot be clearly made out at all.

Vertical sections, lastly, often show that the interlaminar spaces are traversed by a larger or smaller number of curved or straight calcareous partitions, or "interlaminar septa," which are commonly more or less horizontal in direction, and thus run parallel with the concentric laminæ (Plate XXVIII, fig. 9).

Specimens occasionally, but not very commonly, present themselves in the "Caunopora-state."

Obs.—*Hermatostroma episcopale* is a common Stromatoporoid in parts of the Devonian rocks of Britain, and the reference of the species to *Hermatostroma*, rather than to *Stromatopora* or *Stromatoporella*, appears to be justified by its minute structure. It agrees, namely, with the first of these genera, and differs from the two latter in its possession of "continuous" radial pillars, and also in the fact that these structures are furnished with well-marked axial canals. The specimens known to me are, however, as a rule, so imperfectly preserved, that, though it is possible to determine their generic affinities, they do not throw any additional light upon the structure of the genus *Hermatostroma*.

Hermatostroma episcopale differs from *H. Schlüteri*, the only other recorded species of the genus, in the following characters:

(*a*) The astrorhizal system of *H. episcopale* is very well developed, and astrorhizal cylinders are present; on the other hand, in *H. Schlüteri* astrorhizæ are apparently not developed in any recognisable form.

(*b*) The skeletal tissue of *H. episcopale* is not so coarse as that of *H. Schlüteri*, and the axial canals of the radial pillars are proportionately less developed.

(*c*) The skeleton-fibre of *H. episcopale*, apart from the presence of the axial canals above spoken of, is minutely porous; whereas in *H. Schlüteri* the skeleton-fibre, but for the above-mentioned canals, appears to be solid. It is to be remembered, however, that the porous character of the skeleton-fibre can be recognised in *H. episcopale* in certain specimens only, and it is therefore quite possible that the apparently solid nature of the skeleton-fibre in the only known example of *H. Schlüteri* may be simply the result of imperfect preservation.

(*d*) The interlaminar spaces of *H. episcopale* are usually intersected by more or less numerous "interlaminar septa," which generally have a direction more or less conforming to that of the concentric laminæ themselves. Similar structures do not occur in any marked form in *H. Schlüteri*.

Distribution.—Hermatostroma episcopale is not uncommon in the Devonian of Shaldon and Bishopsteignton, and occurs more rarely in the pebbles of the Triassic conglomerates at Teignmouth.

Family—IDIOSTROMIDÆ.

Genus 1.—Stachyodes, *Bargatzky*, 1881.

(Introduction, p. 107.)

1. Stachyodes verticillata, *M'Coy* sp. Pl. VIII. figs. 9—14; Pl. XI, fig. 5; and Pl. XXIX, figs. 1 and 2.

Stromatopora (Caunopora) verticillata, *M'Coy*. Brit. Pal. Foss., p. 66, woodcuts *a* and *b*, 1851.

Stachyodes ramosa, *Bargatzky*. Zeitschr. der deutschen Geol. Ges., Jahrg., 1881, p. 688.

— verticillata, *Nicholson*. Mon. Brit. Strom., General Introduction, p. 107, pl. viii, figs. 9—14; and pl. xi, fig. 5, 1886.

The cœnosteum in this type consists of rounded cylindrical stems (Plate VIII, fig. 9), rooted basally, and terminating distally in rounded ends, the diameter varying from $\frac{1}{2}$ cm. up to as much as $1\frac{1}{2}$ cm.

The surface is generally more or less extensively covered with the rounded or polygonal apertures of the zoöidal tubes (Plate VIII, fig. 9), thus giving the fossil the aspect of a dendroid Monticuliporoid, or of a species of *Pachypora* with small corallites. In many specimens, however, the surface is not uniformly occupied by the zoöidal apertures, but larger or smaller areas may be covered by a thin imperforate calcareous membrane (Plate VIII, fig. 12). The surface does not exhibit "mamelons," nor are astrorhizæ developed.

As regards the internal structure of the cœnosteum, the centre of each stem is occupied by a main axial tube, from $\frac{1}{2}$ to $\frac{2}{3}$ mm. in diameter, which is crossed by more or less numerous curved or straight tabulæ, and which gives off smaller lateral branches, which are directed upwards and outwards. These lateral branches subdivide, and may also be more or less extensively furnished with tabulæ. The principal axial tube seems to terminate at the end of the stem in one, two, or more apertures, but the extremities of the branches are commonly in a state of bad preservation, and may not exhibit any openings.

Longitudinal sections (Plate VIII, figs. 10 and 14) show that the lateral divisions of the main axial tube become connected, as they pass outwards, with numerous small zoöidal tubes, which are continued to the surface, and which have few tabulæ or none. Long sections further show, in an exceedingly marked and characteristic manner, the mode of growth of the cœnosteum. Such sections, namely, always exhibit a series of delicate, curved, concentric lines, the convexities of which are directed towards the distal ends of the branches (Plate VIII, fig. 10). These lines are due to the formation of successive conical layers of cœnosteal tissue, which are much thicker over the growing ends of the branches than elsewhere. Hence, as viewed in long sections, these lines are seen to be comparatively wide apart in the centre of the branches, but to approximate gradually to one another as they approach the surface, with which they ultimately become nearly parallel.

Transverse sections of the cœnosteum (Plate VIII, fig. 11) show the cross-sections of the main axial tube and its lateral offshoots. Moreover, owing to the fact that the zoöidal tubes in proceeding to the surface bend outwards till they become nearly rectangular to the axis of the stem, the peripheral portion of a transverse section shows the zoöidal tubes in *longitudinal* section.

The skeletal tissue of *Stachyodes verticillata* is of the reticulate type, neither radial pillars nor concentric laminæ being recognisable as distinct structures. Sections of the skeleton, taken in any direction, show that the sclerenchyma is traversed by a series of exceedingly delicate and close-set tubuli, which in the main run parallel with the zoöidal tubes, but frequently branch and anastomose with one another. The precise appearance presented by these tubuli in thin sections varies according as they are infiltrated with calcite or with oxide of iron. In the latter condition—which is the one of most frequent occurrence—the tubuli appear in long sections of the skeletal fibre as delicate and closely approximated dark lines (Plate VIII, fig. 14), whereas in cross-sections of the fibre they appear as minute dark and well-defined dots (Plate XI, fig. 5).

Obs.—As there is only one known species of *Stachyodes*, and as its peculiarities are exceedingly well marked and distinctive, it is unnecessary to add anything to the above description. The only Stromatoporoid with which it would be possible, even on a superficial examination, to confound *S. verticillata* is *Idiostroma oculatum*, Nich.; but, apart from grosser differences between the two, a thin section of *Stachyodes verticillata* would be at once recognised by the highly characteristic minute tubulation of the skeleton-fibre.

Having examined a very large series of both German and British specimens (the former collected by myself from Bargatzky's typical locality), I do not see any reason to doubt the identity of *Stachyodes ramosa*, Barg., with the previously described *Stromatopora verticillata* of M'Coy. It is true that M'Coy has described his species from very small examples, and he states that the diameter of the stems is from "one to two lines," but this is clearly a matter of little importance. The stems in the British examples which I have examined never fall below a tenth of an inch in diameter, and their average diameter is about three tenths of an inch, but I cannot think that this is a matter of specific value.

I have never seen an example of *Stachyodes verticillata* in the "Caunopora-state."

Distribution.—*Stachyodes verticillata*, McCoy, is a not uncommon form in the Devonian Limestone of Shaldon and Teignmouth (pebbles in the Triassic conglomerates). In the German Devonians I am only acquainted with it as occurring in the limestones of Hebborn, in the Paffrath district, where it is by no means uncommon.

Genus 2.—Amphipora, *Schulz*, 1882.

(Introduction, p. 109.)

1. Amphipora ramosa, *Phill.* sp. Pl. IX, figs. 1—4, and Pl. XXIX, figs. 3—7.

Caunopora ramosa, *Phillips.* Palæozoic Foss. of Cornwall, &c., p. 19, pl. viii, fig. 22, 1841.

Stromatopora (Caunopora) ramosa, *M'Coy.* Brit. Pal. Foss., p. 67, 1851.

AMPHIPORA RAMOSA, *Schulz.* Die Eifelkalkmulde von Hillesheim, p. 90, pl. xxii, figs. 5 and 6, and pl. xxiii, fig. 1, 1882 (Jahrg. d. königl. preuss. geol. Landesanstalt für 1882).
— — *Nicholson.* Mon. Brit. Strom., Introduction, p. 109, pl. ix, figs. 1—4, 1886.

The cœnosteum in *Amphipora ramosa* is in the form of slender cylindrical stems, from 2 to 7 mm. in diameter, which may be simple, or may branch in a dichotomous manner. The surface of the cœnosteum is smooth, exhibiting neither "mamelons" nor astrorhizæ, and presenting itself under two different aspects (Plate IX, fig. 1). In one series of specimens the surface shows numerous irregularly rounded or vermiculate zoöidal apertures, with prominent tuberculate margins, giving to the fossil the aspect of a small dendroid *Alveolites.* In another series of specimens the surface is covered with a thin imperforate calcareous membrane, and the fossil looks like a stem of some such coral as *Lithostrotion junceum.* Partly decorticated specimens may show zoöidal apertures over part of the surface, while other portions are covered with a calcareous membrane; but there is reason to think that the two conditions of the surface are not simply due to the state of preservation, but indicate differences in the state of the organism in different examples (see p. 110).

As regards the internal structure of the skeleton, the cylindrical cœnosteum is traversed by a wide axial tube, which is intersected by transverse or funnel-shaped tabulæ (Plate IX, figs. 2 and 4, and Plate XXIX, fig. 4). The general cœnosteal tissue is completely reticulate, of the type of that of the *Stromatoporidæ,* neither radial pillars nor concentric laminæ being recognisable as distinct structures. The skeleton-fibre (Plate XXIX, fig. 6 *a*) is apparently solid, without pores or tubuli, each lamina being traversed by a median, dense, and dark-coloured primordial layer, thickened on both sides by lighter-coloured, fibro-crystalline, secondary sclerenchyma, and thus resembling the structure seen in many corals.

Irregular zoöidal tubes radiate outwards from the axial tube, to open on the surface by definite apertures; but the development of the zoöidal tubes is very variable, and they are generally short and sinuous, and are apparently for the most part destitute of tabulæ.

Many examples of *Amphipora ramosa* have the cylindrical cœnosteum surrounded by a sheath of large-sized lenticular vesicles, which are in turn surrounded by the delicate imperforate calcareous cuticle above spoken of (Plate IX, figs. 2 and 3, and Plate XXIX, fig. 5). Other specimens either show no traces of marginal vesicles and a bounding membrane (Plate IX, fig. 4), or they may have the marginal vesicles imperfectly developed and of small size (Plate XXIX, figs. 6 and 7). The significance of the above variations of structure cannot be at present fully estimated; but it is possible that the marginal vesicles are connected with reproduction, and that they correspond with the "ampullæ" of the Stylasterids and of *Millepora*.

Obs.—*Amphipora ramosa*, Phill. sp., being the only known species of the genus *Amphipora*, I have nothing special to add to the above description of its general characters. In an examination of a large number of transverse and longitudinal sections of the species one is at once struck with the fact that certain specimens (Plate IX, fig. 3, and Plate XXIX, fig. 5) are composed of a comparatively dense central core of reticulated tissue, which is traversed by a large axial canal, and is enclosed in a sheath of large peripheral vesicles bounded externally by a delicate calcareous membrane. Other specimens, on the contrary, have a generally more loosely reticulate structure, and have comparatively small marginal vesicles, while an axial canal may apparently be wanting or imperfectly developed (Plate IX, fig. 4, and Plate XXIX, figs. 6 and 7). Other examples, lastly, appear to be completely devoid both of the marginal zone of vesicles and of the external calcareous cuticle (Plate IX, fig. 4), though a well-marked axial tube may be present. It seems most probable that these different forms are really different conditions of a single type, though it must be admitted that at present we have no decisive evidence in support of this view.

I have never seen any example of *Amphipora ramosa* in which "Caunopora-tubes" are developed.

Distribution.—*Amphipora ramosa* occurs in great numbers in the Devonian rocks of both Germany and Britain, marking a distinct horizon, which the German geologists have determined as being in the upper portion of the Middle Devonian rocks (the "Ramosa-bänke" of Schultz). The *Amphipora-ramosa*-beds of the German Devonians are admirably seen at Hebborn (Paffrath district) and at Hillesheim (in the Eifel). In Britain the species occurs abundantly in the Devonian Limestones of Devonshire, at Shaldon, Newton Abbot, Teignmouth, &c.

Genus 3.—Idiostroma, *Winchell*, 1867.

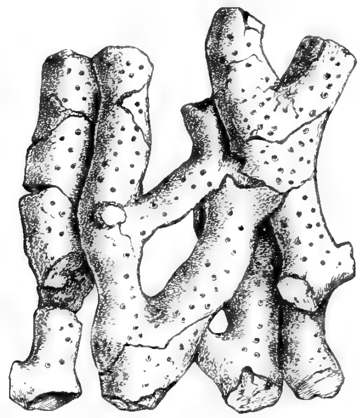
(Introduction, p. 99.)

1. Idiostroma oculatum, *Nicholson*. Pl. XXIX, figs. 8—11; woodcuts, figs. 32, 33.

Idiostroma oculatum, *Nicholson*. Mon. Brit. Strom., Introduction, p. 101, figs. 14 and 15, 1886.

The cœnosteum in this form consists of slender cylindrical stems, from 3 to 10 mm. in diameter, which branch and inosculate freely, so as to give rise to fasciculate masses of considerable size (woodcut, fig. 32). The surface is devoid of "mamelons" or astrorhizæ, and is partly covered with the irregularly rounded

Fig. 32.



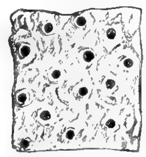


Fig. 32.—A fragment of the cœnosteum of *Idiostroma oculatum*, Nich., of the natural size. Devonian, Büchel. *a*. A small portion of the surface of the same enlarged.

or vermiculate apertures of the zoöidal tubes, while other portions are covered with a smooth calcareous membrane.

As regards internal structure, the general cœnosteal tissue is more or less reticulate; but stout radial pillars are usually clearly recognisable in transverse sections of the stems (Plate XXIX, fig. 9). Such sections also generally show with extreme clearness that the skeleton is built up of definite concentric layers surrounding a central core of loose reticulate tissue. The skeleton-fibre is almost certainly porous (as it is in *I. Rœmeri*, Nich.); but owing to the extent to which all the specimens examined are mineralised, this point cannot be certainly ascertained.

Each stem typically exhibits in longitudinal section (Plate XXIX, fig. 11) a well-developed axial tube, which is provided with transverse or infundibuliform tabulæ. This central tube gives off lateral branches, which are also tabulate, and which ascend obliquely towards the surface, giving off secondary branches in their course. Hence in transverse sections (Plate XXIX, fig. 9) we may see not only the central opening representing the section of the main axial canal, but also a variable number of apertures external to this, representing sections of the secondary tubes above spoken of. Tangential sections (Plate XXIX, fig. 10) likewise often show these secondary tubes as seen when obliquely divided. None of the specimens examined show the final terminations of the axial tubes, so that it is unknown whether or not they open on the surface.

Zoöidal tubes are sometimes well exhibited in the peripheral portions of transverse sections of the stems; but in longitudinal sections they are usually badly shown, apparently owing to their tortuous character.

Many specimens of *Idiostroma oculatum* exhibit embedded tubes which have the general character of "Caunopora-tubes," since they open on the surface by

Fig. 33.

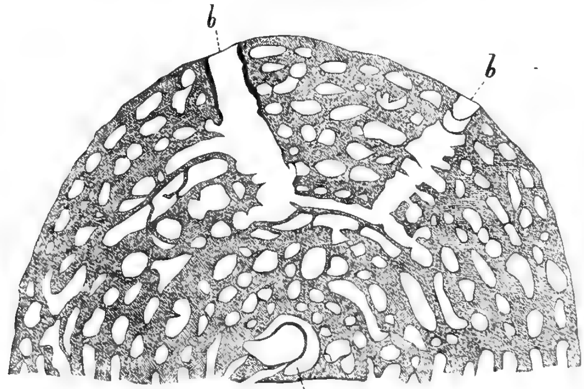


Fig. 33.—Transverse section of half of a stem of *Idiostroma oculatum*, Nich., enlarged about 12 times. *a*. The axial canal transversely divided. *b b*. Large radially directed tubes embedded in the cœnosteum, opening inferiorly into the interlaminar spaces, but acquiring thickened walls, and becoming intersected by tabulæ where they approach the surface.

rounded apertures with thickened margins, and are provided with proper walls (woodcuts, figs. 32 *a* and 33). Other examples show no traces of these embedded tubes (Plate XXIX, fig. 8). Sections of the stems (Plate XXIX, fig. 11, and woodcut, fig. 33) show that these supposed "Caunopora-tubes" possess a thickened proper wall in the outer part of their course, but apparently lose this as they are traced internally, till they appear in some cases to open directly into the interlaminar spaces of the cœnosteum. Doubt is thus thrown upon the true nature of these embedded tubes; and if they were *constantly* present there would be good ground for thinking that they really belong to the organism with which they are associated. This conclusion is, however, rendered doubtful by the fact that some specimens do not show any traces of the presence of these tubes; and, in spite of a laborious investigation, I must still confess myself as unable to come to any positive conclusion as to whether or not these embedded tubes are adventitious. In view, however, of the extent to which the calcareous tissue of a shell enclosed in a crust of the recent *Hydractinia echinata* may be eaten away or absorbed by the parasite, I feel inclined to doubt if any stress can be laid upon the apparent absence of a proper wall to the embedded tubes of *Idiostroma oculatum* in the more deeply buried part of their course.

Obs.—The only other species of the genus *Idiostroma* with which I have any personal acquaintance is *Idiostroma Roemeri*, Nich., of the Devonian rocks of Germany (Introduction, p. 100, Plate IX, figs. 6—10). From this latter species the present form is at once distinguished by its slender stems, its fasciculate mode of growth, the characters of its surface, and the much less complete development of the zoöidal tubes.

Distribution.—Not uncommon in the Devonian Limestones of Büchel, in the Paffrath district. It is also of not very rare occurrence in the Devonian Limestones of South Devon (Teignmouth, Shaldon, &c.).

SUPPLEMENT TO THE HISTORICAL INTRODUCTION.

In what follows I have given a brief notice of all the memoirs or works dealing with the Stromatoporoids which are known to me as having been published subsequent to the autumn of 1885, at which time the first part of the present Monograph was in print.

In the later part of 1885 Herr Fritz Frech described some Stromatoporoids from the Upper Devonian rocks of Germany in a paper entitled "Die Korallenfauna des Oberdevons in Deutschland" ('Zeitschr. d. deutschen Geol. Ges., Jahrg.,' 1885). Following Bargatzky and Maurer, the author selected a species of *Actinostroma* as being the form described by Goldfuss as *Stromatopora concentrica*. In an appendix, however, the author states that he is now satisfied that this identification is incorrect, though he still regards an *Actinostroma* as being the true *Stromatopora concentrica*, Goldf. A Stromatoporoid (apparently a *Stromatoporella*) is identified with the *Stromatopora stellifera* of A. Römer; and a new species, of uncertain affinities, is described under the name of *Stromatopora philoclymenia*. In 1886, in his work entitled "Die Cyathophylliden und Zaphrentiden des deutschen Mitteldevon" ('Palaeontologische Abhandlungen,' Berlin), Herr Frech discusses the nature of "*Caunopora*," and concludes that the fossils included under this name are the result of the commensal growth of a Stromatoporoid with an *Aulopora* or a *Syringopora*.

In 1886, Mdlle. Eugenia Solomko published a work on the Stromatoporoids of the Devonian rocks of Russia (pp. 48, with two plates, St. Petersburg, 1886). As it is written in Russian I have, unfortunately, been unable to read this memoir, but an analysis of its contents is given by Waagen and Wentzel in the 'Palæontologia Indica,' "Salt Range Fossils," ser. 13, vol. vii, 1887. Mdlle. Solomko deals principally with points connected with the general structure of the Stromatoporoids, and proposes a classification based upon the structure of the skeleton-fibre. The Stromatoporoids are regarded as belonging to the Sponges (*Pharetrones*). No new species are described.

In 1886, Mr. E. O. Ulrich described and figured a species of *Labechia* from the Cincinnati group of Ohio under the name of *L. montifera* ('Contributions to North American Palæontology,' vol. i, p. 33, woodcut and pl. ii, figs. 9 and 9 *a*).

Mr. Ulrich has been so good as to supply me with a specimen of this form, and I think it is certainly identical with that previously described by me under the name of *L. ohioensis*.

In 1886, Dr. C. Rominger published a paper on the "Minute Structure of *Stromatopora* and its Allies" ('Proc. Acad. Nat. Sci. Philadelphia,' pp. 39—56, 1886). This paper is principally occupied with a criticism of the memoir on the structure of the skeleton of the Stromatoporoids published in 1878 by Dr. Murie and the present writer; but as Dr. Rominger wrote without having previously made himself acquainted with the General Introduction to the present work, it is unnecessary to discuss his views in detail. Dr. Rominger further resuscitates a number of manuscript names of Stromatoporoids which he had employed in a paper which had been laid before the Academy of Sciences in Philadelphia in 1871, but which had never been published. The names in question cannot, however, be now allowed to have any validity, since the forms to which they were applied by Dr. Rominger have been described, prior to 1886, under other titles in various published memoirs by other investigators.

In 1886, the present writer published two parts of a paper entitled "On some New or Imperfectly described Species of Stromatoporoids" ('Ann. and Mag. Nat. Hist.,' ser. 5, vol. xvii, pp. 225—239, pls. vi—viii; and vol. xviii, pp. 8—22, pls. i and ii). The species dealt with are fully described, and in all cases figures of the microscopic structure of the skeleton are given. The following forms are described and figured:—*Actinostroma clathratum*, Nich.; *A. verrucosum*, Goldf.; *A. hebbornense*, Nich.; *A. astroites*, Rosen sp.; *A. bifarium*, Nich.; *A. stellulatum*, Nich ; *A. Schmidtii*, Rosen sp.; *A. intertextum*, Nich.; *Stromatoporella laminata*, Barg. sp.; *S. eifeliensis*, Nich.; *S. damnoniensis*, Nich.; *S. arachnoidea*, Nich.; *S. curiosa*, Barg. sp.; *S. granulata*, Nich.; *Labechia conferta*, Lonsd. sp.; *L. ohioensis*, Nich.; *L. canadensis*, Nich. and Mur.; *L. serotina*, Nich.; *Lophiostroma* (*Labechia?*) *Schmidtii*, Nich.; *Rosenella dentata*, Rosen sp.; *R. macrocystis*, Nich.; and *R. pachyphylla*, Nich.

In 1887, the third part of the preceding memoir was published ('Ann. and Mag. Nat. Hist.,' ser. 5, vol. xix, pp. 1—17, pls. i—iii). The following species are described and figured:—*Clathrodictyon vesiculosum*, Nich. and Mur.; *C. variolare*, Rosen sp.; *C. Linnarssoni*, Nich.; *C. striatellum*, D'Orb. sp.; *C. crassum*, Nich.; *C. fastigiatum*, Nich.; *C. regulare*, Rosen sp.; *C. cellulosum*, Nich. and Mur.; *C. ostiolatum*, Nich.; *C. laxum*, Nich.; *C. retiforme*, Nich. and Mur.; and *C.* (*?*) *tuberculatum*, Nich.

In 1887, Waagen and Wentzel published the volume of the "Salt Range Fossils" dealing with the Stromatoporoids and some of the Corals ('Palæontologia Indica,' ser. 13, vol. vii, pp. 925—962, pls. cxvii—cxxi). The earlier portion of this work is occupied with a discussion of the general structure and zoological affinities of the Stromatoporoids, which the authors divide into two families, and refer to the Hydrocorallines. It would, however, be unprofitable to discuss at length the views on the above subjects propounded in the work now under consideration; since it may be reasonably assumed that the authors would have materially modified many of their statements had they been acquainted with the previously published "General Introduction" to the present Monograph, of the existence of which they appear to have been in ignorance. The authors retain the genus *Cœnostroma*, Winch., as the type of their family *Cœnostromidæ*, upon the ground that it possesses astrorhizæ; whereas they assert these structures to be wanting in *Stromatopora concentrica*, Goldf., the type of the genus *Stromatopora*. As a matter of fact, however, astrorhizæ are always more or less largely developed in *Stromatopora concentrica*, Goldf., so that the alleged distinction between *Cœnostroma* and *Stromatopora* cannot be maintained. The authors further propose five new genera of Stromatoporoids under the titles of *Carterina*, *Circopora*, *Disjectopora*, *Irregulatopora*, and *Rosenia*. Having had no opportunity of examining specimens of the first four of these genera, I do not feel myself competent to discuss their relationships. The last-mentioned genus, however, is proposed for the fossil described by von Rosen under the name of *Stromatopora astroites*, and I have shown that this is really a species of *Actinostroma*. The most interesting and important point established by the researches of Waagen and Wentzel is that forms of the Hydrozoa related to *Stromatopora* proper occur in the "Productus Limestone" of the Salt Range of India, the age of which is regarded as Permo-Carboniferous. We may, therefore, look forward with confidence to the future discovery of Stromatoporoids in the Carboniferous rocks of Europe and America.

In 1889 Herr Joseph Wentzel published a memoir entitled "Ueber fossile Hydrocorallinen (Stromatopora und ihre Verwandten) nebst einem Anhange" ('Lotos,' Neue Folge, Bd. ix, pp. 1—24, pls. i—iii); but this is essentially a kind of abstract of the earlier portion of the work just spoken of, and, for reasons given above, does not require detailed discussion.

In 1889 Professor Lindström published a memoir with the title "Ueber die Gattung Prisciturben, Kunth" ('Bihang till K. Svenska Vet.-Akad. Handlingar,' Bd. xv, Afd. 4, No. 9, p. 10, pl. i). In this memoir Lindström shows that the genus *Prisciturben*, Kunth, is not referable to a Perforate Coral, but that it is founded upon a mixed organism resulting from the commensalism of a Stromatoporoid and a Cyathophylloid coral.

In 1889 appeared the second part of the present Monograph, in which *Actinostroma fenestratum* and *Clathrodictyon confertum* are described for the first time.

In 1890 the present writer recorded the occurrence in Devonian deposits in

Western Australia of two European Stromatoporoids, viz. *Actinostroma clathratum*, Nich., and *Stromatoporella eifeliensis*, Nich. ("Notes on the Palæontology of Western Australia," 'Geol. Mag.,' dec. 3, vol. vii, p. 193, pl. viii).

In 1891 appeared the third part of the present Monograph. The species described in this for the first time are *Labechia scabiosa*, *L. stylophora*, *Stromatopora Carteri*, *S. inæqualis*, and *S. florigera*.

Lastly, in 1891 was published part iv of the memoir by the present writer, "On some New or imperfectly Known Stromatoporoids" ('Ann. and Mag. Nat. Hist.,' ser. 6, vol. vii, pp. 309—328, pls. viii—x, and two engravings). The forms described are principally American, and include the following:—*Stromatopora antiqua*, Nich. and Mur.; *S.* (*Caunopora*) *Hudsonica*, Daws.; *S. Carteri*, Nich.; *S. borealis*, Nich.; *Actinostroma expansum*, Hall and Whitf. sp.; *A. Tyrrellii*, Nich.; *A. Whiteavesii*, Nich.; *A. matutinum*, Nich.; *A. fenestratum*, Nich.; *Syringostroma ristigouchense*, Spencer sp.; *S.* (*Stromatopora*) *nodulatum*, Nich.; and *S. densum*, Nich. The species described for the first time are *Stromatopora borealis*, *Actinostroma Tyrrellii*, *A. Whiteavesii*, and *A. matutinum*. It is further pointed out that the form described by the author from the Hamilton formation of Ontario under the name of *Stromatopora nulliporoides* ('Report on the Palæontology of Ontario,' 1875, p. 78) is identical with the previously described *Cœnostroma incrustans* of Hall and Whitfield from the Devonian rocks of Iowa, and that the latter is properly referable to the genus *Stromatoporella*.

APPENDIX.

By the kindness of Professor Edward Orton, of the State University of Ohio, I have been permitted to re-examine the fossil which I originally described as a Stromatoporoid under the name of *Dictyostroma undulatum*, and which I regarded as the type of the genus *Dictyostroma* ('Palæontology of Ohio,' vol. ii, p. 254, pl. xxiv, fig. 6, 1875). In the Introduction to the present work (p. 85) I pointed out that the genus *Dictyostroma*, for want of knowledge of its microscopic structure, could not be regarded as being "adequately defined or satisfactorily established." Having now made a careful examination of the original example of *Dictyostroma undulatum*, Nich., by means of thin sections, I am able to state that the fossil so named is certainly not referable to the Stromatoporoids. Its precise affinities are not absolutely clear, but it is sufficient for my present purpose to point out that the genus *Dictyostroma*, Nich., must no longer be regarded as a member of the great series of the *Stromatoporoidea*.

INDEX

TO THE

FAMILIES, GENERA, AND SPECIES OF STROMATOPOROIDS DESCRIBED IN THIS MONOGRAPH.

[Names of genera or species which are regarded as synonyms, or invalid, are printed in italics.]

PLATE XXVI.

Fig. 1.—Surface of a specimen of *Stromatoporella granulata,* Nich., of the natural size. Devonian (Hamilton Formation), Arkona, Ontario.

Fig. 1 *a*.—Tangential section of the same, enlarged about ten times.

Fig. 1 *b*.—Vertical section of the same, similarly enlarged.

Fig. 2.—Surface of a specimen of *Stromatoporella Selwynii*, Nich., enlarged. Devonian (Corniferous Limestone), Port Colborne, Ontario. This figure is repeated from Pl. I, fig. 14, where it is referred to *Stromatoporella granulata*, Nich.

Fig. 3.—Tangential section of the same, enlarged about ten times. (The section is slightly oblique.)

Fig. 4.—Vertical section of the same, similarly enlarged.

Fig. 5.—Tangential section of *Stromatoporella socialis*, Nich., showing part of one of the astrorhizal cylinders, enlarged about ten times. Middle Devonian, Teignmouth [pebble in the Triassic conglomerates].

Fig. 6.—Tangential section of another specimen of the same, from the same locality, showing "*Caunopora*-tubes." Enlarged about ten times.

Fig. 7.—Vertical section of the preceding specimen, similarly enlarged.

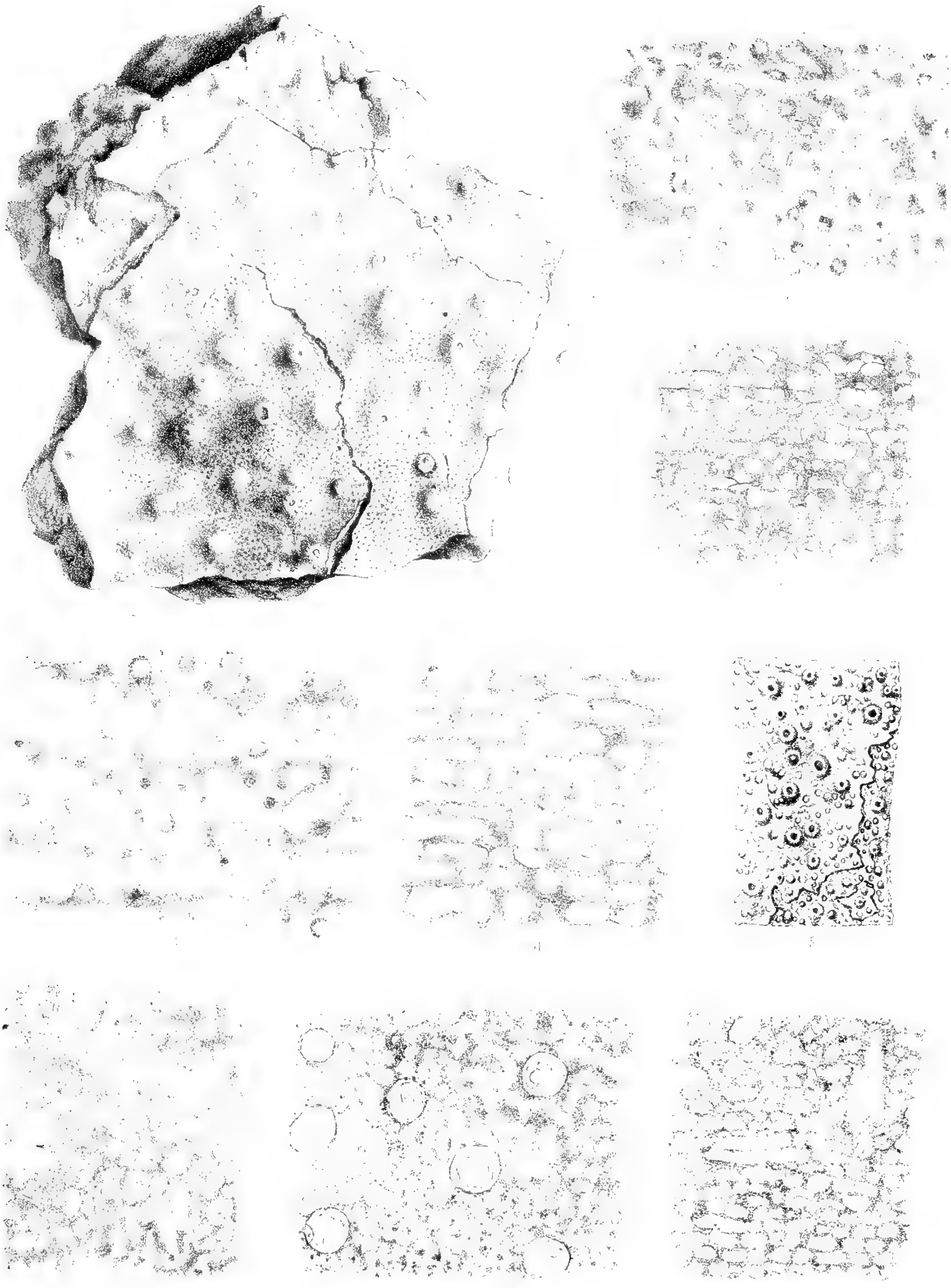


PLATE XXVII.

FIG. 1.—Surface of *Stromatoporella eifeliensis*, Nich., enlarged. Middle Devonian, Gerolstein.

FIG. 2.—Tangential section of the same, enlarged ten times, from the same formation and locality.

FIG. 3.—Vertical section of the preceding specimen, similarly enlarged.

FIG. 4.—Specimen of *Stromatoporella solitaria*, Nich., of the natural size, showing the characters of the surface. Middle Devonian, Gerolstein.

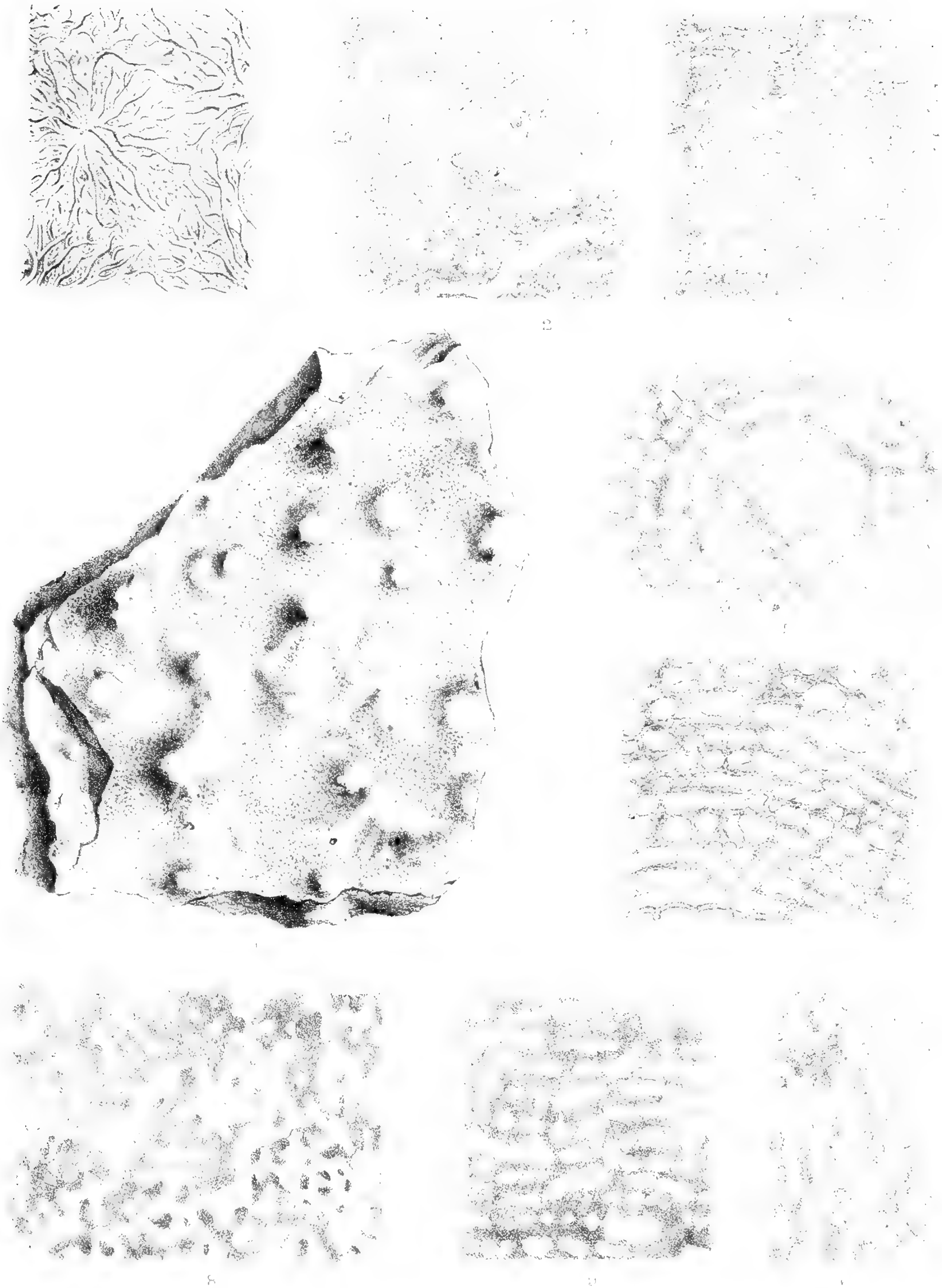
FIG. 5.—Tangential section of the same, across one of the astrorhizal mamelons, enlarged ten times, from the same formation and locality.

FIG. 6.—Tangential section of the same, traversing a space between two astrorhizal mamelons, similarly enlarged [erroneously referred in a paper in the 'Ann. and Mag. Nat. Hist.,' ser. 5, vol. xvii, pl. viii, fig. 5, to *S. eifeliensis*].

FIG. 7.—Vertical section of the same, similarly enlarged.

FIG. 8.—Tangential section of *Stromatoporella damnoniensis*, Nich., enlarged about ten times. Middle Devonian, Devonshire. (From the pebble beds in the Trias of Teignmouth.)

FIG. 9.—Vertical section of the same, similarly enlarged.



H.A.N. [illegible] del.
A.T. [illegible] lith.

PLATE XXVIII.

FIG. 1.—A specimen of *Stromatoporella curiosa*, Barg., of the natural size, forming a crust upon a Rugose Coral. Middle Devonian, Büchel (Paffrath District).

FIG. 2.—Tangential section of the same, enlarged between 10 and 12 times.

FIG. 3.—Vertical section of the same, similarly enlarged.

FIG. 4.—Portion of a polished section of *Hermatostroma episcopale*, Nich., of the natural size. Middle Devonian (pebble in Triassic conglomerate), Teignmouth.

FIG. 5.—Tangential section of another specimen of the same, from Shaldon, South Devon, enlarged 10 times.

FIG. 6.—Vertical section of the preceding specimen, similarly enlarged.

FIG. 7.—Tangential section of another example of the same, enlarged about 15 times. Devonian, Shaldon.

FIG. 8.—Tangential section of another example of the same, enlarged about 15 times. Teignmouth.

FIG. 9.—Vertical section of the preceding, similarly enlarged.

FIG. 10.—Portion of a tangential section of *Hermatostroma episcopale*, Nich., from the Devonian of Shaldon, enlarged rather more than 20 times, showing the porous nature of the skeleton-fibre.

FIG. 11.—Part of a vertical section of the preceding specimen, similarly enlarged, showing the canal-system infiltrated with some opaque material.

FIG. 12.—Fragment of *Hermatostroma Schlüteri*, Nich., of the natural size. Middle Devonian, Hebborn (Paffrath District).

FIG. 13.—Part of the surface of a concentric lamina of the same, greatly enlarged.

PLATE XXVI

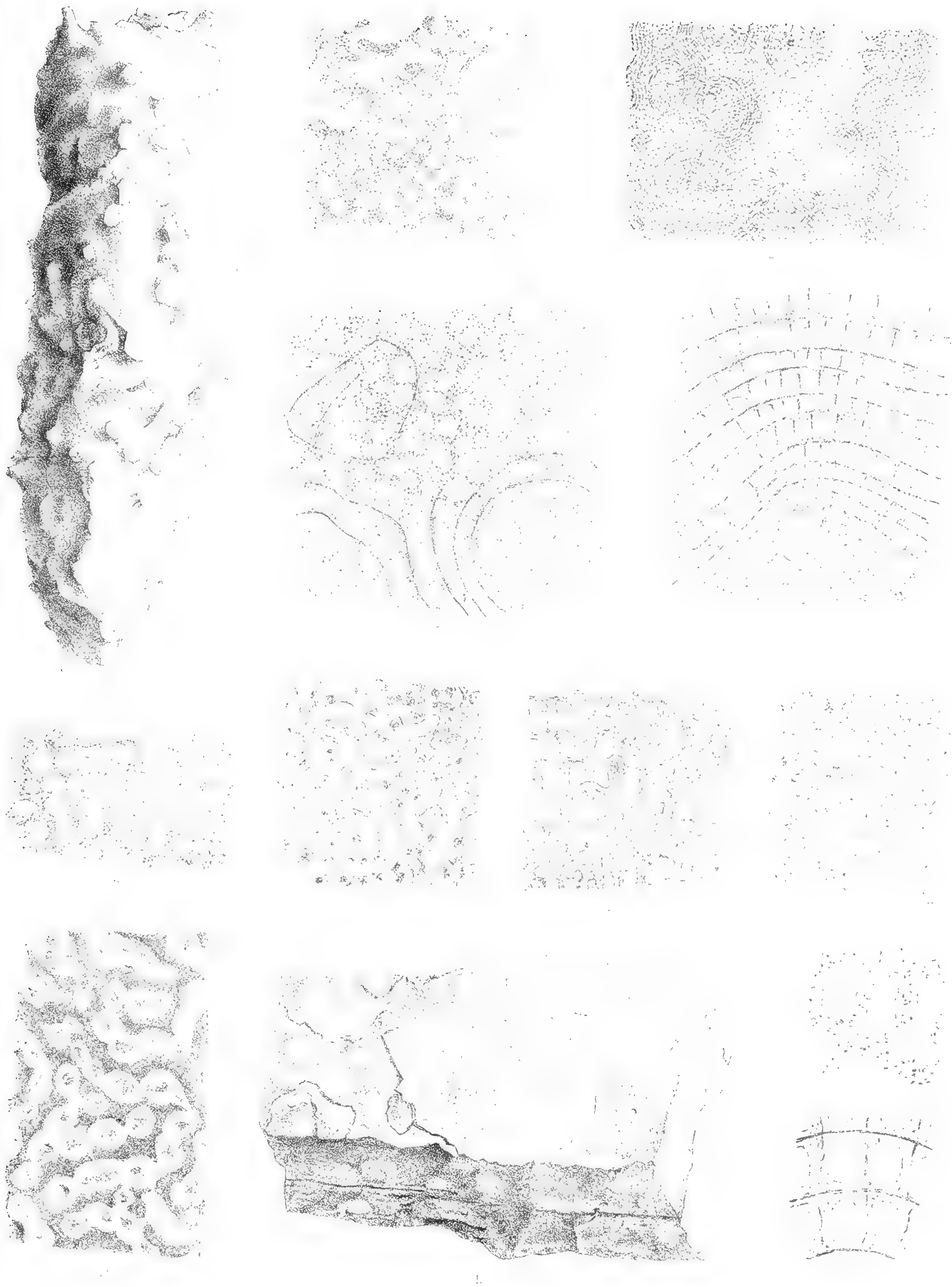


PLATE XXIX.

Fig. 1.—Part of a polished transverse section of a specimen of *Stachyodes verticillata*, M'Coy sp., of the natural size. From a Devonian pebble in the Triassic conglomerates of Teignmouth.

Fig. 2.—Part of a polished vertical section of the same species, of the natural size. From the same locality.

Fig 3.—Part of a polished section of a specimen of Devonian limestone containing numerous stems of *Amphipora ramosa*, Phill., sp., of the natural size. Shaldon, South Devon.

Fig. 4.—Part of a longitudinal polished section of *Amphipora ramosa*, Phill. sp., enlarged about 10 times. Shaldon, South Devon.

Fig. 5.—A transverse polished section of a stem of the same species, similarly enlarged. Shaldon, South Devon.

Fig. 6.—Part of transverse thin section of a stem of *Amphipora ramosa*, Phill., sp., in which no axial canal is shown, and the marginal vesicles are comparatively small, similarly enlarged. Shaldon, South Devon.

Fig. 6 *a*.—A portion of the preceding section, enlarged still further, showing the structure of the skeleton-fibre.

Fig. 7.—A polished transverse section of a stem of *Amphipora ramosa*, Phill., sp., enlarged about 10 times. No axial canal is seen in this section, and the marginal vesicles are comparatively small. Shaldon, South Devon.

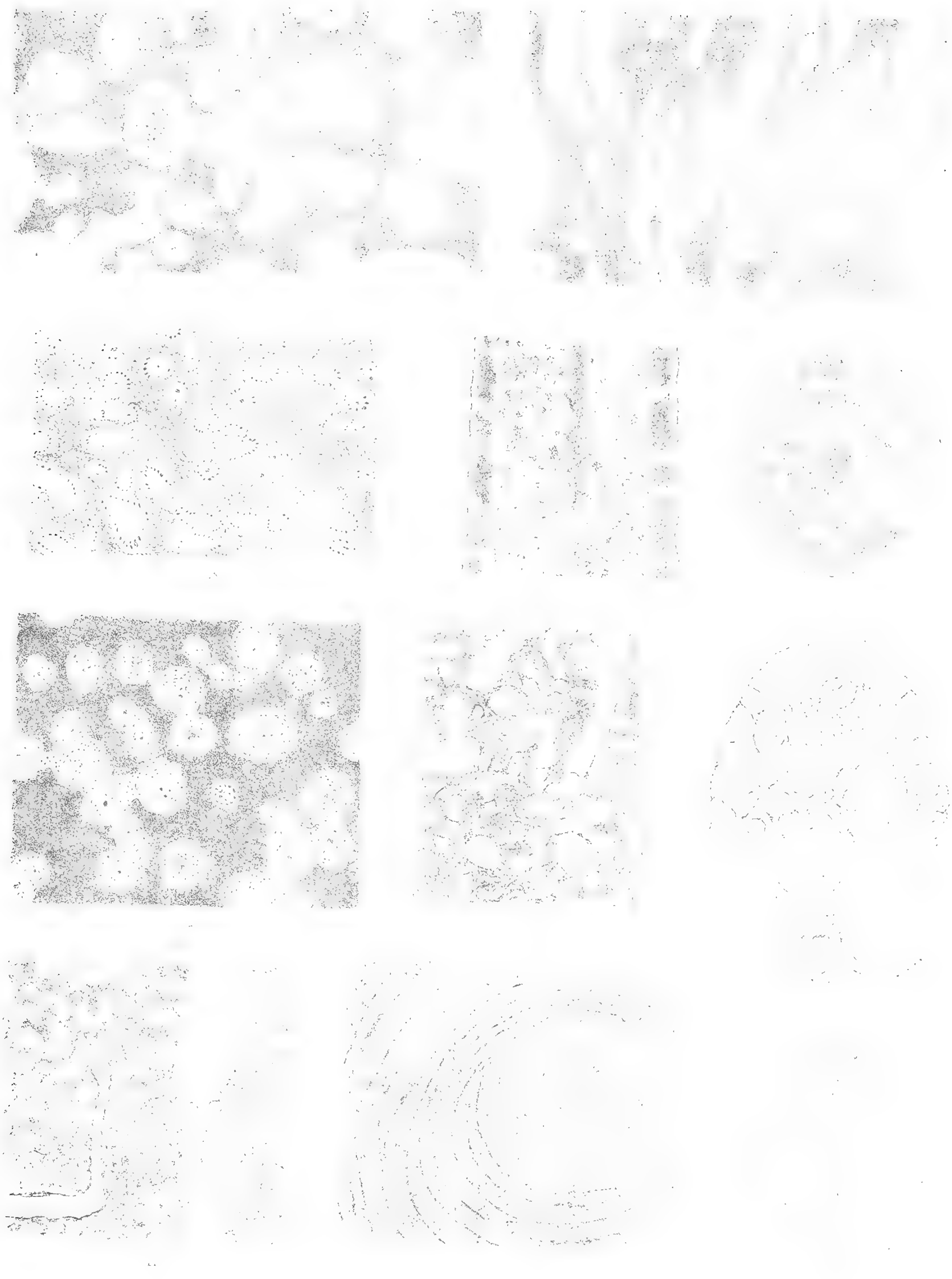
Fig. 8.—Part of a transverse section of a specimen of Devonian limestone containing a colony of *Idiostroma oculatum*, Nich., of the natural size. Shaldon, South Devon.

Fig. 9.—Part of a thin section of the preceding specimen, showing a single stem transversely divided; enlarged 10 times. Shaldon, South Devon.

Fig. 10.—Part of a tangential section of a stem of *Idiostroma oculatum*, Nich., enlarged 10 times, showing Caunopora-tubes (?) and tabulate canals. Middle Devonian, Büchel (Paffrath District).

Fig. 11.—Part of the vertical section of the preceding specimen, similarly enlarged, showing the axial tabulate canal, and a (?) Caunopora-tube.

PLATE XIV



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A. T. Hollick lith

THE

PALÆONTOGRAPHICAL SOCIETY.

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LONDON:

MDCCCXCII.

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 II.

SOME BIVALVED AND UNIVALVED SPECIES.

PAGES 73—124; PLATES XIII—XVII.

WITH ADDENDA AND CORRIGENDA TO PART I.

LONDON:

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ADDENDA ET CORRIGENDA.

Part I.

Page 11. After the 16th line from the top *add* 1885, J. M. Clarke. The Higher Devonian Fauna of Ontario County, New York, pp. 43, 44.

Pages 16 and 19. Pl. IV, fig. 3, is *Ceratiocaris tyrannus* (not *C. Murchisoni*).

Pages 20 and 21. Pl. VI, fig. 11, is *Ceratiocaris tyrannus* (not *C. valida*).

Page 23. Before the 10th line from the bottom *add*:—A specimen of *C. tyrannus* from the Upper Coldwell beds, near Troutbeck, Westmoreland, is in Professor Törnquist's collection, Lund.

Page 25. In the last two paragraphs lines 2nd and 5th from the bottom may refer to *Ceratiocaris tyrannus* rather than to *C. gigas* or *C. Murchisoni.*

Page 37. Add to the footnote—and 'Mem. Geol. Survey,' explan. sheet 23 (1879), pp. 9, &c.

Page 44. The 4th paragraph from the bottom refers to *Ceratiocaris patula* (not to *C. robusta*).

Pages 61 and 72. Pl. XI, fig. 16, may belong to the genus *Elymocaris*, Beecher, as suggested at p. 62.

Pages 62 and 72. *Ceratiocaris ? lata* belongs most probably to *Hymenocaris.*

We have to add that in the Lee Collection, British Museum, there are—

I, 1163. From the Upper Ludlow beds of Logan Water, portions of the tail-pieces of *Ceratiocaris papilio.*

I, 1169. From the Lower Ludlow of Leintwardine, near Ludlow, the end of an abdomen, telson, and cercopods of *C. papilio.*

I, 1167. From the Lower Ludlow of Church Hill, Leintwardine, the inside exposure of a left-hand valve of *C. Halliana.*

I, 1170. From the same locality a nearly perfect specimen of *C. Halliana*, Young.

I, 1168. From the Lower Ludlow beds, Ludlow—*C. cassia.*

PART II.

The Table given at pages 2 and 3 of Part I (1888) indicates that bivalved forms with the carapace-valves more or less easily separable, and either pod-shaped or conchiferoid, come near to *Ceratiocaris* lately described in that Part. Some of these we shall deal with presently. There is one form, however, having a folded shield, like that of *Nebalia*, which has the lateral halves of the carapace and the exserted abdominal segments so much like those features in *Ceratiocaris* that it seems advisable to take it (*Hymenocaris*) into consideration at once. We may here remark that, with regard to the two associates of *Hymenocaris* in the Table at page 2, we have not yet obtained any further information about Barrande's "*Cytheropsis testis*;"[1] and that *Proricaris* (wrongly referred to this group as *Protocaris*) is not a Phyllopod, but had been conjecturally made up of portions of the limbs of *Eurypterus* or *Pterygotus*. (See 'Report Brit. Assoc.' for 1889 (1890), p. 68.)

It will be convenient to take up in succession to *Hymenocaris* those forms (*Lingulocaris*, &c.) resembling the shells of some bivalve molluscs, and then the little pod-like *Caryocaris*, which is probably not far removed zoologically from *Ceratiocaris*. Subsequently those with flat sutured carapaces (*Aptychopsis*, *Peltocaris*, and *Pinnocaris*) will be described, and then such as have flat entire carapaces (*Discinocaris*); and, lastly, the Apus-like forms (*Dithyrocaris*).

A. *Phyllopodous Forms with Hinged or Folded Valve-like Carapaces.*

V. *Genus*—Hymenocaris, *Salter*, 1853.

Salter, 'Report British Assoc.' for 1852 (1853), Transact. Sect., pp. 56—58.
Morris, 'Catal. Brit. Foss.,' 1854, p. 109.
H. Woodward and Salter, 'Catal. and Chart Foss. Crust.,' 1865, p. 17.
Salter, 'Memoirs Geol. Survey Great Britain, &c.,' vol. iii, 1866, p. 293; 2nd edit., 1881, p. 484.

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[1] The form quoted as such by MM. de Tromelin and Lebescoute in 1875 is not the same (see Dr. C. Barrois's "Mémoire sur la Faune du Grès Armoricain," 'Annales Soc. Géol. du Nord,' vol. xix, 1891, pp. 147 and 149).

H. Woodward, 'Catal. Brit. Foss. Crust.,' 1877, p. 75.

T. R. Jones and H. Woodward, 'Report Brit. Assoc.' for 1883 (1884), p. 217; 'Monogr. Brit. Palæozoic Phyllop.,' Pal. Soc., pt. 1, 1888, p. 2.

Etheridge, 'Foss. Brit.,' vol. i, Palæozoic, 1888, p. 55.

Woods, 'Catal. Type Fossils Woodw. Mus. Cambridge,' 1891, p. 136.

This Palæozoic Phyllopod was first noticed and named by Mr. J. W. Salter. It is a somewhat shrimp-like form, allied to the living *Nebalia* and the Silurian *Ceratiocaris*. The carapace is simply bent on the back, so as to form two subtriangular lateral flaps or attached valves. Several (eight or nine) abdominal segments are exposed, ending with six delicate, tapering caudal appendages. Its generic characters are recognised in a detailed description of its one best-known species.

1. Hymenocaris vermicauda, *Salter*. Plate XIII, figs. 1—14.

Hymenocaris vermicauda, *Salter*. Report Brit. Assoc. for 1852 (1853), p. 58.
— — *Morris*. Catal. Brit. Foss., 2nd edit., 1854, p. 109.
— — *Salter*. In Murchison's Siluria, 1st edit., 1854, p. 42, foss. 3; 3rd edit. (including Sil. Syst.), 1859, p. 45, foss. 5, fig. 1; 4th edit. (including Sil. Syst.), 1867, p. 44, foss. 6, fig. 1.
— — *Woodward and Salter*. Catal. and Chart Foss. Crust., 1865, p. 17, fig. 1.
— — *Salter*. Mem. Geol. Survey Great Brit., vol. iii, 1866, p. 293, pl. ii, figs. 1—4 (the last is a restoration); pl. v, fig. 25; 2nd edit., 1881, p. 484, the same figs.
— — *Baily*. Figures Charact. Brit. Fossils, 1867, p. 8, pl. iv, figs. 1 *a*, 1 *b* (restoration).
— — *Bigsby*. Thesaurus Siluricus, 1868, p. 75.
— — *Salter*. Catal. Camb. Silur. Foss. Cambridge, 1873, p. 10, woodcut (restoration).
— — *H. Woodward*. Cat. Brit. Foss. Crust., 1877, p. 76.
— — *Huxley, Newton, and Etheridge*. Catal. Cambr. Sil. Foss. Mus. Pract. Geol., 1878, pp. 7, 10.
— — *T. R. Jones*. Geol. Mag., 1883, p. 463.
— *T. R. Jones and H. Woodward*. Report[1] Brit. Assoc. for 1883 (1884), p. 217; ibid.[2] for 1888 (1889), p. 178, figs. 2—5.
— — *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 55.
— — *Woods*. Catal. Type Fossils Cambridge, 1891, p. 136.

[1] The First Report of the Committee, consisting of Mr. R. Etheridge, Dr. H. Woodward, and Professor T. Rupert Jones (Secretary), on the Fossil Phyllopoda of the Palæozoic Rocks.

[2] The Sixth Report.

Hymenocaris vermicauda has its carapace folded or bent along the back, so as to form an overarching carapace (as in *Nebalia*) with two symmetrical, suboval, valve-like sides, somewhat resembling saddle-flaps, not so deep in front as behind, obliquely rounded or semi-elliptical below, and with a very slightly convex dorsal line.[1] The curvature of the ventral edge varies in fulness and in obliquity with individuals, and is nearly always modified by the pressure to which the shale or mudstone containing the fossils has been subjected. The specimens are all flattened laterally; some are lengthened, and some shortened, according to their position relative to the direction of the squeeze; and nearly all are crumpled or "plaited"[2] with parallel foldings, coarse or fine, at right angles to the line of pressure.

Some of the best preserved individuals measure $\frac{9}{10}$ inch (21 mm.), others 1 inch (23 mm.), and others (imperfect otherwise) even more, along the back line. Those with the first two measurements are $\frac{8}{10}$ inch (19 mm.) in height; and their angular length (from antero-dorsal to postero-ventral point) is $1\frac{3}{10}$ inches (56 mm.). Many smaller individuals occur.

The carapace was thin (hence the name = "membranous") and apparently smooth. No definite structure has been observed, but Salter noted "short wavy lines" on the carapace and the abdominal segments ('Mem. Geol. Survey,' vol. iii, p. 294), and a marginal furrow along the posterior border of the valves (p. 293).

Owing to the compressed and plaited condition of the schistose matrix, it is difficult to define the original outline of the ends of the carapace. The fig. 4 in pl. ii, 'Mem. Geol. Surv.,' vol. iii, is a restoration, and its truncate anterior end is a very doubtful feature. The outline given of a specimen shown in fig. 3 (loc. cit.) is not supported by the specimen itself.[3] The front angle, though often modified or suppressed by the imperfect cleavage of the squeezed mudstone, is sometimes perfect enough to show that it was much sharper than in the fig. 4 referred to above, in which the truncation is probably due to fracture of one of the specimens used in making this restoration of the animal. The posterior margin appears to have sloped downwards and outwards, with a bold ventral curve, but usually without the sinuous (ogee) bend under the dorsal angle which *Ceratiocaris* generally exhibits.

The relative position of carapace and body-segments has been subjected to much interference, between the death and the imbedment of the specimens, from the decomposition of the soft parts or connecting tissues and the shifting of the

[1] Much like the carapace-valves of *Ceratiocaris Pardoëana* in shape (Monogr., part i, 1888, pl. v, figs. 1 and 2.

[2] Salter, 'Quart. Journ. Geol. Soc.,' vol. x, 1854, p. 209; and 'Mem. Geol. Surv.,' iii, 1866, p. 247, note.

[3] The two small spikes figured in the same illustration are illusory, as are also the three needle-like projections in the woodcut in 'Siluria,' 1854, 1859, and 1867, though often copied in text-books.

harder covering; yet Mr. Salter's determination of the more truncate or wider (higher) end of the carapace being the hinder margin seems to be well founded, whether the abdomen be still in apposition or not.

The crumpled bed-planes of the hard shale or flagstone frequently exhibit crushed body-joints of the *Hymenocaris;* but these relics of the abdominal portion vary much in the number of attached segments. Sometimes four or five, but not uncommonly six or seven body-joints occur, with or without the telson being apparent. Eight or nine together are less frequent. In one instance (in the Owens College Museum) ten or eleven segments can be counted, besides an obscure telson, in an unattached body (Pl. XIII, fig. 10) lying on a slab containing numerous specimens of carapaces and body-rings of *Hymenocaris* (from Garegfelen, collected and given by Mr. D. Homfray). In this case some (five or six) segments, which appear to have been softer than the others, may have been within the carapace, for they differ from the others in size and distinctness of outline.

The crushing and squeeze have rendered even the best and most promising specimens so obscure that much doubt still exists in the observations on this Phyllopod. Mr. Salter determined nine exposed body-rings ('Mem. Geol. Surv.,' vol. iii, p. 293, but only eight are shown in his pl. ii, fig. 4), with one pair of styles and two pairs of stylets attached to the last joint (op. cit., pl. v, fig. 2). The abdominal joints vary from about $\frac{3}{10}$ to $\frac{4}{10}$ inch (7 to 9 mm.) in height, sometimes to $\frac{5}{10}$ (12 mm.), very rarely to $\frac{6}{10}$ and $\frac{7}{10}$ (15 and $17\frac{1}{2}$ mm.), but in one case to $\frac{8}{10}$ inch (20 mm.), according to size of individuals and the accidental crush.

The caudal appendages consist of six setæ, springing from the terminal edge of the last body-segment or telson, and arranged in three pairs, namely, a central pair, 5·75 mm. long, and two outside pairs, each of which has its inner spine or seta, 8 mm. long, and its outer spinule, 3·17 mm. long (see Pl. XIII, fig. 9, magnified).

In his "Monograph of the Phyllopod Crustacea of North America" ('Twelfth Annual Report of the U.S. Geol. Survey,' 1883), Dr. A. S. Packard figured and described (pp. 437, 536, and 590, pl. xxxvi, fig. 7, and pl. xxxvii, fig. 5) the cercopods of *Nebalia*. An embryonic *N. Geoffroyi* has two strong tapering cercopods, each terminating with a long seta between two short spinose setæ. If the two cercopods were reduced and united laterally, the six setæ would be brought together, and represent the three paired (or doubly trifid) cercopods of *Hymenocaris*. In other words, *Hymenocaris* has caudal appendages equivalent to the terminal setæ of the *Nebalia* referred to if these latter were brought together laterally, and stood out directly from the last body-segment or telson without any differentiated basal cercopods.

Hymenocaris vermicauda occurs in the Lower Lingula-flags, especially "in the upper portions of the true Lingula-flags" (Salter, *op. cit.*, p. 293, and 'Catal. Pal. Foss. Cambridge Mus.,' p. 10), near Tremadoc, Ffestiniog, and Dolgelly. The particular localities[1] are the railway-cutting near Wern, not far from Penmorfa; Pentre'r-felin, west of Penmorfa; Gareg-felen; Bryntwr Summerhouse; and especially the hill descending to Penmorfa Church; Moel-y-gest, the hill behind Portmadoc; Borth cove or harbour, near Portmadoc; also at Ffestiniog; Gwern-y-barcud ('Mem. Geol. Surv.,' vol. iii, p. 294), Moel-hafod-Owen, and other places near Dolgelly; and doubtfully at Pont Seiont, Caernarvon. A specimen in the British Museum is from the 'Upper Tremadoc' schistose shale of Garth, near Portmadoc. The Halifax Museum also possesses one or more specimens from the "Upper Tremadoc flags" of Garth, Portmadoc.

The rippled flagstones of the Lingula series near Tremadoc, at the village of Y-Felin-newydd, and near Pentre'r-felin and Wern, on the Criccieth road, are marked with tracks referred, with good reason, by Mr. Salter to *Hymenocaris vermicauda* ('Quart. Journ. Geol. Soc.,' vol. x, 1854, pp. 208—211; and 'Mem. Geol. Surv.,' vol. iii, p. 248 and p. 294, pl. i).

§ 1. Carapaces.

The chief specimens which we have met with and regarded as illustrative of this species are the following:

1. A large specimen (Pl. XIII, fig. 1) wanting the caudal extremity. Both the carapace and the eight abdominal segments have been obliquely squeezed from above and behind towards the infero-anterior region; and the left-hand carapace-valve here shown is, in particular, somewhat lengthened backwards and downwards.

This occurs in dark-grey slaty mudstone, minutely micaceous, from the Middle Lingula-flags, at Borth, Portmadoc. In the Cambridge Museum ($\frac{A}{161}\ \frac{b}{286}$).

It is referred to in the 'Report on British Palæozoic Phyllopoda' for 1888 (1889), p. 178, fig. 4.

This is very similar to the specimen figured by Salter in the 'Mem. Geol. Surv.,' vol. iii, 1866, pl. ii, fig. 1, which is in the Museum of Practical Geology, and which lies in dark-grey schistose mudstone from Penmorfa, near Tremadoc.

2. Carapace and abdomen of a large individual (Pl. XIII, fig. 12). Both are imperfect and much compressed. The two valves are indistinctly indicated; the

[1] Mr. David Homfray, who collected the larger portion of the known specimens of this genus, has favoured us with a note of the localities.

abdomen retains some trace of caudal spines, but has probably been turned upside down.

In bluish-grey shaly flagstones with rusty facings. From the Lingula-flags at Borth, Portmadoc. Cambridge Museum ($\frac{A}{171}\ \frac{a}{15}$).

3. A distorted and somewhat crushed, but otherwise nearly perfect individual (Pl. XIII, fig. 2). The abdominal segments (eight well shown with a trace of another) are turned up behind at a sharp angle with the carapace; and the last segment retains some portions of the caudal appendages.

In bluish-grey flagstone with rusty facings. Middle Lingula-flags; Borth, Portmadoc. British Museum, I 322. D. H.

4. The broken front part of a valve, with eight segments (and trace of a ninth) lying at an angle with it, and retaining portions of the tail-spines. Pl. XIII, fig. 3.

In bluish-grey slaty flagstone with rusty facings. Portmadoc. British Museum, I 322. D. H.

5. Carapace or left-hand valve, lying separate from seven body-segments, not perfect, but retaining a remnant of one of the caudal spines. Pl. XIII, fig. 4.

In dark grey slaty mudstone, minutely micaceous. Middle Lingula-flags; Borth, Portmadoc. In the Cambridge Museum ($\frac{A}{161}\ \frac{b}{286}$).

Referred to in the 'Report Brit. Assoc.' for 1888 (1889), p. 178, fig. 3.

6. A small specimen (Pl. XIII, fig. 5), showing the right-hand side of a carapace having a bold posterior ogee curve that has been increased by pressure. Also eight body-segments, turned downwards at right angles, and retaining the full number of cercopods, namely, a small central pair, flanked on each side by one large and one small spine. Of these appendages the middle pair are rather shorter than those in fig. 9 (magnified $2\frac{1}{2}$ diameters), but the outer pairs are of about the same length.

In dark-grey slaty mudstone. Middle Lingula-flags; Borth. Cambridge Museum ($\frac{A}{161}\ \frac{b}{287}$. D. H.).

Referred to in 'Report Brit. Assoc.' for 1888 (1889), p. 178, fig. 5.

7. A large carapace, or left-hand valve (Pl. XIII, fig. 13), modified by pressure, and widened into an irregular lozenge shape.

In dark-grey schistose mudstone. Lingula-flags; Portmadoc. Museum Practical Geology, marked $\frac{1}{29}$; Wyatt-Edgell Coll. 'Catal. Camb. Sil. Foss.,' 1878, p. 10.

8. Distorted valve, narrowed by pressure, and imperfect by fracture at the lower part of the posterior edge. Pl. XIII, fig. 6. In contrast with fig. 13. Referred to in the 'Report British Assoc.' for 1888 (1889), p. 178, fig. 2.

In dark-grey slaty flagstone, very minutely micaceous, much squeezed. From the Ffestiniog group; Borth, Portmadoc.

Cambridge Museum ($\frac{A}{173}$).

§ 2. Body-segments.

9. Eight body-segments, of large size, without caudal appendages (Pl. XIII, fig. 7). Much compressed, thereby having greater height than originally. In bluish-grey slaty flagstone with rusty facing, squeezed. Lingula-flags; Cae'n-y-coed, near Maentwrog.

Cambridge Museum ($\frac{A}{174}$ $\frac{B}{297}$. D. H.).

Referred to in 'Report Brit. Assoc.' for 1883 (1884), p. 221.

10. Five body-segments, with portions of the tail-spines on the last (Pl. XIII, fig. 14), somewhat crumpled by oblique pressure. In light bluish-grey schistose mudstone with rusty facings. Borth, Portmadoc.

British Museum, I 322.

11. Six (?) body-segments, with remnants of the tail-spines (Pl. XIII, fig. 8). In dark-grey slaty mudstone, minutely micaceous, squeezed. Portmadoc.

Museum Pract. Geol., marked $\frac{1}{29}$; Wyatt-Edgell Coll. 'Catal. Cambr. Sil. Foss.,' 1878, p. 10.

12. The last three body-segments, with the six caudal appendages well exhibited (Pl. XIII, fig. 9). Magnified $2\frac{1}{2}$ diameters. This is the same specimen as that figured in the 'Mem. Geol. Surv.,' vol. iii, pl. v, fig. 25. In dark-grey slaty mudstone, Lower Lingula-flags; Moel-y-gest, Tremadoc.

13. Two groups of narrow body-segments, separate from their carapaces. Pl. XIII, fig. 10 shows eleven (?) joints, five or six of which seem to have been soft, round, and indistinct, whilst five or six were harder, more angular, distinct, and terminated with caudal spines. Fig. 11 shows 15 (?) segments, separated, distorted, and possibly not all belonging to one and the same animal. In dark-grey slaty mudstone with Lingulæ, squeezed. Lingula-flags; Gareg-felen, D. H. The Owens College, Manchester.

The gradation in size of the abdominal segments from fig. 7 to figs. 1, 12, 2, 3, 14, and 4, and to figs. 5, 8, 10, 11, and 9 ($\times$ $2\frac{1}{2}$), may be accounted for by relative age alone.

2. Hymenocaris ? lata, *Salter*, 1866. Fig. 4 (woodcut).

Hymenocaris ? latus, *Salter*. Mem. Geol. Surv., vol. iii, 1866, p. 240 (in list).
Ceratiocaris ? latus, *Salter*. Ibid., p. 294, woodcut 5; 2nd edit., 1881, p. 486, woodcut 5.
— — *Salter*. In Siluria, 1867, p. 516.
— — *Salter*. Catal. Cambr. Silur. Foss., 1873, p. 16.
— — *H. Woodward*. Catal. Brit. Foss. Crust., 1877, p. 71.
— — *T. R. J. and H. W.* Geol. Mag., 1885, p. 465.
— — — Ibid., 1886, p. 460.

Ceratiocaris ? latus, *T. R. J. and H. W.* Report Brit. Assoc. for 1885 (1886), p. 351.

— — — Monogr. Brit. Palæoz. Phyll., part i, 1888, p. 63.

— — *Woods.* Catal. Type Foss. Camb. Mus., 1891, p. 134.

Mr. Salter's figure referred to above is a restoration of five (?) body-segments, which apparently had been embedded in an oblique position and crushed endwise so as to be widened and shortened, with a subspiral outline, 28 mm. broad by 12 mm. high (the restoration gives 22 by 15 mm.). See Fig. 4 (woodcut).

The direction of pressure must have been at right angles to the minute plaiting of the matrix, obliquely crossing the compressed remains of the animal, and therefore not quite coincident with the long axis of the original individual.

Fig. 4. — *Hymenocaris lata*, Salter. Some obliquely squeezed abdominal segments. From Garth.

These segments are probably not too broad for some such individual as that to which fig. 7 of our Pl. XIII belonged; but they are so narrow in their longitudinal succession, though with great apparent breadth, and Salter's restoration makes them taper so rapidly, that we may conveniently keep the specific name given by Salter, though we prefer to adopt his first suggestion (in the list at p. 240, op. cit.) that it was referable to *Hymenocaris*.

In dark-grey flagstone, Upper Tremadoc group; Garth, Portmadoc. Cambridge Museum.

VI. *Genus*—Lingulocaris, *Salter*, 1866.

Salter, 'Mem. Geol. Survey,' vol. iii, 1866, pp. 252 and 294; 2nd edit., 1881, p. 485.

H. Woodward, 'Catal. Brit. Foss. Crust.,' 1877, p. 76.

T. R. Jones, 'Geol. Mag.,' 1883, p. 463.

T. R. Jones and H. Woodward, 'Report Brit. Assoc.' for 1883 (1884), pp. 217 and 223.

Etheridge, 'Foss. Brit.,' vol. i, Palæoz., 1888, p. 58.

This was determined and described as a Palæozoic bivalved Phyllopod, from the Upper Tremadoc slates of Tu-hwnt-i'r-bwlch, Garth, Portmadoc, North Wales, by Mr. J. W. Salter, in the 'Memoirs of the Geological Survey,' vol. iii, 1866, pp. 253 and 294. His description of the generic characters is as follows:—"A thin bivalve crustacean shell, with a generic form like that of a *Modiola* or *Mytilus*, with scarcely prominent beaks, and *no ?* hinge-teeth; the surface of the carapace is covered by fine, raised, concentric lines."

1. Lingulocaris lingulæcomes, *Salter*, 1866. Plate XIV, fig. 4 (?).

Lingulocaris lingulæcomes, *Salter*. Mem. Geol. Survey (Appendix to Ramsay's Geol. North Wales), vol. iii (1866), pp. 253 and 294, pl. x, figs. 1 and 2; and 2nd edit. of Ramsay's Geol. North Wales, 1881, p. 485, pl. x, figs. 1, 2.
— — — Catal. Cambr. Silur. Foss. Cambridge, 1873, p. 16, woodcut.
— — *Bigsby*. Thesaur. Silur., 1868, p. 76.
— — *H. W.* Cat. Brit. Foss. Crust., 1877, p. 76.
— — *H., N., and E.* Cat. Cambr. Foss. Mus. Pract. Geol., 1878, p. 15 ($\frac{2}{5}$).
— — *T. R. J. and H. W.* Rep. Brit. Assoc. for 1883 (1884), p. 223.
— — *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 58.
— — *Woods*. Catal. Type Foss. Cambridge, 1891, p. 136.

In the Woodwardian Museum at Cambridge are two specimens of a bivalve ($\frac{A}{273}$), there labelled "*Mytilocaris lingulæcomes*, Salter," from the Upper Tremadoc slates, Garth, Portmadoc, one of which, seemingly representing the outside, but somewhat crumpled longitudinally, approximates in its outline and size ($1\frac{3}{10} \times \frac{1}{2}$ inch $= 32 \times 12$ mm.) to Mr. Salter's restoration (?), fig. 1, pl. x, and woodcut in 'Cat. Cambridge Foss.,' p. 16. The other is a less perfect internal cast. Otherwise we have not met with any corresponding specimen; in the Museum of Practical Geology, however, there is an imperfect internal cast showing the dorsal aspect, somewhat deformed by pressure, of a bivalved form (Pl. XIV, fig. 4), which may possibly belong to *L. lingulæcomes* or an allied form, referred to in the 'Catal. M. P. G. Mus. Cambr. Sil. Fossils,' 1878, p. 28, as "Bivalve Crustacean." It is marked D$\frac{4}{49}$. From the Upper Llandeilo, near Builth; in dark flagstone minutely micaceous.

In the Halifax Museum are specimens of this species from the Upper Tremadoc flags at Portmadoc.

An imperfect specimen in schistose mudstone from the Upper Tremadoc series at Garth, Portmadoc, in the Museum of Practical Geology, much crushed, marked $\frac{2}{4}$, as well as six rather small, crushed, and distorted specimens ($\frac{2}{5}$) are referred to *L. lingulæcomes* at p. 15, 'Catal. Cambr. and Silur. Foss. M. P. G.,' 1878.

2. Lingulocaris siliquiformis, *Jones*, 1883. Plate XIV, figs. 1 and 2.

Lingulocaris lingulæcomes, *Huxley, Newton, and Etheridge*. Catal. Cambr. Silur. Foss. Mus. Pract. Geol., 1878, p. 15 ($\frac{2}{4}$).

Lingulocaris siliquiformis, *T. R. Jones.* Geol. Mag., 1883, p. 464.
— — *T. R. Jones and H. Woodward.* Report Brit. Assoc. for 1883 (1884), pp. 215 and 223; ibid. for 1888 (1889), p. 177, figs. 8 and 9.

In the British Museum are casts of the insides of two bivalves ("48654" and "I, 2590") labelled "*Lingulocaris;*" but, though probably belonging to Mr. Salter's genus here mentioned, they differ much from its first species in outline. They are longer, sharper at one end, and more nearly resembling a pea-pod in shape. This species we have distinguished as *L. siliquiformis.*

At p. 223 of the First Report (1883) we described this Cambrian Phyllocarid as differing from Salter's *L. lingulæcomes,* as above. One specimen (Pl. XIV, fig. 1), rather wrinkled by crush, in bluish-grey slaty mudstone, with rusty facings, from the Upper Tremadoc series at Garth Hill, Portmadoc, was presented to the British Museum by the Rev. J. F. Blake (No. I, 2590). Another (fig. 2), in grey slaty micaceous mudstone, also in the British Museum, is marked "48654 from the schistose Bala rock at Bwlch-y-gaseg, near Cynwyd, Corwen; J. P., March 14th, 1868."

3. Lingulocaris Salteriana, *T. R. J. and H. W.*, 1889. Plate XIV, fig. 3.

Lingulocaris Salteriana, *T. R. Jones and H. Woodward.* Report Brit. Assoc. for 1888 (1889), pp. 176 and 177, figs. 6 and 7.

The British Museum has a fine specimen of one of the old Cambrian Phyllocarids from the Tremadoc-slate series (No. I, 2591). It is a black, shining, and filmy valve (or compressed bivalved carapace), seen as an impression and counterpart on a split slab of hard, dark-grey, micaceous mudstone, which has been subjected to the usual lateral pressure. The valve, $3\frac{1}{4}$? $\times$ $1\frac{1}{8}$ inches (83 by 28 mm.), is acutely subovate or sharply boat-shaped in outline, convex below and straight above, and was acute probably at each end, though one of them is damaged. It retains a remnant of one of the small, subtriangular, terminal extensions of the dorsal edge, such as are present in *L. siliquiformis.* See fig. 6 in our Sixth Report, for 1888, p. 178.

The surface is peculiarly marked with what seem to be modifications of ornamental striæ or linear plaits, namely, very small lenticular and bead-like elevations, which may have resulted from raised longitudinal striæ being crossed by the delicate plaiting of lateral pressure at slightly different angles.

We dedicated this fine species to the memory of our friend Mr. J. W. Salter, whose labours in elucidating these old Phyllopodous forms are well known. It was found by Dr. R. Roberts in the Tu-hwnt-i'r-bwlch quarry at Portmadoc, with *Asaphus*.

Another of the old associates of *Hymenocaris* in the Tremadoc series is the "second specimen" mentioned at p. 220 of our First Report (1883). Though smaller than the foregoing ($2\frac{6}{8} \times \frac{13}{16}$ inches, 70 by 21 mm.), it is of a somewhat similar shape, having been acute at both ends (probably, though one is broken), elliptically curved below and nearly straight above, thus having the outline of a sharp-ended boat (fig. 7 in our Sixth Report (for 1888), p. 179). It is not really "emarginate" at one end, as stated at p. 220 of the First Report, that appearance being due to a slight transverse crack and some inequality of the surface near the end, which was probably acute, but has been squeezed out of shape and frayed away by the longitudinal plaiting of the hard, compressed, slaty shale or mudstone. The cross-pressure has also coarsely plaited the valve throughout, and somewhat lengthened it.

From the upper part of the Lower Lingula-flags at Cae'n-y-coed, near Maentwrog. Coll. Mr. D. Homfray. Woodwardian Museum, Cambridge ($\frac{A}{160}$).

A somewhat similar but badly preserved fossil, from the Brathay Flags of Long Sleddale (Marr Coll. in the Cambridge Museum), is probably a *Lingulocaris* of the same or a closely allied species ('Catal. Type Foss. Camb. Mus.,' 1891, p. 136).

4. Lingulocaris, sp. Plate XIV, figs. 5 *a*, 5 *b*.

'Report. Brit. Assoc.' for 1889 (1890), p. 65.

An interesting specimen in M. Lebesconte's collection (at Angers) from the 'Schiste ardoisier inférieur (Faune 2de)' of Angers (Maine et Loire), very closely resembles *Lingulocaris Salteriana*, J. and W., shown by fig. 6, at p. 179 of our Sixth Report (for 1888), and in Pl. XIV, figs. 1 and 2. Unfortunately it is badly preserved and not quite perfect.

It was probably about 80 mm. long when perfect; it is 21 mm. broad (high) where widest, at a third of its length from one end, which, if it be the anterior, is more acute than in *L. siliquiformis*. The dorsal line was gently convex, and the ventral was much fuller, with a somewhat angular convexity. Fig. 5 *b* shows the sectional area at the widest part; its contours may have been modified by pressure. Much of the surface of the cast is thickly dotted over with possible indications of spinules or small tubercles.

VII. *Genus*—Saccocaris, *Salter*, 1868.

'Proceed. Geol. Polytech. Soc. W. R. Yorkshire,' vol. iv, 1868, pp. 588, 589.

In 1867 Mr. Salter noticed a relatively large oblong carapace from the Lingula flags, and at first referred it to *Hymenocaris*, but subsequently to a new genus, *Saccocaris*. The characters of this genus as first determined are mainly those of its first-described species, which here follows.

1. Saccocaris major, *Salter*. Plate XIV, fig. 6.

Saccocaris, *Salter*. Report Proceed. Geol. Polytech. Soc. West Riding of Yorkshire (for 1867), vol. iv, 1868, pp. 588, 589.
Hymenocaris (Saccocaris) major, *Salter*. Catal. Palæoz. Fossils Cambridge Museum, 1873, p. 7.[1]
— major, *Etheridge*. Mem. Geol. Surv., vol. iii, 2nd edit., 1881, p. 366 (in list).
— (Saccocaris) major, *T. R. Jones and H. Woodward*. Report Brit. Assoc. for 1883 (1884), pp. 219, 220.
Saccocaris major, *T. R. Jones and H. Woodward*. Ibid. for 1888 (1889), pp. 175, 176.
Saccocarix (sic), *Etheridge*. Brit. Foss., part 1, Pal., 1888, p. 55.
Saccocaris major, *Woods*. Catal. Type Foss. Camb. Mus., 1891, p. 136.

In the Woodwardian Museum at Cambridge there are three specimens labelled "*Hymenocaris ? major*," with some doubt, and possibly by Salter himself. Only one of them, however, answers to Salter's brief generic description.

This specimen (marked $\frac{A}{160}$), which most nearly corresponds with the original description, namely, "a large ovate carapace, strongly emarginate behind, and larger than *H. vermicauda*," is a relatively large, thin, filmy compressed valve, $4\frac{2}{10}$ inches long and 2 inches high (120 by 51 mm.), suboblong, with nearly parallel dorsal and ventral borders, the former straighter than the latter, which has a slight outward (downward) curve. Obliquely elliptical in front, the acme

[1] Here entered as "*Hymenocaris* (*Saccocaris*, 'Halifax Trans.,' 1867) *major*, Salter, n. s." The reference is a mistake for 'Report Proceed. Geolog. Polytech. Soc. West Riding, Yorkshire, for 1867' (Leeds, 1868). The reference is to vol. iv, p. 588, 'On *Sacocaris*, a new genus of Phyllopoda from the Lingula-flags,' by J. W. Salter, A.L.S., F.G.S.

of the curvature being above the mesial line, thus making the antero-dorsal much shorter than the antero-ventral curve.

Apparently blunt or truncate behind, with a gentle outward curve rather above the middle. The exact line of this posterior margin is not clearly seen, owing to its passing into the substance of the black schistose mudstone, the valve having been delicately plaited (with the stone), and gently undulate throughout, in lines parallel to the long axis of the valve; and pressure having acted at right angles to its length, this longitudinal plaiting (pleating) is transverse to the hind border, and the whole surface is compressed and corrugated from edge to edge. The hinder margin of the valve, indeed, is barely perceptible, having been shredded or frayed off by its extremely plaited state, or, in other words, frittered away in longitudinal shreds parallel with the plaiting of the rock, showing probably that this end was of thinner consistence than the rounded front edge, which has not been affected nearly so much, having probably been thicker, or even slightly rimmed.

This frayed condition often occurs with the ends of phyllopodous specimens in the Lingula-flags. There are also some irregular concentric lines in the antero-ventral area of the specimen, caused by depression in the convexity of the valve. By the cross-pressure the specimen must have lost something in height, and has had its length exaggerated.

The valve, slightly hollow, is probably the right-hand valve, showing its inside. Several concentric, irregular, narrow foldings, following the contour of the anterior and antero-ventral border, are apparently due to the compression of the convexity of the valve.

This specimen, No. 1 at p. 220 of the First Report, and fig. 1, p. 178, Report for 1888, is marked $\frac{A}{160}$, $\frac{b}{297}$, in the Woodwardian Museum of the Cambridge University, and was collected by Mr. D. Homfray from the upper part of the Lower Lingula-flags at Cae'n-y-coed, near Maentwrog.

This was at first (in 1867) regarded by Mr. Salter as a flat carapace, "after the manner of *Apus*;" but afterwards (in 1873) he referred it to the bivalved, folded, or Nebalioid forms of carapace, and placed it as an ally of *Hymenocaris*, with the name *Saccocaris*. In shape it differs much from the valves of that genus, as it wants their triangular form, due to the dorsal line forming an angle with the front edge, which slopes rapidly downwards and backwards all along the ventral, to join the posterior margin, with a bold, oblique postero-ventral curve. Differing also remarkably in size, it must be assigned to a different generic group, and we thought it best to recall the name which Salter was at first inclined to give it, namely *Saccocaris*.

We have met with no evidence of the body-segments alluded to by Mr. Salter, nor are the "three distinct ridges on the hinder border" recognisable. On the upper part of the posterior region there are some small suboblong pits, which may possibly indicate the bases of former prickles or tubercles.

2. Saccocaris minor, *T. R. J. and H. W.*, 1891. Plate XIV, figs. 7—9, and fig. 10 (?).

Saccocaris minor, *T. R. Jones and H. Woodward.* Report Brit. Assoc. for 1890 (1891), p. 424, figs. 1—17.
— — *Woods.* Catal. Type Foss. Cambridge, 1891, p. 137.

On a large piece of the " Upper Shale (= Daear-fawr Shale) west of the Craig known as Craig-yr-hyrddod, Arenig," North Wales, kindly submitted by Professor T. McKenny Hughes, F.R.S., for examination, are numerous, and at first sight somewhat obscure impressions of a bivalved Phyllocarid, together with some body-segments of the same. The rock is "the top bed of shale tangled among the porphyries of the Mountain Arenig. It is, therefore, the highest fossiliferous zone of the *Arenig* of Arenig." The slab, measuring 18 by 10 inches, and half an inch thick, consists of a hard, dark-coloured, fine-grained flagstone (dark-blue within and weathering dull rusty grey), not argillaceous nor calcareous, made up of minute, fragmentary, crystalline particles. One edge is straight and ragged, and the opposite edge is rounded, as if it had been a part of a large fissile concretion. The slab separates horizontally into two parts, and the counterpart surfaces are covered with the fossil impressions, which are mainly convex on one of the faces, and concave on the other. One larger convex cast (Pl. XIV, fig. 7) lies almost alone on the rusty weathered back of the piece that bears the concave impressions. These carapaces and abdominal segments are merely dark films, more or less flattened, and squeezed across their length. Some, however, among the numerous individuals are less distorted by pressure, especially the one (fig. 7), which is isolated on a different (outer and broadly rippled) surface of the stone.

The crowded fossils lie mostly oblique to the long axis of the stone, near to each other, often close together, more or less parallel, and generally with the same end in one direction. On the plate at page 425 of the Report for 1890 some of the best preserved specimens were selected and outlined just as the individuals lie on the stone; sometimes, as figs. 1 and 2, 9, 10, and 11, 7, 15, 16, and 17, in groups. See also Pl. XIV, fig. 9.

These carapace-valves are more or less oval-oblong in outline, but often imperfect, and in nearly all cases modified in shape by pressure.

The largest individual (Pl. XIV, fig. 8), 37 mm. long and 22 mm. high (broad), having nearly its original shape, has its upper and lower edges slightly convex and nearly parallel; the upper (dorsal) edge is somewhat more fully curved than the other, especially in the antero-dorsal region. The front end (to the left hand in the figure) was probably rounded, but is broken; the hinder extremity is obliquely truncate, but bears some indication of an ogee curvature, such as is seen in many *Ceratiocaridæ* and other Phyllocarids. Three abdominal segments (one imperfect) are still attached to this end of the carapace; the first two are about 5 mm. long, and the third about 7 mm. They appear to have been originally as deep as the carapace,[1] and each segment at its hollow curve below its convexity and lateral articulation was marked with vertical striæ.

The surface of fig. 8 bears five delicate, longitudinal, gently curved subparallel lines. These lines are partly raised and partly hollow, as if, having a consistency different from that of the rest of the valve, they have been differently affected by the pressure to which the matrix had been subjected.

Fragments of probably a specimen similar to the foregoing lay close to it, as shown by fig. 2, p. 425 of the Report for 1890 (Eighth Report).

There is a remarkable similarity in outline between Pl. XIV, fig. 8, here described, and fig. 6, namely, *Saccocaris major*, Salter. Although the relative size differs very much (110×50 mm. and 37×22 mm.), and the proportions are also somewhat different ($110\times50 : 101\times66$), we are inclined to refer the two specimens (both of which are from the Cambrian rocks) to the same genus. Probably, if it were not for the broken anterior border in fig. 8, and the broken posterior margin of *Saccocaris major*, they might have presented a still stronger likeness.

We have regarded this form as a new species, and named it *Saccocaris minor*, defined as follows:

Carapace valve suboblong, arched above, nearly straight below, elliptically rounded in front, with the acme of curvature probably coincident with the mesial line of the valve; truncate behind, with a slightly projecting and blunt angle at its upper fourth. Surface marked with five longitudinal, slightly curved, subparallel lines, somewhat like the nervures in an insect's wing; one or more of the lines seem to branch backwards. Abdominal segments present (see Pl. XIV, figs. 8 and 9, and other figs. in Report for 1890), and are of considerable interest as connecting this old form with *Hymenocaris*, *Ceratiocaris*, and other allies. Some of the caudal spines are obscurely preserved on the slab.

Owing to the pressure that has so greatly affected the specimens on the two counterpart faces of the split slab, there is considerable variation in the outlines of the individuals, nor do they quite match fig. 8, Pl. XIV. Fig. 3 (Report of 1890) measures 27×15 mm.; fig. 4 (1890), 27×10 mm.; fig. 7 (1890), 28×11 mm.; fig. 9 (1890), 23×7 mm.; fig. 11 (1890), 25×8 mm. Nevertheless some features of fig. 8, Pl. XIV, are traceable in the majority. Looking at the

[1] This would agree with Mr. Salter's suggestion that the body-rings in *S. major* were probably as high (wide) as the valve itself.

selected outlines drawn from the slab in 1890, we see the rounded front in figs. 3, 4, 5, 9, 11, 15, 17 of the Report, and partially in figs. 7, 10, and 14 of that Report. Figs. 3 and 15 (1890) retain some of the proportionate height of Pl. XIV, fig. 8; but others seem to have become narrower by cross-pressure, but this may have been an original specific feature (although very doubtful). Some trace of the hinder ogee outline is visible in figs. 3, 5, 7, 9, 11, and 15 of the Report (sometimes neater than in Pl. XIV, fig. 8); also in figs. 14 and 17, which are apparently *reversed* valves, with the dorsal edge downwards. The superficial longitudinal lines are evident in all the valves; and 4, 5, 7, and 15 (1890) show the backward branching, but in fig. 17 the branching veins seem to have a forward direction. Unequal pressure may have modified these appearances. We regard these smaller valves as being most probably immature forms, rather than showing either sexual or specific differences. Abdominal segments are attached to the valves in figs. 3, 4, 7, and 14 of the Report; and are separate in figs. 6, 8, 12, 13, and 16 of that series. In shape, size, and ornament these differ too much for us to pretend to decide whether they are really all of one kind or not, the modes and degrees of preservation probably making more distinctions than originally existed. Pl. XIV, fig. 8, represents fig. 1 of the Report, and fig. 9 comprises figs. 9, 10, 11 of the Report.

Bearing in mind the gregarious habits of modern Entomostraca, it seems most probable that we have here another illustration of the crowding together of numbers of individuals of *one species* which lived in the same shallow lagoon, a portion of which may have been dried up (as in a modern shore pool), leaving its inhabitants to perish in the sun and to be covered up with a fresh layer of mud by the next tide. Such a local accumulation of animal matter may have caused a segregation of special mineral matter in the matrix, and have given rise to the local concretion.

The slab and its counterpart from the Arenig slates, as mentioned above (p. 86), collected by Professor T. M'Kenny Hughes, are preserved in the Woodwardian Museum at Cambridge.

A small specimen of an imperfect valve in the Woodwardian Museum (marked $\frac{A}{170}$) from Wern, near Portmadoc, in a bluish schistose mudstone, weathering greenish-grey, shows a definitely sinuous (ogee) posterior margin, thus presenting a feature seen in some specimens of *Saccocaris minor* (as also in *Ceratiocaris*). This posterior moiety of a valve is 23 mm. long by 15 mm. high. We figure it here (Pl. XIV, fig. 10) as being probably of the same genus, if not of the same species as *S. minor*.

This specimen was described at p. 220 of the First Report (1883), and figured in outline at p. 179 of the Sixth (1888) Report, fig. 10, as being doubtfully a part of the valve of a *Ceratiocaris*.

VIII. *Genus*—CARYOCARIS, *Salter*, 1863.

SALTER, 'Quart. Journ. Geol. Soc.,' vol. xix, 1863, pp. 135, 139.
BIGSBY, 'Thesaur. Silur.,' 1868, p. 73.
T. R. JONES, 'Geol. Mag.,' 1883, p. 463.
T. R. JONES and H. WOODWARD, 'Report Brit. Assoc. for 1883' (1884), pp. 217 and 221.
— — 'Monogr. Brit. Pal. Phyllop.,' pt. 1, 1888, p. 3.
ETHERIDGE, 'Foss. Brit.,' vol. i, Palæoz., 1888, p. 46.

Mr. J. W. Salter determined *Caryocaris* ('Quart. Journ. Geol. Soc.,' vol. xix, p. 139) as having a "bivalved carapace (with distinct hinge-pits), rounded anteriorly, subtruncate behind, and with the back and front subparallel. The surface is smooth, or with only oblique wrinkles near the margins, but with no parallel lines of sculpture." The body and abdominal appendages were unknown to Mr. Salter; but he suggested, in a restoration ('Quart. Journ. Geol. Soc.,' vol. xix, p. 137, fig. 15), a strong, tapering telson (or last body-segment), carrying a sharply lanceolate style and stylet, much like fig. 16 *a*, Pl. XI of this Monograph (Part I, 1888). Mr. Marr has found in association with *Caryocaris*, at the tramway bridge crossing the Seiont in Caernarvonshire, some small slender spines or pointed styles, from about $\frac{8}{10}$ to $\frac{12}{10}$ inch in length, which are longer than Salter's ideal figure; but Prof. Malaise, of Gemboux, Belgium, has favoured us with the loan of a specimen showing three definite sharp dagger-like stylets as the cercopods of this genus (see the figure at p. 91).

1. CARYOCARIS WRIGHTII, *Salter*, 1863. Plate XIV, figs. 11—15; and Figures 5 and 6 (woodcuts).

CARYOCARIS WRIGHTII, *Salter*. Quart. Journ. Geol. Soc., vol. xix, 1863, pp. 137, 135, fig. 15, and p. 139.
— — — Catal. Cambr. Silur. Foss. Cambridge, 1873, p. 21, woodcut.
— — *H. Woodward*. Catal. Brit. Foss. Crustac., 1877, p. 70.
— — *H. N. and E.* Catal. Camb. Silur. Foss. Mus. Pract. Geol., 1878, p. 19.
— — *T. R. J. and H. W.* Report Brit. Assoc. for 1883 (1884), p. 222.
— — *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 46.

The test is smooth, thick, and somewhat horny in appearance, often with light purplish tints, sometimes black and filmy, rarely white and thick (fig. 12). The ventral margin is thickened with a raised rim; and sometimes the appearance of two such rims arises from the impression of one valve marking the ventral region of the other. The extremities rarely exhibit any raised margin; and we have not recognised the dorsal rim nor the hinge-marks alluded to by Salter.

Owing to the relative solidity of the valves this fossil is not unfrequently preserved in shape, even when the "plaiting" or imperfect cleavage of the compressed flagstone crosses them at various angles. Hence these valves are not so much altered in form in the Skiddaw Slates as the *Hymenocarides* are in the Lingula-flags: yet occasionally, when they lie parallel with the superinduced grain of the schist, their ends are frayed out or "plaited" into a mere fringe. A very much *crumpled* specimen from near Keswick was figured by Mr. Salter in the 'Geologist,' vol. iv, 1861, p. 74, before he described the genus and species in detail.

Of the great number of individuals present in the Skiddaw Slates, the shape of most has been more or less modified by pressure. Though Mr. Salter adopted the narrow end as the anterior in his figures, we prefer to regard the broader and prow-shaped end as the front.

Taking fig. 13 (B. M. 47935) as presenting a well-preserved outline, we regard the narrow end as the posterior, vertically truncate, and very slightly sinuous; whilst the anterior end is broader (higher), with an acute angle above the medial line, and passing gently into the slightly convex dorsal margin, and with a bold elliptical curve into the strongly convex ventral margin. Fig. 14 (B. M. 42162), though somewhat crumpled, shows these features. Fig. 11 (M. P. G. $\frac{2}{55}$) has both ends modified into nearly upright curves. Fig. 12 (M. P. G. $\frac{2}{54}$, D$\frac{5}{13c}$) has the anterior almost as truncate as the posterior. Fig. 15 (C. M. $\frac{A}{533}$, $\frac{a}{47}$), has the anterior obliquely truncate. How far some of these modifications may be due to differences of growth and habit it is difficult to say, but certainly pressure has been mainly concerned with them.

With regard to size, some measure $\frac{13}{10} \times \frac{5}{10}$ inch, or $32 \times 12{\cdot}5$ mm.; $\frac{12}{10} \times \frac{4}{10}$ inch, or 29×10 mm.; $1 \times \frac{3}{10}$ inch, or $25 \times 12{\cdot}5$ mm.; and $\frac{7}{8} \times \frac{2}{8}$ inch, or 22×6 mm.

This small, pod-like,[1] Palæozoic Phyllopod abounds in the Skiddaw Slate (Lower Llandeilo or Arenig group) at many places near Keswick—as, for instance, at Braithwaite Brow, where specimens are numerous on many bed-planes of the hard shales or flagstones; and Mr. Salter mentions Causey Pike and Grassmoor, Cumberland ('Catal. Pal. Foss. Cambridge,' 1873, p. 21). H. Woodward mentions Barff and Longside ('Catal. Brit. Crust.,' 1877, p. 70). It has been collected by Mr. J. E. Marr at the Nantlle tramway or "Wantlle railroad," Pont Seiont, near Caernarvon (Upper-Arenig group); see 'Quart. Journ. Geol. Soc.,' xxxii, 1876, p. 134. The "phyllopod crustaceans" mentioned, ibid., p. 135, and preserved in the Woodwardian Museum, Cambridge, are several specimens of *Caryocaris*, and

[1] Somewhat like the seed of the custard-apple, but more slender in shape.

some small caudal styles which may possibly have belonged to species of the genus, though they somewhat resemble those associated with the Upper-Silurian *Peltocaris* and *Discinocaris* in the Coniston Mudstone of Skelgill, also collected by Mr. Marr.

Professor Lapworth records the occurrence of *Caryocaris Wrightii* in the shales of Arenig age at Bennane Head, in the Ballantrae area, on the Firth of Clyde ('Geol. Mag.,' 1889, p. 22).

Professor C. Malaise, of Gemboux, has obligingly lent us three specimens of *C. Wrightii*, obtained by him from the Arenig series of Huy and Nannine, Belgium. Of these specimens, one is large (Fig. 5, woodcut), one imperfect, and one small with a trifid tail partly extruded from below the narrow extremity (Fig. 6, woodcut). They are black and shiny; in hard, black, micaceous shale, jointed, with ferruginous facings.

Fig. 5.—*C. Wrightii.* Compressed carapace showing right valve. Huy, Belgium.

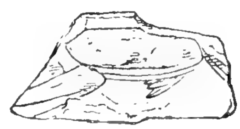

Fig. 6.—*C. Wrightii.* Compressed carapace showing left valve and the trifid caudal appendage; with fragments of other valves? Huy, Belgium.

The small specimen with caudal appendage is of great interest: first, because it corroborates our opinion that the smaller end is the posterior extremity of the valve; secondly, because in it we have the only certain evidence of the form of the cercopods in this animal (Fig. 6, woodcut). They are not wholly exposed, but evidently comprise three lancet-shaped, flat, thin, blade-like members, one of which, apparently larger than the others, as far as they are exposed, may be the style or chief cercopod. We do not know any set of style and stylets exactly corresponding to these. Those of *Elymocaris* (Beecher, 'Report Geol. Surv. Pennsylv.,' 1884, p. 13, pl. ii, fig. 1) have a close resemblance: so also *E. ? longicauda* (Sharpe), *supra*, Part I, Pl. XI, fig. 16 *a*; and *C. patula*, ib., fig. 11. One of the nearest in shape (but not in size) is the much larger trifid set of caudal appendages belonging to a Carboniferous species of *Dithyrocaris* (undetermined) described and figured by Mr. R. Etheridge, jun., in the 'Quart. Journ. Geol. Soc.,' vol. xxxv, 1879, p. 466, pl. xxiii, fig. 2; and those of *D. testudineus*, Scouler, 'Geol. Mag.,' 1873, pl. xvi, fig. 1.

The larger specimen (Fig. 5, woodcut), measuring 27×10 mm., has the ordinary shape, like Pl. XIV, fig. 13; Fig. 6, woodcut, is smaller (19×7·5 mm.), and more crushed.

2. Caryocaris Marrii, *Hicks*, 1876. Plate XIV, figs. 16—18.

Caryocaris Marrii, *Hicks.* Quart. Journ. Geol. Soc., vol. xxxii, p. 138.
— — *H. Woodward.* Catal. Brit. Foss. Crust., 1877, p. 70.
— — *T. R. J.* Geol. Mag., 1883, p. 464.
— — *T. R. J. and H. W.* Report Brit. Assoc. for 1883 (1884), pp. 215 and 222.
— Marri[rrii], *Woods.* Catal. Type Fossils Cambridge, 1891, p. 134.

Much like *C. Wrightii* in general appearance, but smaller, being both shorter and narrower; nearly straight on dorsal and ventral margins, but sometimes slightly curved (Pl. XIV, figs. 16 and 18), probably from the effect of pressure. One end narrower and less decidedly truncate than others (fig. 17), and sometimes rounded (figs. 16 and 18), having been modified by pressure. A good specimen (fig. 17) is black, shining, and somewhat leech-like.

In the Woodwardian Museum, Cambridge, some specimens from the Upper Arenig schists on the Nantlle tramway are labelled *C. Marrii*, Hicks. 1. One, with a black test, compressed, measures $\frac{6}{10} \times \frac{3}{10}$ inch, or 15 × 7·5 mm.; and this has been so much squeezed that possibly it is now even narrower than it originally was; but the front end is broken, and the hinder end is fringed off with the "plaiting" of the rock. This seems to be *C. Wrightii.* It is somewhat thickened at the ventral edge. 2. A similar but imperfect specimen, modified with oblique "plaiting." Ventral border thickened. 3. Two imperfect specimens on one slab ($\frac{A}{446}$), one of which, probably about $\frac{8}{10}$ inch or 19 mm. long, is only $\frac{2}{10}$ inch or 3·5 mm. across (high). The ends are modified by cleavage-pressure. This (fig. 18) approaches most nearly to Dr. Hicks's description of *C. Marrii.*

A specimen in the British Museum (42162, Pl. XIV, fig. 17) has kept the shape of its ends more perfectly, and they are more decidedly truncate than in *C. Wrightii*, one extremity being more bluntly truncate and higher than the other. Another, in the Museum Pract. Geol. ($\frac{2}{55}$, fig. 16), is truncate at one extremity, whilst the valve, narrow throughout, tapers with a rounded end at the other; and this seems to us to be probably one of the best preserved outlines of *C. Marrii.* It corresponds with a good specimen (hollow cast with $\frac{A}{533}$) in the Woodwardian Museum, which is 20 mm. long × 4 mm. wide, truncate at both ends, one of which is wider (4 mm.) than the other (2·5 mm), and straight throughout, not curved like fig. 16, and having a close relationship to fig. 17; whilst, with its curved outline and rounded end, fig. 16 has fig. 18 for a poor representative.

All these individuals of *C. Marrii* occur on the same slabs as, and generally close to, *C. Wrightii.* It is possible that the two forms show sexual differences.

Note.—The specimens, figs. 13, 14 (*C. Wrightii*), and 17 (*C. Marrii*), Pl. XIV, occur in greyish-black flagstone,[1] from near Keswick, traversed by numerous, parallel, dark lines, superinduced, but not affecting the shape of the fossils.

Fig. 18 (*C. Marrii*) is in a greyish-black micaceous mudstone, squeezed and jointed, joint-faces weathered brownish.

3. Caryocaris? Salteri (*M'Coy*), 1861.

Hymenocaris Salteri, *M'Coy*. Exhib. Essay[2] (in German), 1861, p. 168; Annals and Mag. Nat. Hist., 1862, vol. ix, p. 140; ibid., 1867, vol. xx, p. 201.

? — vermicauda, *Hochstetter*. Jahrb. k.-k. geol. Reichsanst., vol. xii, 1861 (Sitzungsb. k.-k. geol. Reichs.), p. 23.

? Caryocaris Salteri, *Salter*. Quart. Journ. Geol. Soc., vol. xix, 1863, p. 139 (*note*).

Caryocaris Salteri, *Bigsby*. Thesaur. Silur., 1868, p. 73.

Hymenocaris Salteri, *Bigsby*. Ibid., p. 200.

— — *R. B. Smyth*. Report of Progress Geol. Surv. Victoria, 1874, p. 33.

— — *Etheridge, jun*. Catal. Australian Fossils, 1878, p. 17.

The references to this Australian species (from Redesdale, Victoria) are given in the 'Catalogue of Australian Fossils,' by R. Etheridge, jun., 1878, p. 17. There is some uncertainty, however, as to its generic relationship; for in a paper written by Mr. Salter in 1862, and published in the 'Quart. Journ. Geol. Soc.,' vol. xix, 1863, p. 135, &c., after noticing that the Australian Graptolites sent to the International Exhibition in London (1862) were recognisable as belonging to the Llandeilo series as determined in the north of England, he adds in a foot-note (p. 139), "There is even a crustacean [from the same Australian beds] apparently of the genus *Caryocaris*, which M'Coy has done me the favour to name *Hymenocaris Salteri*." Thus it is evident that Salter saw one example, if not more, of this Australian species in 1862, and did not regard it as a *Hymenocaris*.

[1] Some of the Skiddaw slates are minutely micaceous.

[2] One of the essays prefatory to the 'Catalogue of the Victorian Exhibition at Melbourne,' 1861, German edition, 8vo, Melbourne, 1861.

B. *Shield-like Phyllopodous Carapaces sutured along the Back.*[1]

Before we proceed with the comparative descriptions, we may remark that a few little fossils,[2] similar to those about to be described, were noticed long ago by palæontologists, before the Crustacean characters of the latter were recognised; and their general likeness to the opercula of Ammonites[3] led some observers to suggest that they may have belonged to *Goniatites*, an "Ammonitidal" Cephalopod found occasionally in strata of the same formation (Devonian) as that in which certain of these Aptychus-like fossils occur.[4] Many of the real Crustacean species, however, occur in beds in which *Goniatites* are unknown.

Of the Phyllopodous forms under consideration we have some, like *Discinocaris*, which could not, on account of their shape in general, and the presence of the frontal piece in particular, have belonged to any Cephalopod. Next we have a large series of forms which occur in beds wherein no *Goniatites* have been found; and some occur in beds containing *Goniatites*, though their outlines do not correspond exactly with the apertures of the shells of such Cephalopods.

As other Phyllopods, such as *Estheria*, are imbedded in Devonian rocks, it is not strange that these Phyllocarida should be there also.

Whilst, however, we are far from denying that some forms, now associated with undoubted shield-bearing *Phyllopoda*, may hereafter be shown to be Molluscan, we are certain that some have no relation to Mollusca.

We are the more strengthened in our opinion of the affinities of the Palæozoic Crustacean shields, because the ornamentation often agrees with that of known Phyllopod carapaces, both in the minute, ridge-like, concentric lines of growth, and, in some cases, in the delicate surface-ornament between them.

Another objection to the supposed *Aptychus*-nature of many of these circular and ovate shields arises from the fact that they were not originally flat discs or plates, as may be seen by examining a series from various localities.

Thus *Discinocaris Browniana* was in some degree convex, with a low conical apex; *Aspidocaris triasica* was evidently conical, as may be seen by the split state of the outer rim, caused by the flattening of the whole shield; others, as *Lisgocaris Lutheri*, had elevated sub-conical carapaces. *Aptychopsis* not unfrequently

[1] Some Phyllocarids (*Discinocaris* and *Aptychopsis*) placed among Entomostraca were referred to in Part I of this Monograph (1888), pp. 4 and 8.

[2] *Aptychus lævigatus*, Goldfuss, 1832; *A. vetustus*, d'Arch. and de Vern., 1842; *Aptychi* of Goniatites, von Keyserling, 1846; *Aptychus dubius*, F. A. Römer, 1850; *Aptychus* of a Goniatite, F. A. Römer, 1850 (see 'Report Brit. Assoc. for 1884' (1885), p. 77.

[3] Calcareous and bipartite, *Aptychus;* corneus and undivided, *Anaptychus*.

[4] See, for instance, Dr. Dames' remarks in the 'Neues Jahrb. für Min.,' &c., 1884, pp. 275—279.

exemplifies the same condition and similar breakage. These conditions are compatible with the nature of Phyllopods.

With reference to *Goniatites* having *Aptychi* or *Anaptychi*, and as to some of the so-called Phyllopodous shields being really such parts of *Goniatites*,[1] we have to state that, in confirmation of Herr Kayser's discovery of a "*Spathiocaris*," in the body-chamber of a Devonian Goniatite,[2] we have seen some similar examples from Bicken; and that we believe some of the so-called little shield-like fossils which come from Goniatitiferous Devonian strata will have to be referred to *Goniatites*. Thus we must look with some doubt on the following Devonian forms:

Discinocaris dubia (Roemer) .	See our Second Report, 1884 (1885), p. 79.
„ *lata* (Woodward)	. „ „ „
„ *congener* (Clarke)	. „ „ p. 80.
Spathiocaris ungulina, Clarke	. „ „ p. 81.
Pholadocaris Leeii, Woodward „ *sp.*	. „ „ p. 82.
Ellipsocaris Dewalquei, Woodward „ *sp.*	„ „ p. 83.
Cardiocaris Roemeri, Woodward „ *bipartita*, Woodward „ *Veneris*, Woodward „ *Koeneni* (Clarke)	. „ „ p. 84.
Dipterocaris pes-cervæ, Clarke „ *vetusta* (d'Arch. and de Vern.) „ *procne*, Clarke	„ „ p. 85.

These, then, require further investigation; but as numerous specimens having undoubted structural features of Phyllopods occur in the Silurian strata that do not yield Goniatites, and as some even of the genera enumerated above are not always associated with Goniatites, there is no reason why members of the group should not occur even in Goniatitiferous strata. Thus some of the foregoing species may have no relationship with the Cephalopods among which they have been buried, but were lineal descendants of Silurian forms.

In his paper in the 'Neues Jahrbuch,' &c., 1884, Band i, p. 275, &c., "On the Phyllopod-nature of *Spathiocaris*, *Aptychopsis*, and similar bodies," met with in strata of Silurian, Devonian, and Carboniferous ages in Europe and North

[1] See our Second Report, 1884, p. 76.

[2] See Kayser, 'Zeitsch. d. deutsch. geol. Ges.,' vol. xxxiv, 1882, pp. 818, 819; and von Koenen, 'Neues Jahrb. f. Min.,' &c., 1884, pp. 45, 46.

America, and described by M'Coy, Salter, Barrande, Meek, Hall, Clarke, ourselves, and others, after an elaborate criticism of the subject, Dr. W. Dames concludes:

1. That some of the bodies in question are the *Aptychi* of *Goniatites.*

2. That for others this explanation is, according to our present knowledge, inadmissible.

3. That the last are, however, in no case Phyllopods.

1. As intimated above, we accept the first conclusion. The British Museum has obtained several specimens of these Aptychus-like bodies[1] from the black limestone of Bicken; and Mr. Robert Etheridge, jun., discovered among them a specimen of a small *Goniatites intumescens* with an imperfect *Aptychus in situ* in its mouth-aperture. This *Aptychus* seems to agree most nearly in form with the so-called *Cardiocaris lata* from Budesheim in the Eifel,[2] also observed by Mr. J. M. Clarke at Bicken.[3] The other specimens of *Aptychus*-like bodies, not *in situ*, but from the same black Devonian limestone, agree very closely with Mr. Clarke's *Spathiocaris Koeneni*,[4] also from Bicken.

2. Even after all those forms of supposed Phyllopod shields which occur in beds in which Goniatites have been found shall have been re-examined, we feel convinced, with Dr. Dames, "that for others this explanation is, according to our present knowledge, inadmissable."

The first and second reports drawn up by ourselves[5] on the Phyllopoda (Brit. Assoc.) fully confirm Dr. Dames' own conclusion that *all* the simple disc-like or bivalved shells met with in the older rocks cannot be regarded as the opercula of Cephalopods. There are, indeed, many special characters about these Palæozoic Phyllopod shields that will require to be carefully examined before they can all be referred to *Goniatites.* We would draw attention to the varied form of the notch, the absence in some and the presence in others of the dorsal suture; the presence in different genera of the rostral portion of the shield in the circular and oval forms, and the possible existence in some of a hinder trigonal shield-piece (*Pholadocaris*, *Dipterocaris*); the shape of the shield itself; the ornamentation; and, lastly, the substance composing it. Usually it is possible to discern the

[1] We have also seen a specimen of *Aptychus* sent to Mr. John Edward Lee, of Torquay, by Prof. Ferd. Römer, of Breslau, and labelled "*Aptychopsis*, sp. = operculum of *Goniatites intumescens*, Upper Devonian, Bicken, near Herborn, Nassau," in Dr. Römer's own handwriting. Some of these specimens have been figured in the 'Geol. Mag.,' dec. 3, vol. ii, pl. ix, figs. 1—6, in illustration of a paper (pp. 345—352) treating of this subject in full, and of the relationship of the fossil Phyllopods under notice to Nebalia.

[2] See 'Geol. Mag.,' 1882, dec. 2, vol. ix, p. 388, pl. ix, fig. 13.

[3] 'Neues Jahrb.,' &c., 1884, vol. i, p. 181, pl. iv, fig. 2.

[4] Ibid., fig. 1.

[5] Also 'Geol. Mag.,' 1883, dec. 2, vol. x, pp. 461—464; and 1884, dec. 3, vol. i, pp. 348—356.

difference in character between crustacean and molluscan structures, as also between these and obscure ichthyic fragments.

We note the following assertion in reference to the body-rings of *Discinocaris:* "Even if the structures observed are really body-rings, no stronger proof against their phyllopod nature could be brought forward, for the body-rings, as well as all the other parts of the Phyllopod (except the shell), are *too tender and fragile* to remain recognisable in beds of such great age."[1] (Dames, *op. cit.*)

In the presence of the long array of Insect-remains, of the most delicate and fragile characters, discovered in the Devonian and Carboniferous formations of North America, France, England, and elsewhere, this argument against the possibility of delicate organisms being preserved falls to the ground, whilst the relative thickness and durability of the calcareous or chitinous covering of the body-segments in these ancient Crustacea afford no proof for or against their Phyllopod nature, any more than does their relatively greater size when contrasted with existing Entomostraca. Moreover body-rings of *Ceratiocaris* are by no means rare in some Silurian strata.

3. In the third conclusion, "that even those forms which cannot be referred to *Aptychi* of Cephalopods are in no case the shields of Phyllopods," Dr. Dames is simply stating a matter of opinion, for of their exact nature and true zoological position Claus himself (to whom he seems to refer) is not at all positive, whilst Dames admits that he has not examined the original specimens.[2]

IX. *Genus*—Aptychopsis, *Barrande*, 1872.

Barrande, 'Syst. Sil. Bohême,' vol. i, Supplement, 1872, pp. 436 and 455.
H. Woodward, 'Geol. Mag.,' vol. ix, 1872, p. 564.
H. Woodward, 'Report Brit. Assoc.' for 1872 (1873), p. 323.
Armstrong, Young, and Robertson, 'Catal. Western-Scottish Fossils,' 1876, p. 7.
H. Woodward, 'Catal. Brit. Foss. Crustac.,' 1877, p. 69.
Nicholson and Etheridge, jun., 'Monogr. Sil. Foss. Girvan,' vol. i, 1880, p. 24.
T. R. Jones, 'Geol. Mag.,' 1883, p. 462.
T. R. J. and H. W., 'Report Brit. Assoc.' for 1883 (1884), p. 216.

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[1] Prof. A. von Koenen, replying to Herr Dames on behalf of Mr. J. M. Clarke, very justly observes, "I cannot see that this at all meets the argument, since the relative age of strata is of little influence on the preservation of fossils; on the other hand, there are plenty of examples in which fossil animals have been furnished with hard, horny, and even calcareous parts which are wanting in their nearest recent analogues. I will only recall here *Aptychus* and *Anaptychus*" ('N. Jahrbuch,' &c., 1884, Bd. ii, p. 45). The recent *Nautilus* has a fleshy hood; the fossil Ammonite had usually a hard calcareous *operculum*, but in some Liassic forms the operculum was *horny*.

[2] See our observations on this subject at pp. 4—8 of Part 1 (1888) of this Monograph.

T. R. J. and H. W., 'Geol. Mag.,' 1884, pp. 349 and 354.
T. R. J. and H. W., 'Report Brit. Assoc.' for 1884 (1885), p. 87.
T. R. J. and H. W., 'Monogr. Brit. Pal. Phyllop.,' pt. 1, 1888, p. 2.
ETHERIDGE, 'Foss. Brit.,' vol. i, Palæoz., 1888, p. 45.

A circular or elliptical, slightly convex, tripartite shield or carapace; divided by a median "dorsal" suture extending from the posterior margin forward to within half, or a third, or a fifth, of the length of the test, according to the shape of the latter, and then meeting the apex of a symmetrical V-shaped suture, which extends to the front margin at different angles in different species. This angular ("nuchal") suture forms a line of much weaker resistance than the longitudinal suture; and the carapace has very frequently given way after the death of the animal, and allowed the triangular ("rostral," "cephalic," or "complementary") portion to be removed, together with the anterior limbs and soft parts of the animal as suggested by Dr. H. Woodward.[1] Thus an angular notch is often present in the forepart of the fossil carapace. The median suture has often been pressed inwards, but sometimes it has parted, leaving the two larger parts of the test separate. These remain as sub-triangular plates (the principal or lateral parts), straight-edged and angular on the inner margin, and either elliptically curved or almost semi-circular on the outer or free borders. They occur usually as black carbonaceous films on the bed-planes of the strata; but sometimes they have a somewhat corneous or chitinous appearance.

A concentric linear ornament covers the whole shield; numerous delicate ridges and furrows, following the curve of the outer margin, are concentric to the point where the dorsal and nuchal sutures meet in front of the centre of the test. The style of ornament is similar to that of the bivalve *Estheria,* which shows a neat arrangement of raised lines of growth, concentric with the umbones. In the case of *Ellipsocaris*, even the interlinear sculpturing is present ('Geol. Mag.,' Oct., 1882, p. 445). Delicate radiate striæ, crossing the concentric lines, are sometimes visible. If the two valves of *Estheria* be laid open, back to back, their surface would represent the shield of *Aptychopsis;* the open angle then formed by their anterior margins would be analogous to the nuchal notch; and for that of their hinder margins we may find an analogue in the split posterior border of *Dipterocaris* and other forms allied to *Aptychopsis.*

M. Barrande indicated the existence of this genus in his 'Parallèle entre la Bohême et la Scandinavie,' 1856, p. 62; here he also stated that Prof. Angelin had found the same kind of fossil in Dalecarlia and Gothland in Upper Silurian strata, at about the same horizon (Angelin's Regiones D et E in the former and Regio E in the latter country) as that in which they occur in Bohemia (étage calcaire inférieur E). See also 'Sil. Syst. Bohême,' vol. i; Suppl., p. 455.

[1] 'Quart. Journ. Geol. Soc.,' xxii, p. 504; and 'Geol. Mag.,' dec. 2, vol. ix, 1882, p. 387.

M. Barrande's careful and elaborate account (*op. cit.*) of what was known of *Aptychopsis* up to 1872 is almost sufficient in every respect.

In the Sixth Report on Fossil Crustacea to the British Association for the Advancement of Science, in 1872, Dr. Henry Woodward defined some Phyllopodous species and grouped them under the same name (independently arrived at) as M. Barrande proposed in the same year (see above). See also Dr. H. Woodward's note on *Peltocaris, Discinocaris*, and *Aptychopsis* in Nicholson and Etheridge's 'Fossils of the Girvan District,' 1880, pp. 210, 211.

M. Barrande included with doubt another form in this genus, namely, his *Aptychopsis? inflata*, 'Syst. Sil. Bohêm.' vol. i; Suppl. p. 459, pl. xxxiii, figs. 22, 23. But this seems to be a *Bolbozoe*, and may stand as *Bolbozoe? inflata* (Barrande), from the hills between Lodenitz and Bubowitz, Étage E, e 2.

There are no Goniatites in 'Étage E,' representing the lower part of the "Fauna III," which is equivalent to the Upper Silurian. There are, however, some Goniatites (five species), rather higher up, in "Étage F," which is in the middle part of "Fauna III."

We have to remark that in *Aptychopsis* the form and proportions of all three valves (lateral and rostral) and their relative position have been so much altered by pressure and other accidents of fossilisation that it is often difficult to fix upon safe data for judging of the exact relationship of the different forms. This is especially the case with the size and angle of the nuchal notch, which, as Barrande has suggested, may have differed with the age of an individual. Therefore the shape of the carapace and of its two lateral moieties or valves, and the character of their ornament, are to be chiefly considered. The following are the recognisable forms of *Aptychopsis* which we have met with:

Bohemian.	1.	*A. prima*, Barrande, op. cit., pl. xxxiii, figs. 10, 12, 16, 19—21. Obovate, subcircular.	Upper Silurian.
—		— var. *longa*, nov. Loc. cit., fig. 11. Obovate, long.	
—		— var. *secunda*. Loc. cit., figs. 1—9, 13—15, 18. Circular.	
British.	2.	*A. Barrandeana*, sp. nov. Pl. xv, fig. 1. Obovate, long, tapering posteriorly.	Upper? Silurian.
—	2*.	— — var. *brevior*, nov. Obovate, tapering posteriorly.	
—	3.	*A. cordiformis*, sp. nov. Pl. xv, fig. 2. Obovate, acute posteriorly.	Middle? Silurian.
—	4.	*A. lata*, sp. nov. Pl. xv, fig. 6. Obovate, broad, subcircular, acute posteriorly.	Middle? Silurian.
Bohemian? and British.	5.	*A. glabra*, H. Woodward. Pl. xv, fig. 11. Circular, small.	Upper Silurian.
British.	6.	*A. Wilsoni*, H. W. Pl. xv, figs. 12 (?), 15, 16. Circular, large.	Upper Silurian.
Bohemian? and British.	7.	*A. Lapworthi*, H. W. (Barrande, op. cit., pl. xxxiii, fig. 17 ?). Pl. xv, figs. 7, 3, 10, 8, 9, 22.[1] Oval.	Middle Silurian.

[1] The *order* of similarity or relationship is thus indicated here and elsewhere.

British. 8. *A. ovata*, sp. nov. Pl. xv, figs. 4 and 5. Ovate. Middle Silurian.
— 9. *A. Salteri*, H. W. Pl. xvii, fig. 6. Suboval. Upper Silurian.
— 10. *A. subquadrata*, sp. nov. Pl. xv, fig. 20. Subquadrate. Lower Silurian.
— 11. *A. angulata* (Baily). Pl. xv, fig. 19. Oblate. Lower Silurian.
— 12. *A. oblata*, sp. nov. Pl. xv, figs. 21, 18, 23. Deeply oblate, wide. Middle Silurian.

No Goniatites have been found with any of these.

We propose in the first place to propound the characters and history of Barrande's typical species *A. prima*, no exact representative of which we have yet met with in Britain.

1. Aptychopsis prima, *Barrande*, 1872. Woodcuts: Fig. 7; and Fig. 10, p. 109.

Aptychopsis primus, *Barrande*. Silur. Syst. Centre Bohême, vol. i, Supplem., 1872, p. 457, pl. xxxiii, figs. 1—21 [*A. prima*, var. *secunda*, &c.].
— — *Römer* (after *Barrande*). Leth. Geogn., 1876, pl. xix, figs. 3 *a*, 3 *b*.
A. prima et var. secunda, *T. R. J. and H. W.* Geol. Mag., 1884, pp. 349 and 354.
— — — Report Brit. Assoc. for 1884 (1885), pp. 79 and 89.

Aptychopsis prima includes, according to M. Barrande (*op. cit.*), round, subcircular, oval, and obovate forms of the tripartite shield-like test, which both Barrande and H. Woodward termed *Aptychopsis* independently in in the same year (1872). Among the figures (when completed in outline) on pl. 33, of 'Syst. Sil. Bohême,' vol. i, Supplem., *circular* or *subcircular* forms are represented by figs. 1—9, 13—15, and 18; and more or less *obovate* tests by figs. 11 (obovate); 10, 12, 16, 19—21 (broad-obovate); and 17 (*oval*). Thus there are four somewhat different shapes among these figures.

Fig. 7.—Specimen of *Aptychopsis prima*, Barrande, from Bubowitz, Bohemia. Typical form. British Museum.

In the British Museum (Natural History) are some specimens labelled by M. Barrande many years ago, as "*Aptychus? primus* (I, 2587)" and "*Aptychus? secundus* (I, 2588)." The former, when perfect, with the two lateral moieties and the frontal (cephalic or rostral) piece in place, were broad-obovate (woodcut, Fig. 7); and the latter (when perfect) were nearly or quite round. Evidently our deceased friend had decided to group these two kinds together, by the time he published the Supplement of the first volume of his great work treating of these and other Crustaceans. The circular shields found in Bohemia are chiefly from the schistose or slaty mudstone of Borek, with some from Litohlow and Kozel,—all in Étage "E, e1"; and the obovate forms come from the same geological origin, but in limestone at other localities, as Butowitz, Slawick, and Wohrada, and rare at Kozel.

We think that "*secunda*" will serve as a varietal name for the round or nearly-round forms, as suggested by us in the 'Geol. Mag.,' 1884, pages 349 and 354, and 'Report Brit. Assoc. for 1884' (1885), pages 76 and 89; M. Barrande's term "*Aptychopsis prima*" being kept for the obovate carapaces; and, if the oval form (fig. 17 of Barrande's plate) matches *A. Lapworthi*, H. W., it is already provided with a specific appellation.

Taking *A. prima*, or the subcircular-obovate form, as typical, on the evidence of the labelled Bohemian specimens in the British Museum (see woodcut, Fig. 7), we know them as having carapaces 25 to 32 mm. long, by 23 to 33 mm. wide, and with the nuchal suture having an angle of about 90° or 100°. See Barrande's figs. 10, 12, 16, 19—21. His fig. 11 may be regarded as *A. prima*, var. *longa* (34 by 28 mm.).

2. APTYCHOPSIS BARRANDEANA, sp. nov. Plate XV, fig. 1; and var. BREVIOR, fig. 14.

At first we regarded our specimens Pl. XV, figs. 1 and 14, as being *A. prima*, Barrande; but we now distinguish important differences between the forms.

The two specimens in the British Museum, in limestone from Bubowitz, and labelled "*Aptychus ? primus*" by M. Barrande, have (if complete) the obovate shape of several of Barrande's figures, and more particularly correspond to his fig. 19. Our fig. 1 is longer and proportionally narrower at the posterior third than any of the Bohemian specimens or figures; so also our fig. 14 (variety) is much narrower posteriorly, with a straight and more sloping outer margin, compared with any of them. They both also have a shallower and wider notch than the Bohemian forms.

This large and distinct species is here named in honour of the eminent palæontologist of Bohemia, who was one of the first to give attention to these phyllopodous fossils.

Pl. XV, fig. 1, is a large left valve, imperfect from the loss of a considerable portion of its upper outer angle; part, however, of the left nuchal slope is distinct, with a very low angle. Measurements:[1] the dorsal suture is 31 mm.

[1] To save trouble the following arrangement of signs may be adopted:

For the vertical suture |
For the breadth of a single valve —
For the left side of the notch ⊿
For the right side of the notch ∠
For the width or gape of the notch ⊢⊣
For the depth of the notch I
For the angle of the notch ∨

long; the breadth of the single valve, 18 ? mm.; slope of the angular suture, 16 ? mm. at 30°; breadth or gape of the nuchal notch, 29 ? mm.; depth of notch, 12 ? mm.; angle of the notch 120°. The two valves united would have a sagittate outline; and the whole carapace would be acute-obovate in shape. The proportion of width to length as 28 to 43 (?).

A. Barrandeana occurs in a black softish shale; and is flattened, cracked, and slightly pyritous. The concentric rings are rather broad; narrower at the outer margin, and close together at the inside (sub-central) angle.

From Dobbs Linn, Moffat.[1] In the Museum of the Geological Survey of Scotland, marked M 4418. (The classification of the successive formations in the Moffat district and vicinity has been worked out by Professor Dr. C. Lapworth, F.R.S., see 'Geol. Mag.,' vol. ix, 1874, pp. 533—6; 'Quart. Journ. Geol. Soc.,' vol. xxxiv., 1878, pp. 240—346; and 'Proceed. Belfast Nat. Field-Club,' ser. 2, vol. i, part 4, Appendix IV, 1878; also 'Catal. Western-Scottish Fossils,' by Armstrong, Young, and Robertson, 1876, p. 24, and 'Geol. Mag.,' 1889 (dec. 3, vol. vi), pp. 20—24, 59—64. Although numerous Phyllopod shields have been met with, no Goniatites have been recorded from these beds.)

Pl. XV, fig. 14, an elliptico-triangular left valve, rounded (probably from damage) at the angles. It is near *A. Barrandeana* in the straight slope of the posterior margin; but is shorter and proportionally broader. It may be regarded a variety (*brevior*) of that species. Measurements: |, 18 (?) mm.; —, 12 mm., ⦣, 7 (?) mm. at 40°; ⌞⌟, 10 (?) mm.; I, 7 (?) mm.; ∨, 100°. Two valves sagittate; perfect carapace, obovate, tapering downwards, or long cordiform, with a wide shallow notch above. Proportion of width to length about 24 to 25.

In black, thin mudstone. Valve thin, black, shiny, crumpled, and cracked. Concentrics broad, and crossed by numerous delicate, raised, rugulose striæ, radiating from the inner angle; these are comparable[2] with those shown on Barrande's figs. 4, 18, and 20, pl. 33, *op. cit.*, and p. 457. This form approaches Barrande's fig. 19 in size, but the latter is broad-obovate and subcircular, whilst our fig. 14 does not affect the circular shape, being slanting and narrowed on its posterior third, like Pl. XV, fig. 1. It is referred to in the 'Report Brit. Assoc.' for 1884 (1885), p. 91.

Moffat beds? British Museum. I, 2585.

Note.—Pl. XV, fig. 1, is comparable with fig. 3 in the plate illustrating Mr. J. M. Clarke's paper on "New Phyllopod Crustaceans from the Devonian of Western New York," in the 'American Journal of Science,' 3rd Series, vol. xxiii, 1882,

[1] This locality is described by Prof. Lapworth in the 'Quart. Journ. Geol. Soc.,' vol. xxxiv, pp. 247, 306, 310, 313.

[2] Also with the ornament in *Pterocaris Bohemica*, Barrande, op. cit., p. 464, pl. xxv, figs. 25 and 26, a unique fossil of a different alliance.

pp. 476—478. The specimen there referred to (p. 477) is regarded by the author as showing the lateral aspect of a folded carapace of *Spathiocaris Emersoni*, Clarke, figured on the same plate (figs. 1 and 2). Though there appears at first sight to be a difficulty in reconciling these figures,[1] we are assured by Mr. J. M. Clarke (in letter dated July 11th, 1892, in answer to enquiry on the subject) that the fig. 3 referred to above is not nearly so satisfactory as fig. 12 among his later illustrations, described in detail in the 'Nat. Hist. New York, Palæontology,' vol. vii, 1888, p. 199, pl. 35, figs. 12—18, where both the open and the folded carapaces are fully treated of. Here also the author has defined and illustrated the gradational forms in successional stages of growth in *Spathiocaris Emersoni*, from the most minute, only 2 mm. long, to one of 28 mm., and he has a fragment of one that was upwards of 80 mm. in length.

3. Aptychopsis cordiformis, sp. nov. Plate XV, fig. 2.

This obovate carapace (now wanting the front plate) is proportionately shorter and broader than *A. prima*, and intermediate to that species and its var. *secunda* in shape. It has a narrower notch than either. Pl. XV, fig. 2, shows a pair of valves, one of them imperfect. Measurements : | , 15 mm. ; —, 9 mm. ; ∆, 7 mm. at 60° ; ⌞, 7 mm. ; I, 6 mm. ; ∨ 60°. Two valves, rather broadly sagittate ; carapace acute-obovate. Concentrics broad. In dark-grey, solid, much crushed, finely micaceous mudstone. The proportion of width to length is as eighteen to twenty-one. This, though obovate, is more acute posteriorly and is narrower and sharper behind than any of Barrande's figured specimens.

From Lower Wenlock beds, Rebecca Hill, Ulverston. Coll. Marr. Cambridge Museum. See 'Catal. Type Fossils Woodwardian Museum,' 1891, pp. 133 and 136, and 'Report Brit. Assoc.' for 1884, p. 93. This has been labelled "*Peltocaris anatina*, Salter," and was referred to under that name in the 'Catal. Cambridge Fossils, &c.,' 1873, p. 93; but the frontal notch is *angular*. The median sutural line is raised along the depressed shield, and broad concentric striæ are present.

P. anatina is probably a different specimen in the Cambridge Museum.

[1] See our Second Report in 'Rep. Brit. Assoc.' for 1884 (1885), p. 81.

4. Aptychopsis lata, sp. nov. Plate XV, fig. 6.

One left valve belonging to a subcircular carapace, which, when perfect, was much broader across its anterior third than in its posterior region. The latter is narrowed suddenly, giving a sub-cordiform outline to the perfect shield. Measurements: |, 15 mm.; —, 11·5 mm.; ⊿, 9 mm. at 60°; ⌣, 9 mm.; I, 8 (?) mm.; V, 60°. The frontal piece would have been more than half the length of the dorsal suture; and the whole shield probably 23 mm. long by 23 mm. where widest. The two valves would be broadly sagittate, or acute cordiform, with re-entrant angle above; the carapace, sub-cordiform, or broad and acute obovate. Proportion: anterior width equal to length.

This is like *A. Barrandeana* and *A. cordiformis* in the narrowing of the posterior region; but it is much shorter and relatively broader than fig. 1, and longer than fig. 2; it has a deeper notch than figs. 1 and 14, and a larger notch than fig. 2, indicating a relatively larger rostral piece. It is not sufficiently circular to match either *glabra* or *Wilsoni*.

In buffish, hard, micaceous shale; the valve has left a rusty impression, with a strong outer rim partially preserved. From a stream east of Nether Stennies Water, six and a half miles north-north-west of Langholm, Dumfriesshire. Mus. Geol. Survey Scotland. M 457 c.

5. Aptychopsis glabra, *H. Woodward*, 1872. Plate XV, fig. 11.

Aptychopsis glabra, *H. Woodward*. Geol. Mag., 1872, p. 565.
— — — Report Brit. Assoc. for 1872 (1873), p. 323.
— — — Catal. Brit. Foss. Crust., 1877, p. 69.
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 354.
— — — Report Brit. Assoc. for 1884 (1885), p. 91.
— — *Etheridge.* Brit. Foss., vol. i, Palæoz., 1888, p. 41.

This unique test, originally circular, has been obliquely flattened, but still retains the appearance of having been "finely striated concentrically."

There are two Bohemian specimens in the British Museum (I, 2588) labelled "*Aptychus ? secundus*," by M. Barrande, which are near allies to this form; as also are figs. 1—9, 13—15, 18, in pl. xxxiii of the 'Sil. Syst. Bohême,' vol. i, Suppl. The two small and round individuals thus labelled (15 mm. in each diameter, nuchal suture with slope of 40°), in shaley mudstone from Borek, may be regarded, as stated above (p. 101), as *Aptychopsis prima*, var. *secunda* (Barrande).

The specimen shown by Pl. XV, fig. 11, is that described in 1872. It has been modified by pressure, but, if restored, would be circular. The notch is wide and deep, rather more than half the length of the dorsal suture. The concentrics numerous and narrow. In these two valves (somewhat obliquely squeezed) the measurements are |, 11 mm.; —, 8 mm.; ⊥, 6 mm. at 60°; ⌐, 6 mm.; I, 6 (?) mm.; V, 60. Two valves, round-ended sagittate; carapace circular; width and length about equal.

This specimen, named *A. glabra* in 1872, has nearly the same proportions as *A. prima*, var. *secunda;* and is like *A. Wilsoni,* but is smaller, and has a relatively smaller notch and no marginal rim. Although apparently smooth, it retains indications of numerous fine concentric lines, as usual in *Aptychopsis*, and, in so far, not quite in accordance with the smoothness intimated by "*glabra.*"

In buff-coloured, very finely micaceous shale. Valves brown, with a trace of a black film, and with minute vermicular hematitic concretions. From the Buckholm beds, Gala series; Meigle, Galashiels, Selkirkshire. Coll. Lapworth. Brit. Mus. No. 59620.

6. Aptychopsis Wilsoni, *H. Woodward*, 1872. Plate XV, figs. 12 (?), 15, 16.

Aptychopsis Wilsoni, *H. Woodward.* Geol. Mag., 1872, p. 565.
— — — Report Brit. Assoc. for 1872 (1873), p. 323.
— — — Catal. Brit. Foss. Crust., 1877, p. 70.
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 354.
— — — Report Brit. Assoc. for 1884 (1885), p. 89.
— — *Etheridge.* Foss. Brit., vol. i, Palæoz., 1888, p. 41.

This species has a discoidal shield, and was briefly described in 1872 as having an angular nuchal suture (making a triangular cephalic plate), and a well-marked median or dorsal suture, and as measuring $1\frac{1}{2}$ inches in length by $1\frac{3}{8}$ inches across. There are three specimens of *Aptychopsis Wilsoni* in the British Museum, and they would probably be almost round in outline if quite perfect. They are from the Riccarton beds (Wenlock beds, Upper Silurian), at Shankend, Slitrig Water, near Hawick; Yad's Linn, near Hawick; and Elliottsfield, near Hawick, Dumfriesshire.

We may add that the cephalic notch is not so deep as in some allied forms; its apex was about one third of the length of the median suture from the front edge of the shield. Concentric lines are apparent on some specimens.

One large specimen would measure 40 mm. in each diameter if complete; its nuchal suture slopes 40°. Another specimen (imperfect) measures 30 mm. across, and has a nuchal slope of 60°; difference of pressure has probably caused this discrepancy.

Pl. XV, fig. 15, two valves, almost perfect; measurements, |, 19 mm., —, 13 mm.; ⊿, 10 mm. at 40°; ‿, 15 mm.; I, 8 (?) mm.; V, 100°. The two valves very broadly and bluntly sagittate; carapace circular.

In dark-grey shale, weathering brownish. Valves rusty impressions. Concentrics nearly obliterated, but apparently were numerous and irregular in width. Mus. Geol. Surv. Scotland. Marked 1/13/4/92.

Pl. XV, fig. 16, two valves, similar to but larger than fig. 15, and more distorted by pressure. |, 26 mm.; —, 17 mm.; ⊿, 12 mm at 30°; ‿, 17 (?) mm.; I, 8 (?) mm.; V, 120°. Valves and carapace as in fig. 15 (allowing for distortion). In thin, grey, mottled ashbed (?), finely micaceous, weathering reddish. Valves rusty impressions; concentrics numerous and irregular; outer rim present in places.

From the Riccarton beds, Yad's Linn, near Hawick. Coll. Lapworth. British Museum. No. 59621.

Pl. XV, fig. 12, may possibly be a fragment of a small *A. Wilsoni*. It consists of the imperfect anterior portions of two valves, with concentric lines, distinct, numerous, and irregular. Measurements: |, 10 (?) mm.; —, 8 mm.; ⊿, 7 mm. at 40°; ‿, 11 mm.; I, 5 (?) mm.; V, 100°.

In a hard, grey, micaceous shale. Longside Burn, Shankend, Roxburghshire. Mus. Geol. Surv. Scotland. M 902 c.

7. Aptychopsis Lapworthi, *H. Woodward*, 1872. Plate XV, figs. 3, 7—10, 22.

Aptychopsis prima, *Barrande* (part). Syst. Sil. Bohème, vol. i, Suppl., 1872, p. 457, pl. xxxiii, fig. 17 only.
— Lapworthi, *H. W.* Geol. Mag., 1872, p. 354.
— — — Report Brit. Assoc. for 1872 (1873), p. 323.
— — — Catal. Brit. Foss. Crust., 1877, p. 70.
— — *Lapworth.* Quart. Journ. Geol. Soc., vol. xxxiv, 1878, p. 331 (in list).
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 354.
— — — Report Brit. Assoc. for 1884 (1885), p. 90.
— — *Etheridge.* Brit. Foss., vol. i, Palæoz., p. 41.
— — *Woods.* Catal. Type Foss. Cambridge, 1891, p. 133.

This Phyllopod shield was briefly described by Dr. H. Woodward in his Report on Fossil Crustacea, Brit. Assoc., for 1872. It is oval in shape, longer in the fore and aft direction than in the transverse diameter. Concentric striæ are preserved in most of the examples, and in two cases the cephalic plate is retained. The best specimen (fig. 9) has this plate in place, but the edges of the notch have been slightly damaged and disturbed by pressure, so that its angularity is somewhat modified. The angle of the nuchal suture is about 60°. In outline the valves are shorter and fuller (more convex) on the posterior outer margin than in *A. prima,* and therefore correspond to fig. 17 in Barrande's plate, and which we separate from *prima* and its var. *secunda.*

Pl. XV, fig. 7, a left valve, with trace of a right. |, 12 mm.; —, 9 mm.; ⊿, 6 mm. at 45°; ⎵, 9 mm.; I, 6 (?) mm.; V, 90°. The two valves broadly sagittate. Carapace oval. In dark-grey thin mudstone, very finely micaceous. Valve structureless, black film; no concentric lines, but roughly impressed by the minutely concretionary surface of the stone. From the Grieston Shales of the Gala group at Inverleithen, above the Moffat group, and equivalent to the upper part of the Middle Silurian. Coll. Lapworth. No. 59620, British Museum.

Pl. XV, fig. 3, two valves, narrowed by crush. |, 10 mm.; —, 3 mm.; ⊿, 4 mm. at 60° (?); ⎵, 4 mm.; I, 4 (?) mm.; V, 60° (?). The two valves subsagittate. Carapace in present condition narrow; oval or elliptical.

This specimen has been narrowed by lateral pressure acting obliquely across the long axis of the shield, as is indicated by imperfect cleavage-planes crossing the modified test at an angle of about 60°. The frontal notch has been narrowed and its sides made unequal.

In hard black mudstone, much like that of Rebecca Hill (Pl. XV, fig. 2). Valves somewhat pyritous, modified by cleavage-pressure almost at right angles to the long axis of the valves. Graptolitic mudstone, No. 9, Skelgill beds; Skelgill Beck. Coll. Marr. Woodwardian Museum, Cambridge. See Catal. Type Fossils Woodw. Mus., 1891, p. 133.

What seems to be a similar example of a modified *Aptychopsis*, squeezed into an even narrower and more lanceolate shape, has been figured by Mr. James Dairon in the 'Transactions of the Geological Society of Glasgow,' vol. vii, part i, 1883, pl. vii, fig. 35, and referred to in the explanation of the plate as "*Discinocaris Browniana*, var. *ovalis*," Dairon.[1]

Pl. XV, fig. 10. Two valves flattened and imperfect. |, 10 mm.; —, 4 mm.; ⊿, 4 mm. at 60°; ⎵, 3 mm.; I, 4 (?) mm.; V, 60° (?). The two valves subsagittate; carapace elliptical. In black, finely micaceous shale. Valves thin, flattened, and

[1] All the little Phyllopod tests figured in this pl. vii are from Moffat (p. 177), and, excepting fig. 29, are termed "*Discinocaris Browniana*" by Mr. Dairon; but most of them appear to belong to other genera. Fig. 29 is *Peltocaris Carruthersii.* Figs. 31 and 34 are round shields of probably *Aptychopsis glabra,* H. W. Fig. 35 seems to be a specimen of *A. Lapworthi* much narrowed by pressure. Fig. 32 is probably a broad *Aptychopsis,* like *A. oblata;* if it be really a *Discinocaris* (*D. undulata?*) it should not have the dorsal suture.

cracked by pressure; concentric lines rather broad, but smaller than in fig. 1. Moffat Shales; Dobbs Linn. Mus. Geol. Survey Scotland. M. 4321c.

Pl. XV, fig. 8. Two valves flattened and separated; grey films of decomposed pyrites; concentrics rather broad. | , 8 mm.; —, 6 mm.; ⦣, 4 mm. at 60°; ‿, 4 mm.; I, 4 (?) mm., ∨, 60°. Two valves round-ended sagittate; carapace oval. In dark-grey mudstone, very finely micaceous; joint weathering reddish. Birkhill Shales, Sundhope Burn. Coll. Lapworth. Brit. Mus. I, 2593.

Pl. XV, fig. 9. Perfect carapace; the specimen described in 1872. Measurements: | , 11 mm.; —, 8 mm.; ⦣, 5 mm. at 60°, ‿, 5 mm.; I, 5 mm.; ∨, 60°. The two valves represent a broad-ended sagittate form; the carapace is oval. Proportion: width 14 to length 16. In a thin dark mudstone, finely micaceous. The valves are black films on a rusty ground; the concentrics are rather broad; the rostral piece is present, but has been slightly shifted.

This is from the Birkhill Shales (upper part of the Moffat Shales, and equivalent to the Llandovery Series) at Eldinhope[1] in the Eldinburn, on the Yarrow, Selkirkshire.[2] Coll. Lapworth. No. 59620, Brit. Museum.

Pl. XV, fig. 22, a small perfect carapace; the parts very slightly disturbed. Whole length 5 mm. (dorsal suture 4 mm., notch 1 mm. deep); breadth of one lateral moiety or valve 1·5 mm., side of the notch 1·5 mm. long at 60°, width of notch 2 mm., angle of notch 60°. Proportion, width 3 to length 5. In a dark-red micaceous shale. Moffat, Dumfriesshire. British Museum. No. 58868.

8. Aptychopsis ovata, sp. nov. Plate XV, figs. 4 and 5; and Woodcut, Fig. 9, p. 109.

This is apparently a distinct species, being ovate (rather broader behind than in front), smooth, and having a strong marginal rim.

Pl. XV, figs. 4 and 5. These are two ovate or suboval shields, larger than the somewhat similar figs. 9 and 22, and destitute of concentric lines (possibly from the effect of fossilisation).

Fig. 4 retains the rostral piece, but each valve has been modified by oblique pressure, and shows no remnant of the test. It measures, | , 15 mm.; —, 10 mm.; ⦣ , 8 mm. at (?); ‿, 8 (?) mm.; I, 7 (?) mm.; ∨, ?. Proportion, width to length as 20 to 22. The two valves broad and roundly sagittate; carapace ovate. Shorter than *A. Salteri*, and with a fuller curve on the posterior third.

In brownish-grey, hard, micaceous shale; valves rusty, slightly oblique and imperfect, as is also the triangular piece at the top edge. The outer margin

[1] See 'Quart. Journ. Geol. Soc.,' vol. xxxiv, p. 280, &c.

[2] Op. cit., p. 282.

has had a strong rim, which is partly preserved. From Stennies Water, six and a half miles north-west of Langholm, Dumfriesshire. Mus. Geol. Survey, Scotland. M, 462 c.

Pl. XV, fig. 5, retains one perfect and one imperfect valve; the notch is empty. It measures: |, 17 mm.; —, 10 mm.; _/, 7 mm. at 45°; ,—,, 9 mm.; I, 6 (?) mm.; V, 90°. Proportion, width to length as 20 to 23. In buffish-coloured, hard, micaceous shale (like that of fig. 4); valves, rusty impressions; the outer rim is partly preserved. Stennies Water, Dumfriesshire. Mus. Geol. Survey, Scotland. M, 466 c.

9. Aptychopsis Salteri, *H. Woodward*, 1882. Plate XVII, fig. 6; and Woodcut, Fig. 8.

Aptychopsis Salteri, *H. Woodward.* Geol. Mag., 1882, p. 389, pl. ix, fig. 17.
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 355.
— — — Report Brit. Assoc. for 1884 (1885), p. 91.

This distinctly marked species had a suboval outline when perfect. The surface is finely striate and rather undulate concentrically, and the outer border seems to have had the edge bent downwards.

This carapace differs from *A. glabra* (Pl. XV, fig. 11) and *A. Wilsoni* (figs. 15

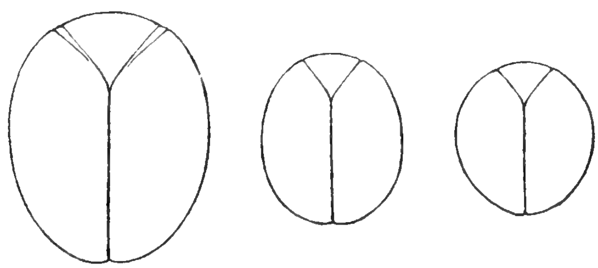


Fig. 8.—*Aptychopsis Salteri.* Fig. 9.—*A. ovata.* Fig. 10.—*A. prima.*
All three of natural size and restored as to outline.

In *A. Salteri* the width is to length as 26 to 33 mm.; *A. ovata*, 18 to 33 mm.; *A. prima*, 18 to 21 mm.; var. *secunda*, 19 to 19 mm., Barrande's fig. 14; and *A. glabra*, 16 to 17 mm.

and 16) in being oval and not circular, and the upper angle of the valve is more acute than in *A. Wilsoni.*

Measurements: |, 25 mm.; —, 13 mm.; _/, 10 mm. at 45°; ,—,, 14 mm.; I, 10 (?) mm; V, 90°. Proportion: width to length as 26 to 35. It is larger and more oval than *A. ovata*, Pl. XV, figs. 4 and 5.

In hard black shale. Upper Silurian (Wenlock Shale); Pencarreg, Caermarthenshire, South Wales. Coll. J. E. Lee. Brit. Museum. I, 1150.

10. Aptychopsis subquadrata, sp. nov. Plate XV, fig. 20.

Mounted on the same tablet, and presumedly from the same locality as *A. angulata* (*infra*, Pl. XV, fig. 19), but in a different matrix, is a slightly convex cast of a suborbicular, or apparently subquadrate shield, with a relatively long dorsal suture and a short notch; and somewhat squeezed laterally. It is in a brown, fine-grained sandy mudstone, full of hollow impressions of minute fossils (Encrinital, &c.). Concentric lines, indicated on the cast, are rather broad and irregular. This differs markedly from fig. 19, and indeed from any other form we have met with. We must therefore regard it as a new species, and we propose to call it *subquadrata*.

Measurements: |, 7 mm.; —, 5 mm.; ⦣, 3 mm. at 45°; ⌴, 4 mm.; I, 3 (?) mm.; ∨, 90°. Proportion, width and length equal.

From the Lower (?) Silurian; Cloncannon, Tipperary, Ireland. Mus. Geol. Survey, Ireland.

11. Aptychopsis angulata (*Baily*, 1860). Plate XV, fig. 19, and figs. 13 ? and 17 ?.

Cucullella angulata, *Baily*. Explan. Sheet 135, Geol. Surv. Ireland, 1860, p. 13, fig. 4 (woodcut).

Aptychopsis glabra (?), *T. R. J. and H. W.* Report Brit. Assoc. for 1884 (1885), p. 91.

This somewhat convex specimen and its hollow counterpart occur in the bed-plane of a thin, brownish, hard, fine-grained sandy mudstone from Tipperary, Ireland. It was figured as *Cucullella angulata* by the late W. H. Baily in the 'Explan. Geol. Survey Ireland,' Sheet 135, 1860, as noticed by us in the 'Report Brit. Assoc. for 1884' (1885), p. 91. The valves are represented by brown stains. The concentrics are distinct, rather numerous, and irregular in strength.

The outline of the complete carapace seems to have been a somewhat oblate circle, that is, widened transversely. It is not nearly so truly discoidal as *A. glabra* or *A. Wilsoni*, from which its oblateness, resulting from greater transverse width, separates it.

Measurements: |, 7 mm.; —, 7 mm.; ⦣, 6 mm. at 40°; ⌴, 9 mm.; I, 5 (?) mm.; ∨, 100°. The width of the whole carapace to its length was probably as 14 to 12.

From the Lower (?) Silurian beds at Cloncannon, County Tipperary, Ireland. Mus. Geol. Survey Ireland.

There are two other carapaces, probably oblately circular in shape, when perfect, which approach *A. angulata.*

Pl. XV, fig. 13, consisting of one perfect and one imperfect valve, has been somewhat shortened by crumplings, induced by pressure at right angles to the dorsal axis. It may, therefore, have been more nearly circular, like *A. glabra.* No trace of concentrics remain on the disturbed and somewhat pyritous surface.

Measurements at present: |, 7 mm.; —, 8 mm.; $\angle$, 5 mm. at 45°; ⌞—⌟, 8 mm.; I, 5 mm.; $\vee$, 90°. The apparent proportion of the width of the whole carapace to its length is as 16 to 12.

In black, finely micaceous shale. Streamlet, Craigdasher Hill, 4 miles W. of Dunscore, Dumfriesshire. Mus. Geol. Survey Scotland. M 4516.

Pl. XV, fig. 17, consists of two valves flattened and distorted by oblique pressure, and represented by rusty films, with numerous concentrics almost regular in width.

Measurements: |, 14 mm.; —, 12 mm.; $\triangle$, 6 (?) mm. at (?); ⌞—⌟, 9 (?) mm.; I, 5 (?) mm.; $\vee$ (?). The proportion of width to length of the perfect carapace was probably about 24 to 19.

In grey mudstone, dark-grey at heart, very finely micaceous, much squeezed, having its fossil-bearing plane (the bed is one inch thick) at an angle of 50° with the cleavage-plane. From the Brathay (Lower Coniston) Flags, Nanny Lane, Troutbeck, Windermere; collected by Mr. J. E. Marr, F.R.S. Woodwardian Mus., Cambridge.

It is referred to in the 'Geol. Mag.,' 1884, p. 355; the 'Report Brit. Assoc. for 1884' (1885), p. 92; and the 'Catalogue of Type Fossils in the Cambridge Museum,' 1891, p. 134.

12. Aptychopsis oblata, sp. nov. Plate XV, figs. 18, 21, 23.

Some extremely oblate, or quite transversely oval, carapaces have now to be noticed.

Pl. XV, fig. 21, has two valves each semi-elliptical transversely, together making an oval, with a broad shallow notch between them anteriorly. The angles below the notch retain a particular convexity, bounded by a distinct furrow parallel with the almost obliterated usual concentric lines of growth, which seem to have been of irregular widths, and to have ended at the outer margin with a flattish rim. The central umbonal convexity in each valve looks like the area of a certain stage of growth defined by some altered conditions of existence, as in the valves of many Lamellibranchiate Molluscs.

The measurements are |, 16 mm.; —, 15 mm.; ⦣, 10 mm. at 35°; ⌊—, 11 mm.; I, 5° (?) mm.; ∨, 110°; width of carapace to its length, as 30 to 21 (about).

The two counterparts of this specimen occur in dark-grey, hard, shaly flagstone. Valves, black films.

Balmangan Bay, west side of Kirkcudbright Bay. Mus. Geol. Survey Scotland. Marked B 135 D; 2/13/4/92.

Pl. XV, fig. 18, a pair of valves belonging to a small transversely oval carapace. The two valves subreniform, having the re-entrant angle between them. They measure, |, 4·5 mm.; —, 6 mm.; ∠, 2 (?) mm. at 45° (?); ⌊—, 3·5 mm.; I, 2·5 (?) mm.; ∨, about 90°. Proportion of width to length, as 12 to 7 (about).

Black films in black sub-bituminous shale; concentrics obliterated. Dobbs Linn. Mus. Geol. Survey Scotland. M 4260 C.

Pl. XV, fig. 23, a subreniform pair of valves belonging to a small transversely oval carapace. Measurements: |, 4 mm.; —, 5 mm.; ⦣, 3 mm. at 30° (?); ⌊—, 4 mm.; I, 2 mm.; ∨, about 120°. The notch is half the length of the dorsal suture in depth. Proportion of width to length as 10 to 6.

In yellowish-grey shale, made up of greenish-grey and buff laminæ, very finely micaceous. Valves dark-brown films; concentrics obliterated.

Gala group; Gala Hill, Galashiels. Coll. Lapworth. British Mus. No. 59620.

X. *Genus*—Peltocaris, *Salter*, 1863.

Dithyrocaris, *Salter*. Quart. Journ. Geol. Soc., vol. viii, 1852, p. 391.
Ceratiocaris, *Salter*. Ann. Mag. Nat. Hist., ser. 3, vol. v, 1860, p. 161.
Peltocaris, *Salter*. Quart. Journ. Geol. Soc., vol. xix, 1863, p. 87.
— *H. Woodward*. Ibid., vol. xxii, 1866, p. 504.
— — Catal. Brit. Foss. Crust., 1877, p. 77.
— *Nicholson and Etheridge*. Monogr. Silur. Foss. Girvan,[1] vol. i, 1880, p. 210.
— *T. R. Jones*. Geol. Mag., 1883, p. 462.
— *T. R. J. and H. W.* Report Brit. Assoc. for 1883 (1884), p. 216.
— — Geol. Mag., 1884, pp. 349 and 355.
— — Report Brit. Assoc. for 1884 (1885), pp. 76 and 92.
— — Monogr. Brit. Pal. Phyllop., pt. 1, 1888, p.
— *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 62.

[1] The specimen referred with doubt to this genus at p. 212 (pl. xiv, fig. 21) appears to us to belong to *Dipterocaris*, J. M. Clarke (see 'Report Brit. Assoc.' for 1884 (1885), p. 85; probably allied to *Pterocaris*, Barrande.

This Phyllopod has a discoidal, round or oval, tripartite shield, with a straight median dorsal suture, and a curved nuchal suture, which, giving way after death more easily than the other, has left in some instances a rounded, elliptical, or semi-oval cephalic notch in the shield. The separate lateral pieces of the test, instead of a straight sloping inner edge as in *Aptychopsis*, have an inner concave curve meeting the convexity of the outer margin. These two lateral moieties, however, are not so frequently found separate as is the case with *Aptychopsis*. In some instances a smaller notch appears at the bottom or apex of the curved notch, sometimes with a little escutcheon peculiar to it. The shield is smooth in all the specimens here figured. A very dubious indication of concentric striation is traceable in fig. 8.

One allied specimen has been figured and described ('Quart. Journ. Geol. Soc.,' vol. xxii, 1866, p. 504, pl. xxv, fig. 6) which has concentric lines of growth. As it represents a different species, we dedicate it to its discoverer, W. Carruthers, Esq., F.R.S.; see page 116.

1. Peltocaris aptychoides, *Salter*, 1852 and 1863. Plate XVI, figs. 1—3 and 9.

Dithyrocaris aptychoides, *Salter*. Quart. Journ. Geol. Soc., vol. viii, 1852, p. 391, pl. xxi, fig. 10.
Ceratiocaris aptychoides, *Salter*. Ann. Mag. Nat. Hist., ser. 3, vol. v, 1860, p. 161.
Peltocaris aptychoides, *Salter*. Quart. Journ. Geol. Soc., vol. xix, 1863, p. 88, fig. 1; p. 90, fig. 4.
— — *Bigsby*. Thesaur. Silur., 1868, p. 76.
— — *H. Woodward*. Catal. Brit. Foss. Crust., 1877, p. 77.
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 355.
— — — Report Brit. Assoc. for 1884 (1885), p. 92.
— — *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 62.

Mr. Salter, treating of this species, describes and figures a smooth, flat, round, tripartite test, with a nuchal or rostral notch as broad as long, and of a parabolic shape, with a depth of about one-third of the whole length of the test. The umbonal angles at the inner end, or apex, of the notch are often isolated by short curved sutures (fig. 1, 1863), and sometimes lost on account of that sutural division (fig. 10, 1852). His fig. 1 has a round outline (restored ?) measuring 13 mm. each way, and the notch is 4 mm. deep and broad. His fig. 10 shows two valves united, slightly distorted by pressure, and indicating an oblately circular test; the notch (without the innermost small notch) is 3 mm. deep and 4 mm. broad.

Pl. XVI, fig. 1. Valves obscure, black films on black graptolitic shale. From Eldinhope, Selkirkshire. Coll. Lapworth. British Museum. No. 59620.

Measurements: |, 11 mm.; —, 7 mm.; ∠, 4 mm. at about 45°; I, 4 mm.; ‿, 7 mm.; V, about 90°.

Pl. XVI, fig. 2. Valves, light-brown films on grey shale weathering brownish. From the Grieston beds of the Gala Group, at Rotten Gair, Innerleithen. Coll. Lapworth. British Museum. No. 59620.

Measurements: |, 8 mm; —, 5 mm.; ∠, 4 mm. at 60°; I, 2 mm.; ‿, 4 mm.; V, 60°.

Pl. XVI, fig. 3. Valves, black shiny films on black subbituminous shale; slightly displaced by oblique pressure. From Duffkennell, Dumfriesshire. Coll. Harkness. Mus. Pract. Geol. D | $\frac{4}{47}$, $\frac{2}{22}$c. This is probably the specimen figured by Mr. Salter in 1852 (pl. xxi, fig. 10); but our drawings do not quite coincide.

Measurements: |, 9 mm.; —, 6? mm. The sides of the notch are too much displaced for accurate measurement.

Pl. XVI, fig. 9. Valves, slightly separated, are small, black, shiny films, with minute grey bits of the smooth test. The notch is deep, but obscured by matrix. The test, when perfect, would have been round. In black shale from a burn opposite the house of a farm called Polmoody, on the road to Dobbs Linn, which is at the top of Moffat Water, about thirteen miles from Moffat. Collected by Mr. D. J. Brown, of Moffat. This is probably a young form of *P. aptychoides*.

Measurements: |, 3 mm.; —, 3 mm.; ∠, 3? at 70°?; ‿, 2? mm.; I, 2 mm.; V, 40°. Width to length as 6 to 5?

2. Peltocaris anatina, *Salter*, 1873. Plate XVI, figs. 4—9.

Peltocaris anatina, *Salter*. Catal. Palæoz. Foss. Cambridge, 1873, p. 93 (not the figure nor the locality).
— — *H. Woodward*. Catal. Brit. Foss. Crust., 1877, p. 77.
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 355.
— — — Report Brit. Assoc., 1884 (1885), pp. 76 and 93.
— — *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 62.
— —? *Woods*. Catal. Type Foss. Cambridge, 1891, p. 136.

In 1873 (op. cit.) Mr. Salter mentioned this species, but it was not figured. The diagram annexed to it, and given in illustration of the generic type, is *P. aptychoides*. That a *Peltocaris* was intended here is evident from the words "its semi-oval rostrum is seldom found." The specimen (from Rebecca Hill) referred to in the 'Cambr. Catal.,' 1873, p. 93, is an *Aptychopsis* (with an angular notch, see Pl. XV, fig. 2). There is, however, in the Woodwardian Museum an oval Phyllopod shield, having a semi-oval notch (Pl. XVI, fig. 5), which is thought to be such a fossil as Salter intended for his *P. anatina*, if not the specimen itself. It was collected by Mr. J. E. Marr, F.R.S., on the west side of Long Sleddale, in a graptolitic mudstone of the Coniston series.

Pl. XVI, fig. 5. The valves are here represented by delicate grey films on dark-grey shale. They have been probably somewhat narrowed by lateral pressure.

The measurements in the present condition of the fossil are: |, 6 mm.; —, 3 mm.; ⦣, 4 mm. at 65°; ⌞, 3 mm.; I, 4 mm.; V, 50°. The width to length as 6 to 10.

Pl. XVI, fig. 4. Valves, pyritous films in black subbituminous shale; nearly perfect, but the notch is partly obscured by overlying matrix, and somewhat restored in our figure. This has a more oval outline than figs. 1, 2, and 3; and may be referred to *P. anatina*. Probably from the Moffat shales. Coll. J. Farie. Mus. Pract. Geology. D$\frac{4}{46}$.

The measurements are imperfect: |, 9 mm.; —, 5 mm.; ⦣, 4 mm. at 65°; ⌞, 4 ? mm.; I, 4 ? mm.; V, about 50°. The width to length as 10 to 13.

Pl. XVI, fig. 6, is a perfect test, obovate in outline, broad and round anteriorly, and rather pointed behind. Valves, shining black films on black graptolitic shale, from the Moffat series, at Whitehope Burn, St. Mary's Loch.[1] Coll. Lapworth. British Museum. No. 59620.

Measurements: |, 9 mm.; —, 4 mm.; ⦣, 3 mm. at 70°; ⌞, 3 mm.; I, 3 mm.; V, 40°. Width to length as 8 to 12.

Pl. XVI, fig. 7. Valves, black films on black shale. Streamlet, Craigdasher Hill, four miles west of Dunscore, Dumfriesshire. Geol. Surv. Scotland. M. 4490.

Measurements: |, 5 mm.; —, 3 mm.; ⦣, 2 mm. at 70°; ⌞, 2 ? mm.; I, 2 mm.; V, 40°. Width to length as 6 to 7 ?

Pl. XVI, fig. 8. Valves, small shining black films, on black graptolitic shale. From Garpel Glen,[2] about four miles to the west of Moffat. Coll. D. J. Brown.

Measurements: |, 5 mm.; —, 3 mm.; ⦣, 3 mm. at 70°; ⌞, 2 mm.; I, 2 mm.; V, 40°. Width to length as 6 to 7 ?

[1] See 'Quart. Journ. Geol. Soc.,' vol. xxxiv, 1878, pp. 265, 274, and 279.

[2] Ibid., vol. xxxiv, 1878, p. 290.

3. Peltocaris patula, sp. nov. Plate XVI, figs. 10 and 11.

Peltocaris, sp. nov., *T. R. J. and H. W.* Geol. Mag., 1884, p. 355.
— — — Report Brit. Assoc. for 1884 (1885), pp. 76 and 94.
— sp., *Woods.* Catal. Type Foss. Cambridge, 1891, p. 136.

Two small oblate shields, with the oval notch of *Peltocaris*, differ from any of the foregoing species of this genus. In their broad, transversely oval, or elliptical outline they resemble *Aptychopsis oblata*, Pl. XV, figs. 21 and 23. Their proportion of width to length is about 7 mm. to 5 mm.

Pl. XVI, fig. 10. Valves, delicate pyritous films, slightly broken by pressure and somewhat widened. In black graptolitic shale of the Moffat (Birkhill) series, from Belcraig,[1] Annandale. Coll. Lapworth. Brit. Mus. No. 59620.

Pl. XVI, fig. 11. Pyritous films of the valves of a small oblate test, similar to the above, but finely crumpled, separated, and somewhat widened by cross-pressure at right angles to the dorsal axis of the shield. In black graptolitic shale or mudstone from Skelgill Beck, near Ambleside, Westmoreland. Coll. J. E. Marr. Woodwardian Museum, Cambridge.

4. Peltocaris Carruthersii, sp. nov. Plate XVII, fig. 7.

Peltocaris aptychoides, *H. Woodward.* Quart. Journ. Geol. Soc., vol. xxii, 1866, p. 504, pl. xxv, fig. 6.
— — *Lapworth and Swanston.* Proceed. Belfast Nat. Field Club, Appendix, 1877, Table, pl. vii, fig. 24 *b* (fig. 24 *a* is apparently a broken *Discinocaris*, not a *Peltocaris*).
— — *Dairon.* Trans. Glasgow Geol. Soc., vol. vii, 1883, p. 181, pl. vii, fig. 29.

This was noticed in 1866 by Dr. H. Woodward among the fossils from the Moffat shales in Mr. Carruthers' cabinet, but it has been unfortunately mislaid. It differs from Salter's type by its bluntly oval shape and its strong concentric striation. The figure (magnified three times) given of this form in 1866 is about 12 mm. long and 10 mm. wide, with the notch 4 mm. deep and 3 mm. wide. It is somewhat like *Aptychopsis Lapworthi*, but has a rounded notch. The illustration given in 1866 being trustworthy, we propose to treat this as a distinct species, and

[1] See 'Quart. Journ. Geol. Soc.,' vol. xxxiv, p. 284.

name it after our friend Mr. W. Carruthers, F.R.S., who gave much attention to the Moffat fossils. In the table appended to his paper Dr. Lapworth refers his figs. 24 *a* and *b* to the Lower Llandovery beds of Tieveshilly near Portaferry, and Coal-pit Bay, county Down, North-east Ireland.[1]

The late Mr. M. Dairon quoted the object of his fig. 29 from Dobbs Linn, near Moffat.

5. PELTOCARIS ? HARKNESSI, *Salter*, 1863.

PELTOCARIS ? HARKNESSI, *Salter*. Quart. Journ. Geol. Soc., vol. xix, 1863, p. 89, fig. 2 (woodcut).
— — *Bigsby*. Thesaur. Silur., 1868, p. 76.
— — *T. R. J. and H. W.* Geol. Mag., 1884, p. 355.
— — — Report Brit. Assoc., 1884 (1885), pp. 76 and 94.
— — *Etheridge*. Foss. Brit., vol. i, Palæoz., 1888, p. 62.

Shape indeterminate; it may be a piece of any large Phyllopod ? species: the author was uncertain as to its alliance. Graptolitic beds (of Llandeilo age), Dumfriesshire.

XI. *Genus* PINNOCARIS, *R. Etheridge, jun.*, 1878.

R. ETHERIDGE, jun., 'Proceed. Roy. Phil. Soc. Edinb.,' vol. iv, 1878, p. 167.
H. A. NICHOLSON and R. ETHERIDGE, Jun., 'Monogr. Silur. Foss. Girvan, Ayrshire,' vol. i, 1880, pp. 207—209.

Carapace capable of being bent, possibly sutured along the back. Lateral pieces, found apart, in outline like the valves of a *Pinna*. Dorsal (inner) margin straight; front edge rounded (in some cases semicircular, in others elliptically rounded); ventral (outer) margin sinuous, fully convex anteriorly, sloping and partly concave posteriorly. Concentrically striate, with delicate lines following the contour of the margin and centring on a kind of umbo situate at about a third of the length of the valve from its front edge.

The inner border of the anterior third is somewhat oblique in some cases, and apparently the two valves together would open slightly from in front towards the

[1] At the top of the Middle or the base of the Upper Silurian.

subcentral umbo, but there is no direct evidence of an open nuchal notch nor of any cephalic or rostral piece to occupy it. The hinder part of the carapace had a long triangular sulcus, either floored with a thinner kind of test, easily broken so as to come apart in a line with the umbo, and leaving narrow lateral remnants, or possibly sutured. Its ally *Pholadocaris* is not sutured.

1. Pinnocaris Lapworthi, *R. Etheridge, jun.* Plate XV, fig. 24.

Pinnocaris Lapworthi, *R. Eth., jun.* Proc. Roy. Phil. Soc. Edinb., vol. iv (1878), p. 169, pl. ii, figs. 3—5.
— — *Nicholson and Etheridge, jun.* Monogr. Silur. Foss. Girvan, vol. i (1880), p. 210, pl. xiv, figs. 17—20.

Pl. XV, fig. 24, resembles the Girvan specimen as figured (1880), especially fig. 17, except that it has lost a part of the anterior rim, whilst fig. 17 has lost part of the posterior rim. In that fig., and in fig. 20, the filmy ragged edge of the posterior sulcus has been partly preserved, in fig. 17 its edge is entire, whilst in fig. 18 such a ragged selvedge passes beyond the umbo to the front margin, showing, apparently, that there was a continuous junction of the two moieties by thin material throughout the carapace. Pl. XV, fig. 24, is not altogether different in this respect, though the posterior inner selvedge (on the right-hand side of the figure) seems to have been thickened up into a wrinkled rim. It had a stronger umbo than seen in figs. 17, 18, and 19 (Girvan), but this has been crushed down, and is about the same as in fig. 20. There is no radiate ornament.

In fig. 17 (Girvan) there is an associated sharp-pointed narrow body, which has been regarded as being probably one of the tail-spines belonging to this Phyllopod.

These are from the Lower Silurian at Balcletchie, Girvan, Ayrshire. We here figure, Pl. XV, fig. 24, a specimen of the form or variety shown by fig. 17, that is, with the hinder portion less pinched in, from the Upper Silurian of Kendal.

The shield is triangular-obovate; if the two lateral pieces were complete and laid out together the length would be about 25 mm. and the width 20 mm. It is in the British Museum. I, 2952.

No Goniatites accompany these specimens.[1]

[1] The Phyllopod described as accompanying *Pinnocaris* at Girvan belongs to J. M. Clarke's genus *Dipterocaris* (1883; see our Report for 1884 (1885), p. 85). This is of Devonian age in the State of New York, U.S.A.; and, whether or not associated with Goniatites there, it is of Silurian age and without Goniatites in this country.

In the 'Geol. Mag.,' 1882, p. 388, is a foot-note referring to some points of similarity between *Pinnocaris* and *Pholadocaris* (op. cit., p. 388, pl. ix, fig. 16). The latter has in its posterior region a narrow, triangular, sunken area occupied by a thinner (?) test, without a suture. The front third, however, has a broad cervical notch, and in this and its broader outline the German *Pholadocaris* (Devonian) differs from the British *Pinnocaris* (Silurian).

XII. *Genus* Discinocaris, *H. Woodward*, 1866.

Discinocaris, *H. Woodward.* Report Brit. Assoc. for 1865 (1866), Trans. Sect., p. 78.
— — Quart. Journ. Geol. Soc., vol. xxii, 1866, p. 503; Geol. Mag., vol. viii, 1866, p. 72.
— *Bigsby.* Thesaur. Silur., 1868, p. 74.
— *T. R. Jones.* Geol. Mag., 1883, p. 462.
— *T. R. J. and H. W.* Ibid., 1884, p. 348.
— — Report Brit. Assoc., 1883 (1884), p. 216.
— — Ibid., 1884 (1885), pp. 75 and 78.
— — Monogr. Brit. Palæoz. Phyllop., pt. 1, 1888, p. 2.
— *Etheridge.* Foss. Brit., vol. i, Palæoz., 1888, p. 51.
— *Woods.* Catal. Type Foss. Cambridge, 1891, p. 136.

This Phyllopod has normally a round test, slightly conical, without a median or dorsal suture, but an anterior triangular segment is separated from the rest of the disc-shaped shield by a line of suture, and this is usually left as an empty notch. The test is concentrically striated with lines of growth, and occasionally a reticulate or a striate ornament is recognisable between them.

Prof. A. E. von Reuss has figured and described from the Alpine Trias (Raibl beds, near Hallstadt) a very similar form (*Aspidocaris*): 'Sitzberichte k. Akad. Wissensch. Wien, Math.-nat. Cl.,' vol. lv, 1867, pp. 277—281, plate, figs. 1—5; 'Geol. Mag.,' 1882, p. 386, and 1884, p. 351.

1. Discinocaris Browniana, *H. Woodward*, 1866. Plate XVI, figs. 12—19, 21—23.

Discinocaris Browniana, *H. Woodward.* Report Brit. Assoc. for 1865 (1866), Trans. Sect., p. 78; Quart. Journ. Geol. Soc., vol. xxii, 1866, p. 504, pl. xxv, figs. 4, 5 (?), 7; Geol. Mag., vol. iii, 1866, p. 72.

Discinocaris Browniana, *Armstrong, Young, and Robertson.* Catal. West-Scot. Foss., 1876, p. 7.
— — *Bigsby.* Thesaur. Silur., 1868, p. 74.
— — *Lapworth and Swanston.* Proceed. Belfast Nat. Field Club, Appendix, 1877, p. 114, and Table, pl. vii, figs. 24 *a*, 25 *a*, and 25 *c*.
— — *H. N. and E.* Catal. Cambr. Sil. Foss. Pract. Geol. Mus., 1878, p. 28.
— — *T. R. J. and H. W.* Geol. Mag., 1884, pp. 348 and 351.
— — — Report Brit. Assoc., 1884 (1885), pp. 75 and 78.
— — *Etheridge.* Foss. Brit., vol. i, Palæoz., 1888, p. 51.

This is a circular shield-like test, closely resembling a *Discina* at first sight, but it has a section of one-sixth of its arc removed in nearly every specimen. This triangular anterior or nuchal valvular piece is crossed by concentric striæ coincident with the lines of growth on the rest of the test. The rostral notch has normally an angle of about 90°. It extends less than half the length of the shield.

The shape of these little fossils has been much modified by pressure—vertical, lateral, or oblique. In fig. 12 the shell seems to have retained its original shape; others have been widened by pressure, as figs. 15, 16, 22, and especially fig. 17; some have been obliquely squeezed, as figs. 21 and 23; and some have been narrowed by cross-pressure, as figs. 13, 14, and especially figs. 18 and 19.

A larger specimen, and apparently with the two lateral flaps or valves folded together, was figured in the 'Quart. Journ. Geol. Soc.,' vol. xxii, 1866, pl. 25, fig. 5, and described at page 503 as retaining some remains of the tail-segments with the folded shell. Unfortunately the specimen (formerly in Mr. D. J. Brown's cabinet) has been lent or given away, at all events lost, and we cannot at present learn anything more about it.

Pl. XVI, fig. 12. Black shining film on black graptolitic, finely micaceous shale. The test is almost circular and nearly perfect, but the nuchal piece is somewhat obscure, having been broken or slightly shifted, so as to leave a small open angle at the upper part of the left-hand slope of the notch. The width of the shield to the length is as 12 to 11.

From the Moffat shales of Dumfriesshire. Coll. Carruthers. British Museum. No. 58869. This is probably the specimen represented by fig. 7 (somewhat restored), 'Quart. Journ. Geol. Soc.,' 1866, pl. 25.

Pl. XVI, fig. 13. Black film on black shale from Garple Linn. It is slightly deformed by cross-pressure. Mus. Geol. Surv. Scotland. M. 4371.

Pl. XVI, fig. 14. Black film on black shale from Dobbs Linn. Deformed by pressure. Mus. Geol. Surv. Scotland. M. 4439 c.

Pl. XVI, fig. 15. A rather large specimen, but broken and widened by vertical pressure. Black film on black graptolitic shale from Dobbs Linn. Coll. Dairon.

Pl. XVI, figs. 16 *a*, *b*. Pyritous film of a similar fossil, also from Dobbs Linn. Geol. Surv. Scotland. M 4269 c and 4270 c. Fig. 16 *a* gives M 4270 c, being the convex counterpart; and 16 *b* shows the traces of a reticulate ornament between the concentric striæ (as in *Estheriæ*, &c.), magnified forty diameters.

Pl. XVI, figs. 17, 18, and 19. These are filmy representatives of three individuals in the same schistose-graptolitic shale, squeezed, cleaved, and jointed. They have been pyritous, but are decomposed and partially ochreous; their present shapes, whether widened or narrowed, are directly due to the force which has compressed and hardened the shale, its crumplings being at right angles to the pressure.

From the Lower Footbridge, Skelgill; Graptolitic Mudstone, A Z. Coll. Marr. Woodwardian Museum, Cambridge. Fig. 19 is referred to in the 'Report Brit. Assoc. for 1884' (1885), p. 94, and 'Geol. Mag.,' 1884, p. 351, as *Discinocaris*, sp. nov.; and in the 'Catal. Type Foss.,' Cambridge, 1891, p. 136, as *Discinocaris*, sp., from the Coniston Mudstone, Skelgill Beck, Ambleside.

Pl. XVI, fig. 21. A black, strong, shining, imperfect film, in black, finely micaceous shale (with a concave counterpart); the edges of the notch are partially overlapped by matrix, giving them a false, sinuous appearance. A fine specimen, and very slightly distorted. The width was probably about 20 mm., and the length about the same. From the Birkhill shales of the Moffat Series at Dobbs Linn. Coll. Lapworth. This is the same specimen as fig. 25 *b*, pl. 7, 'Proceed. Belfast Nat. Field-Club,' Appendix, 1877.

Pl. XVI, figs. 22 *a* and *b*. Delicate pyritous film on black, finely micaceous, graptolitic shale. Much distorted by vertical pressure (another like it lies on the same bed-plane). Fig. 22 *b* (magnified forty diameters) gives the sub-reticulate and vertically-barred interstitial ornament, like some sculpturing seen among the *Estheriæ*. From Polmoody (see above, p. 114). Coll. D. J. Brown.

Pl. XVI, fig. 23. A rather large, but distorted, pyritous film, imperfect. From the same graptolitic black shale at Dobbs Linn. Coll. D. J. Brown.

2. DISCINOCARIS OVALIS, sp. nov. Plate XVI, fig. 20.

This is a small form, with the usual concentric striæ, a narrow and deep notch, extending to almost half the length of the test, and a neat oval outline, apparently well preserved, with the wedge-shaped anterior piece in place. Delicate greyish film (once pyritous).

Measurements: |, 6 mm.; —, 3 mm.; ⦣, 4 mm. at 65°; ‿, 2 mm.; I, 4 mm.; V, 50°.

From the black, graptolitic, finely micaceous shale of Dobbs Linn. Coll. D. J. Brown.

3. Discinocaris undulata, sp. nov. Plate XVI, figs. 24 *a*, 24 *b*.

This is a large subcircular or subquadrate test (imperfect). As the edge of the more perfect side is flatter than in *D. Browniana*, and the anterior edge is nearly straight, being only slightly curved outwards, the shape is almost subquadrate. The nuchal wedge is clearly evident. The concentric markings consist of broad undulating bands (about seven on a side), with mere traces of fine striæ here and there parallel among them (not shown in the drawing). Interstitial ornament (fig. 24 *b*, magnified forty diameters) is present as an obscure reticulation.

Dr. Lapworth's figure of *D. Browniana* in the 'Proc. Belfast Nat. Field-Club,' Appendix, 1877, pl. 7, fig. 25 *b*, is somewhat undulate, but with fewer bands, and our fig. 21, Pl. XVI, represents it better. There is also a figure given by the late Mr. James Dairon in the 'Trans. Geol. Soc. Glasgow,' 1883, pl. vii, fig. 32, which has an apparently undulate surface, but the bands are too broad and too few, and there is a median suture, making it an *Aptychopsis*.

Pl. XVI, figs. 24 *a*, *b*. A dull black film on the usual black graptolitic shale. Garpel Burn. Coll. D. J. Brown.

Measurements: |, 10 (?) mm.; —, 9 mm.; ⦣, 7 mm. at 45°; ⌞—⌟, 6 mm.; I, 6 mm.; ∨, 90°. Width 18 mm. to length 16 (?).

4. Discinocaris gigas, *H. Woodward*, 1872. Plate XVII, figs. 1, 2, 3, 4 (?), and 5.

Discinocaris gigas, *H. Woodward*. Geol. Mag., 1872, p. 564; Report Brit. Assoc., 1872 (1873), p. 323.
— — *T. R. J. and H. W.* Geol. Mag., 1884, pp. 349 and 351.
— — — Report Brit. Assoc., 1884 (1885), pp. 75 and 80.

A subtriangular fragment of a Phyllopodous shell, showing delicate, concentric, parallel lines (fig. 1), was referred in 1872 by Dr. H. Woodward to a *Discinocaris*, possibly "seven inches in diameter." This was from the Moffat graptolitic shale at Dobbs Linn, Dumfriesshire. It is in the British Museum; also an oblong fragment with fine parallel lines (fig. 4). Some flattened relics of four body-rings, 45 mm. in transverse width, and varying from 5 to 10 mm. fore and aft at present, from the same beds at Ettrickbrigend, Selkirkshire (fig. 5), are in the same collection.

At Cambridge two fragments of the same large kind of carapace (fig. 2) are in the University Museum, from the Coniston mudstone of Skelgill Beck, Ambleside. Collected by Mr. J. E. Marr, F.R.S.

The late Mr. James Dairon, F.G.S., of Glasgow, kindly sent us a sketch (fig. 3) of a fine specimen of this *Discinocaris*, found by Mr. William Brown (of Birkhill, Dumfriesshire) in the graptolitic shales of Dobbs Linn, Moffat. It has somewhat the outline of the bottom of a horse's hoof, boldly curved on one edge, and broadly indented with a shallow triangle on the other. It has been much more convex than it is now, being somewhat crushed, and radiately cracked towards the curved margin. The figure measures 3 inches (73 centimetres) transversely from one side of the curve to the other, and about 2 inches ($5\frac{1}{2}$ centimetres) from the apex of the triangular indentation to the opposite edge. The sides of the notch, about 25 mm. long, slope at 15°, and the angle of the notch is 150°.

Pl. XVII, fig. 1. An iridescent, pyritous film, on a bed-plane of black graptolitic shale from Dobb's Linn, hard and finely micaceous, with ferruginous joints. This is a left-hand posterior corner of a test like fig. 3, except that the hinder border was straighter than in Mr. Dairon's sketch, reproduced as fig. 3; and the concentric lines are more closely set towards the margin. Coll. Lapworth. Brit. Mus. No. 59620.

Pl. XVII, fig. 2. A pyritous film of a crushed portion of the posterior corner of the right side on black, graptolitic, finely micaceous, shale, hard, squeezed, thick, and jointed. Graptolitic mudstone, A. Z.; Skelgill Beck, at the lower footbridge. Fig. 2 is taken from the convex counterpart of the split specimen. Coll. Marr. Woodwardian Museum, Cambridge.

Pl. XVII, fig. 3. Copy of Mr. Dairon's sketch of a large unique specimen. Evidently once subconical, but flattened by pressure. The measurements are stated above. The dotted outline gives the probably correct shape of the test without its nuchal piece.

Pl. XVII, fig. 4. An iridescent film, once pyritous, on the usual black graptolitic shale of the Moffat series at Dobbs Linn. The figure is taken from the convex counterpart. The straight edge is formed by a joint, whilst the other or smooth convex edge, against which the parallel striæ abut, may possibly be a portion of the edge of the nuchal notch of a very large individual, the fragment being 30 mm., and the whole length of such an edge on the notch of fig. 3 is only 25 mm., with the striæ meeting it at a considerable angle instead of being straight as in fig. 4. Coll. Lapworth. Brit. Mus. No. 59620.

Pl. XVII, fig. 5. A greyish film, once pyritous, on the counterparts of thin Moffat shale mentioned above at p. 122. May be regarded as body-segments belonging to *D. gigas*. Coll. Lapworth. Brit. Mus. No. 59620.

Caudal Appendages.

1. Ceratiocaris? Plate XVII, fig. 8.

Of this thin, tapering, fluted style (urotome) or stylet (cercopod), there remains a portion about 29 mm. long. It apparently consists of a dark-brown chitinous substance, nearly of the size and proportions of the urotome in fig. 4, Pl. II, Part 1, 1888, of *Ceratiocaris Halliana.* Without more definite evidence, however, it is not possible to refer it to any special genus.

It is embedded in a hard dark-grey shale of the Riccarton Beds (Upper Silurian), Shankend, Hawick. Coll. Lapworth. British Museum. No. 59620.

A larger specimen (style and stylet), also from the Moffat series, is figured and described in Part 1, p. 45, Pl. XI, fig. 13, as associated with *Aptychopsis,* but probably belonging to *Ceratiocaris.*

2. Ceratiocaris? Plate XVII, fig. 12.

This small, sharp, blade-like body, in the squeezed graptolitic shale of Skelgill, Westmoreland, is longitudinally striated or minutely fluted. It has the shape of a cercopod of one of the small species of *Ceratiocaris* shown in Pl. XI of Part 1 (1888); but those stylets are all *smooth.* It may be the terminal fragment of a rather broad and fluted style, like that of fig. 7 in Pl. XI; but there is nothing to prove a relationship to the *C. papilio* there figured. Coll. Marr. Woodwardian Museum, Cambridge.

3. Caryocaris? Plate XVII, figs. 9—11.

The schistose mudstone of the Nantlle Tramway, near the Seiont, Carnarvonshire, from which these little fossils have come, contain many specimens of *Caryocaris;* but no other Phyllopods have been found in it. Therefore at first sight these little species would seem to be referable to the genus (see above, p. 89), were it not that a *Caryocaris Wrightii,* retaining its caudal appendage, has been found by Prof. Malaise at Huy in Belgium (woodcut, fig. 6, p. 91). In this case the style and stylets are, all three, dagger-shaped, and not long, thin, tapering spines like Pl. XVII, figs. 8—10. If these last do not belong to some form of the associated *Caryocaris,* we must wait for further evidence of their relationship. They are apparently near akin to Pl. XVII, fig. 7, described above.

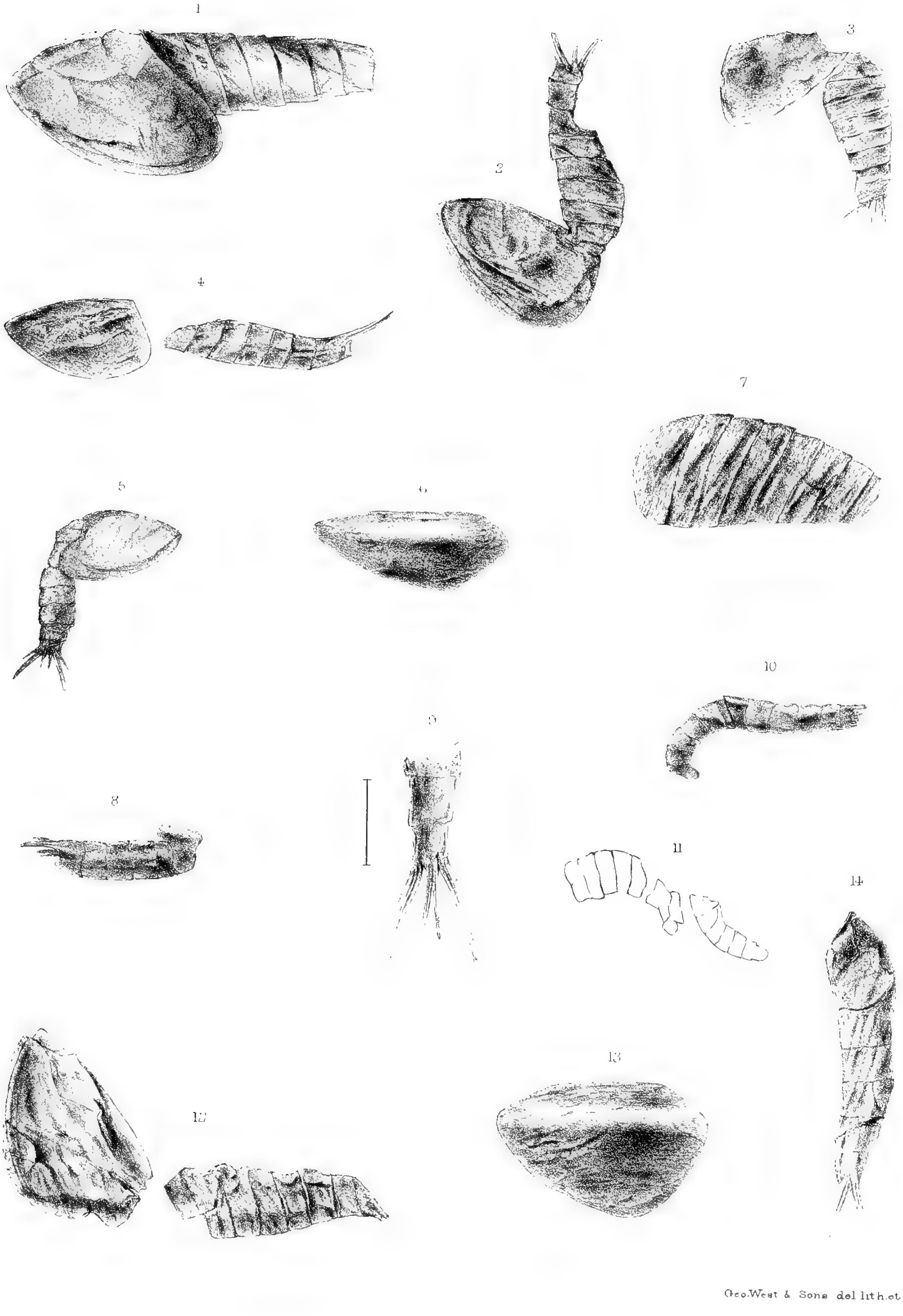
Figs. 8, 9, and 10 were collected by Mr. J. E. Marr, F.R.S., and are in the Woodwardian Museum.

PLATE XIII.

(See pages 74—79.)

Fig.				
1.	*Hymenocaris*	*vermicauda*,	Salter.	Carapace and abdomen. Borth, Portmadoc. Cambridge Museum.
2.	—	—	—	Carapace and abdomen. Borth, Portmadoc. British Museum.
3.	—	—	—	Part of carapace and abdomen. Borth, Portmadoc. British Museum.
4.	—	—	—	Carapace and abdomen separate. Borth, Portmadoc. Cambridge Museum.
5.	—	—	—	Carapace and abdomen. Borth, Portmadoc. Cambridge Museum.
6.	—	—	—	Carapace. Borth, Portmadoc. Cambridge Museum.
7.	—	—	—	Abdomen. Cae'n-y-coed, near Maentwrog. Cambridge Museum.
8.	—	—	—	Abdomen. Portmadoc. Mus. Pract. Geol.
9.	—	—	—	Telson and cercopods. Magnified $2\frac{1}{2}$ diam. Moel-y-gest, Tremadoc. Mus. Pract. Geol.
10.	—	—	—	Abdomen. Gareg-felen. Owens College.
11.	—	—	—	Abdomen. Gareg-felen. Owens College.
12.	—	—	—	Carapace and abdomen. Borth, Portmadoc. Cambridge Museum.
13.	—	—	—	Carapace. Portmadoc. Mus. Pract. Geol.
14.	—	—	—	Abdomen. Borth, Portmadoc. British Museum.

PLATE XIII.



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BRITISH FOSSIL PHYLLOPODA

PLATE XIV.

FIG.

1. *Lingulocaris siliquiformis*, Jones. Left valve. Garth Hill, Portmadoc. British Museum (Page 81.)
2. — — — Left valve. Bwlch-y-gaseg, near Cynwyd. British Museum. (Page 82.)
3. — *Salteriana*, Jones and Woodward. Left valve. Portmadoc. British Museum. (Page 82.)
4. — *lingulæcomes* (*?*), Salter. Dorsal aspect. Near Builth. Museum of Practical Geology. (Page 81.)
5. — sp. Angers, France. M. Lebesconte's Collection. *a*, right valve; *b*, vertical section. (Page 83.)
6. *Saccocaris major*, Salter. Left valve. Cae'n-y-coed, near Maentwrog. Cambridge Museum. (Page 84.)
7. — *minor*, Jones and Woodward. Left valve and body-rings. (Page 86.)
8. — — — Left valve.
9. — — — Three left valves, one with some body-rings. Arenig. Cambridge Museum. (Page 85.)
10. — — (?) — Part of left valve. Wern, Portmadoc. Cambridge Museum. (Page 88.)
11. *Caryocaris Wrightii*, Salter. Skiddaw. Museum of Practical Geology. (Page 89.)
12. — — — Skiddaw. Museum of Practical Geology. (Page 90.)
13. — — — Skiddaw. British Museum. (Page 90.)
14. — — — — — (Page 90.)
15. — — — — Cambridge Museum. (Page 90.)
16. — *Marrii*, Hicks. — Mus. Pract. Geol. (Page 92.)
17. — — — — British Museum. (Page 92.)
18. — — — — Cambridge Museum. (Page 92.)

PLATE XIV

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BRITISH FOSSIL PHYLLOPODA

PLATE XV.

(All figured of the natural size except fig. 22.)

Fig.			
1.	*Aptychopsis*	*Barrandeana*, sp. nov.	Left valve. Mus. Geol. Surv. Scotland. (P. 101.)
2.	—	*cordiformis*, sp. nov.	Two valves. Woodwardian Mus. (P. 103.)
3.	—	*Lapworthi*, H. W.	Two valves, crushed. Woodwardian Museum. (P. 106)
4.	—	*ovata*, sp. nov.	Carapace, squeezed obliquely. Mus. Geol. Surv. Scotland. (P. 108.)
5.	—	— —	Two valves, Mus. Geol. Surv. Scotl. (P. 109.)
6.	—	*lata*, sp. nov.	Left valve. Mus. Geol. Surv. Scotland. (P. 104.)
7.	—	*Lapworthi*, H. W.	Left valve. British Museum. (P. 107.)
8.	—	— —	Two valves. British Museum. (P. 108.)
9.	—	— —	Carapace. British Museum. (P. 108.)
10.	—	— —	Two valves. Mus. Geol. Surv. Scotl. (P. 107.)
11.	—	*glabra*, H. W.	Two valves, squeezed obliquely. British Museum. (P. 105.)
12.	—	*Wilsoni* (?), H. W.	Two valves, imperfect. Mus. Geol. Surv. Scotland. (P. 106.)
13.	—	*angulata* (?) (Baily).	Right valve. Mus. Geol. Surv. Scotland. (P. 110.)
14.	—	*Barrandeana*, sp. nov., var. *brevior*, nov.	Left valve, rounded at ends. [This should have been set straight up.] British Museum. (P. 102.)
15.	—	*Wilsoni*, H. W.	Two valves. Mus. Geol. Surv. Scotl. (P. 106.)
16.	—	— —	Two valves, squeezed obliquely. British Museum. (P. 106.)
17.	—	*angulata* (?) (Baily).	Two valves, squeezed obliquely. Woodwardian Museum. (P. 111.)
18.	—	*oblata*, sp. nov.	Two valves (small). Mus. Geol. Surv. Scotland. (P. 111.)
19.	—	*angulata* (Baily).	Two valves, slightly oblique. Mus. Geol. Surv. Ireland. (P. 110.)
20.	—	*subquadrata*, sp. nov.	Two valves, slightly squeezed. Mus. Geol. Surv. Ireland. (P. 109.)
21.	—	*oblata*, sp. nov.	Two valves. Mus. Geol. Surv. Scotl. (P. 111.)
22.	—	*Lapworthi*, H. W.	Magnified $2\frac{1}{2}$ diameters. Carapace (very small), valves slightly displaced. British Museum. (P. 108.)
23.	—	*oblata*, sp. nov.	Two valves (small). British Museum. (P. 112.)
24.	*Pinnocaris*	*Lapworthi*, R. Etheridge, jun.	Left-hand moiety of a carapace. Kendal. British Mus. (P. 118.)

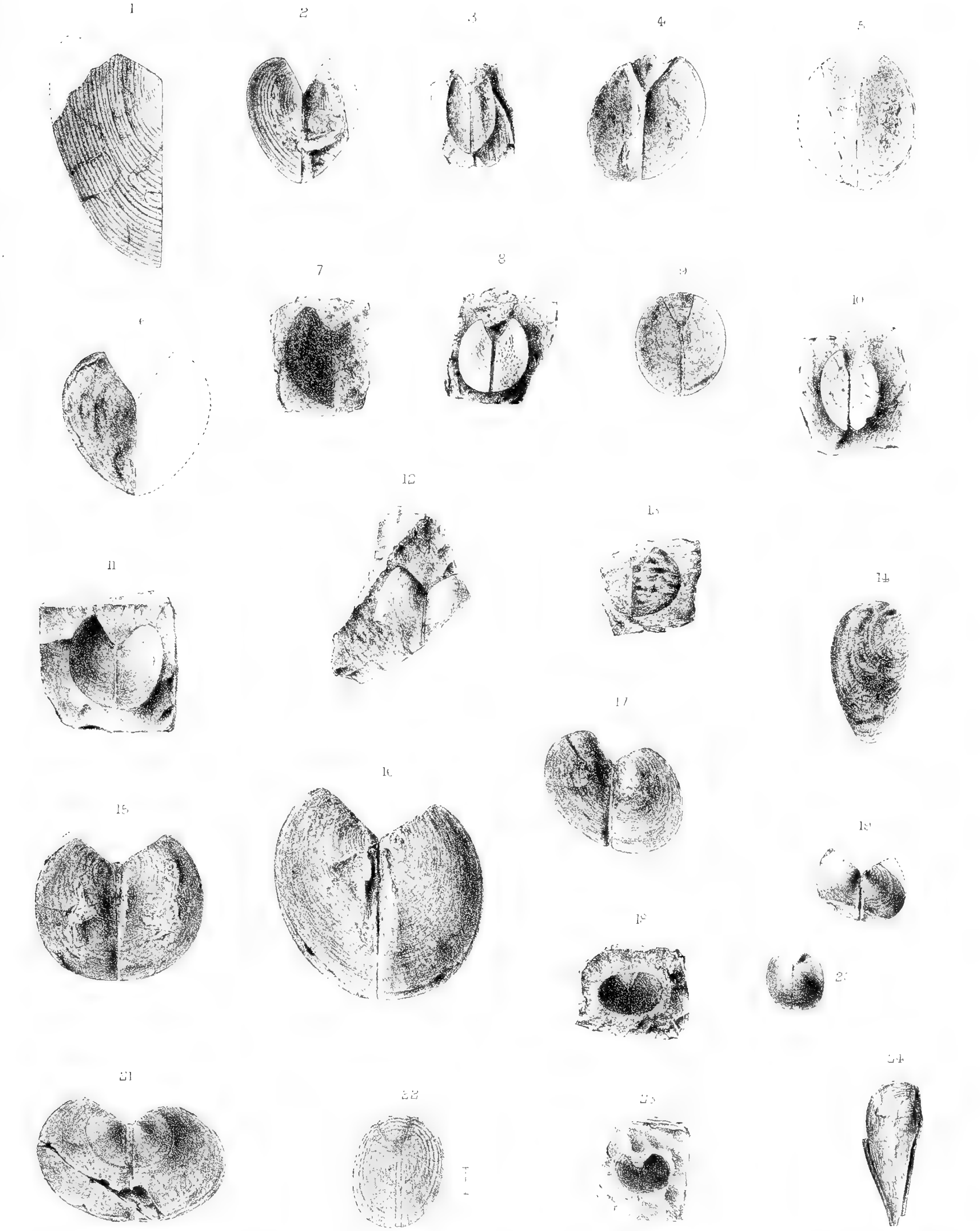

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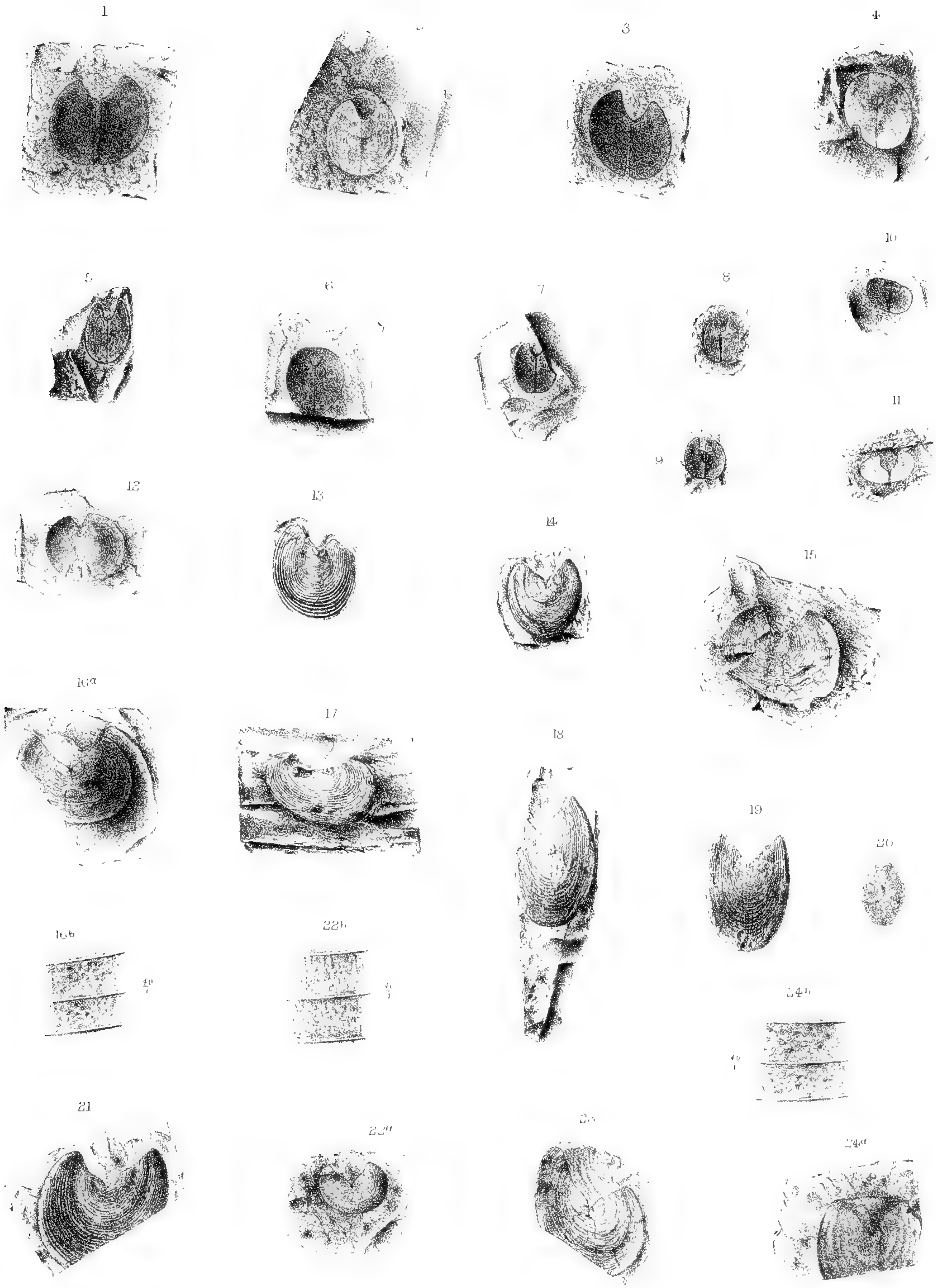
PLATE XVI.

(All the figures are of natural size except figs. 16 *b*, 22 *b*, and 24 *b*, which are × 40.)

FIG.

1. *Peltocaris aptychoides*, Salter. British Museum. (Page 113.)
2. — — — British Museum. (Page 114.)
3. — — — Distorted. Mus. Pract. Geol. (Page 114.)
4. — *anatina*, Salter. Mus. Pract. Geol. (Page 114.)
5. — — — Narrowed by pressure. Cambridge Museum. (Page 115.)
6. — — — Perfect. British Museum. (Page 115.)
7. — — — Mus. Geol. Surv. Scotland. (Page 115.)
8. — — — Coll. D. J. Brown. (Page 115.)
9. — (*aptychoides*, Salter.) Young. Coll. D. J. Brown. (Page 114.)
10. — *patula*, sp. nov. British Museum. (Page 116.)
11. — — — Widened by pressure. Coll. J. E. Marr. Cambridge Museum. (Page 116.)
12. *Discinocaris Browniana*, H. Woodward. Damaged. British Museum. (Page 119.)
13. — — — Squeezed. Mus. Geol. Surv. Scotland. (Page 120.)
14. — — — Squeezed. Mus. Geol. Surv. Scotland. (Page 120.)
15. — — — Widened by pressure. Coll. J. Dairon. (Page 120.)
16. — — — *a*, convex cast, widened by pressure; *b*, interstitial ornament, enlarged 40 diam. Mus. Geol. Surv. Scotland. (Page 121.)
17. — — — Much widened by pressure. Cambridge Museum. (Page 121.)
18. — — — Narrowed by pressure. Cambridge Museum. (Page 121.)
19. — — — Narrowed and flattened by pressure. Cambridge Museum. (Page 121.)
20. — *ovalis*, sp. nov. Coll. D. J. Brown. (Page 121.)
21. — *Browniana*, H. Woodward. Slightly distorted; obscured at the notch. Coll. Lapworth. (Page 121.)
22. — — — *a*, convex cast, widened; *b*, interstitial ornament, enlarged 40 diam. Coll. D. J. Brown. (Page 121.)
23. — — — Distorted. Coll. D. J. Brown. (Page 121.)
24. — *undulata*, sp. nov. *a*, convex cast; *b*, interstitial ornament, enlarged 40 diam. Coll. D. J. Brown. (Page 122.)

PLATE XVI



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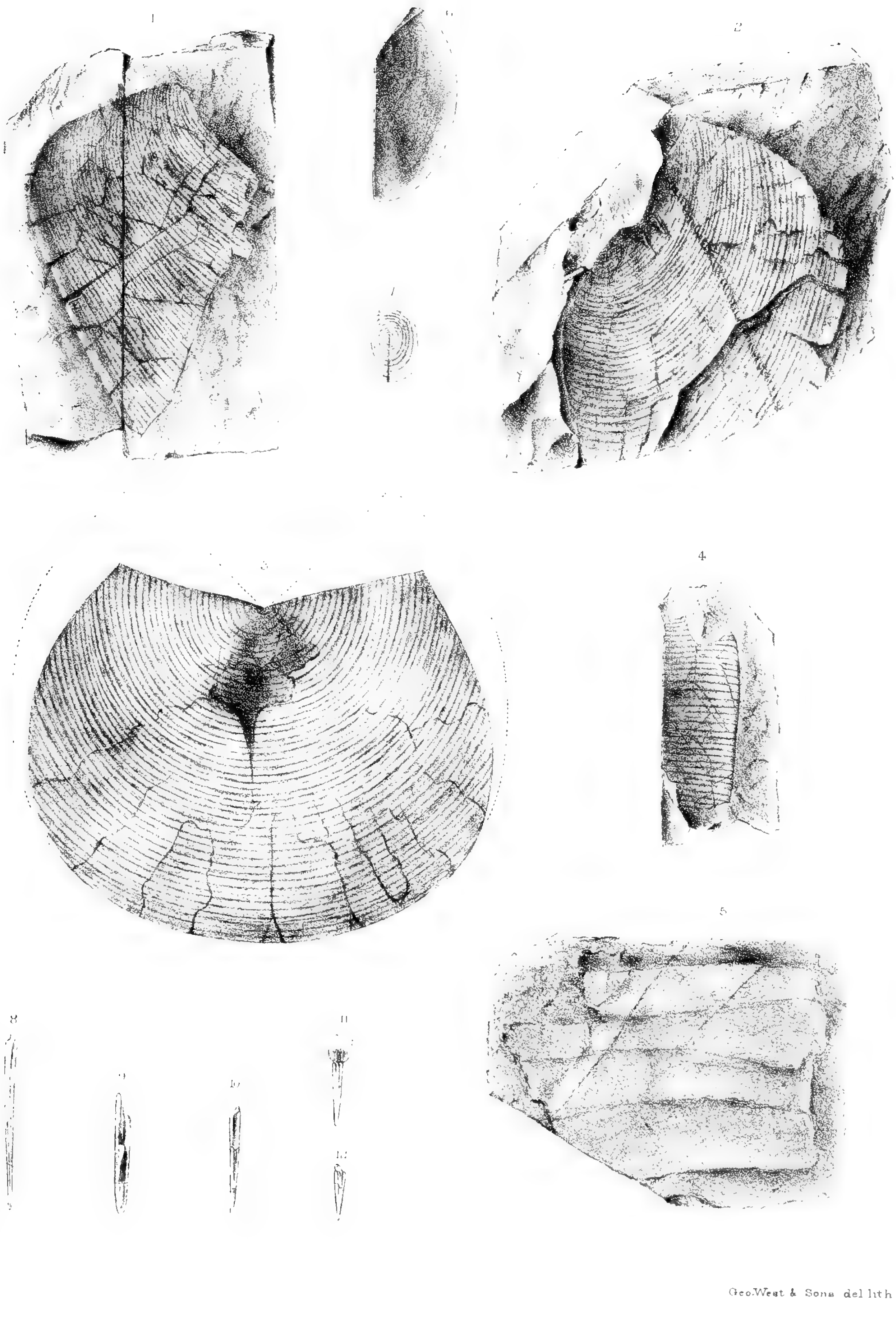
BRITISH FOSSIL PHYLLOPODA

PLATE XVII.

Fig.

1. *Discinocaris gigas*, H. Woodward. Left-hand lower corner of a test. British Museum. (Page 122.)
2. — — — Crushed portion of a test. Cambridge Museum. (Page 123.)
3. — — — Sketch of a large specimen by the late Mr. James Dairon. (The dotted outline has been added to show the more probable form of the shield. The lateral margins in Mr. Dairon's figure are evidently artificial, and not the true margins; nor does it show the real antero-lateral angles. Figs. 1 and 2 indicate the true shape of the postero-lateral angles, and the way in which the lines of growth die out at the margins.) (Page 123.)
4. — (?). Fragment. British Museum. (Page 123.)
5. — (?). Some imperfect body-rings, flattened. British Museum. (Page 123.)
6. *Aptychopsis Salteri*, H. Woodward. Right-hand valve. British Museum. (Page 109.)
7. *Peltocaris Carruthersii*, sp. nov. Carapace. Copied from the 'Quart. Journ. Geol. Soc.,' vol. xxii, pl. 25, fig. 6. (Page 116.)
8. Tail-piece. British Museum. (Page 124.)

9, 10, 11, 12. Tail-pieces. Cambridge Museum. (Page 124.)



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BRITISH FOSSIL PHYLLOPODA

THE

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A MONOGRAPH

OF THE

BRITISH JURASSIC GASTEROPODA.

BY

WILFRID H. HUDLESTON, M.A., F.R.S., F.L.S.,
PRESIDENT OF THE GEOLOGICAL SOCIETY OF LONDON.

PART I, No. 6.

GASTEROPODA OF THE INFERIOR OOLITE.

Pages 273—324; Plates XXI—XXVI.

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206. Rissoina obtusa, *Lycett*, 1853. Plate XXI, figs. 10 *a*, 10 *b*.

1853. Rissoina obtusa, *Lycett*. Proc. Cottesw. Nat. Club, vol. i, p. 80.

Bibliography, &c.—Lycett makes no mention of this species in the 'Cotteswold Hills,' nor does Witchell enumerate any species of *Rissoina* in his 'Geology of Stroud.' It is not absolutely certain that the species under consideration is the one intended by Lycett, although his description tallies fairly. It must be allowed, however, that the name "*obtusa*" is unfortunate, as this is rather a slender shell. As a matter of fact an obtuse apex is characteristic of the genus. although the earlier authors speak of *Rissoina* as pointed.

Description :

Length	3·5 mm.
Spiral angle about	25°.

"Spire obtuse; whorls slightly convex, six; outer lip moderately large; costæ numerous, closely arranged, slightly curved from left to right."—Lycett, *loc. cit.*

Relations and Distribution.—Found sparingly in the Pea-grit at Crickley and Leckhampton. *Rissoina Milleri*, Lycett (Suppl., p. 18, pl. xliv, fig. 10), has some resemblance.

207. Rissoina gymnoides, sp. nov. Plate XXI, fig. 11.

Description :

Length	4 mm.
Height of body-whorl to entire length . .	50 : 100.
Spiral angle (obtuse) about . . .	22°.

Shell subelongate, pupoid, scarcely turrited. Whorls about six, smooth, convex, close; body-whorl about half the height of the entire shell. Aperture square in front and slightly canaliculate, lips only moderately thickened.

Relations and Distribution.—At first sight this might seem to be some form of *Pseudomelania*, since the thickening of the peristome is less obvious than usual in *Rissoina*. But the pupoid character of the spire militates against this supposition. It bears considerable resemblance to *Rissoina gymna*, Cossmann (Ét. Bath., p. 234, pl. xiv, figs. 23, 24), from which it differs in the greater relative length of the spire and in having a wider spiral angle. Four specimens are in my collection from the Lincolnshire Limestone of Weldon.

Note.—Hitherto it has been possible for the most part to assign a family position to the genera of Gasteropoda occurring in the Inferior Oolite; but we now are called upon to consider several groups of shells, more or less turbinate in character, whose family position cannot with certainty be defined. The majority of these were referred to *Turbo* by d'Orbigny.

The following genera are included in the above category, viz. *Amberleya*, "*Littorina*," *Cirrus* (including *Hamusina*), and *Straparollus* (including *Discohelix*).

Preliminary Note on *Amberleya* and "*Littorina*."

There is a twofold difficulty attendant on dealing with the numerous species of fossil shells which I propose to place under one or other of the above genera. To the uncertainty of family affinities there is also to be added the difficulty of synonymy. The former is, of course, the more serious difficulty of the two; for if we are wrong in supposing that *Amberleya*, *Eucyclus*, &c., belong to the Littorinidæ, in that case we are not justified in assigning the generic term "*Littorina*" to the group of smaller species which are associated with them. The older writers, and particularly d'Orbigny, regarded nearly the whole of these forms as belonging to the Turbinidæ, and the modern tendency seems to be to revert to that conclusion. We may use *Amberleya* or *Eucyclus* without pledging ourselves to the family affinities of the genus, but if we use *Littorina* or *Turbo* the case is different. In the following pages "*Littorina*" is used only in a conventional sense.

In 1851, Morris and Lycett ('Grt. Ool. Moll.,' p. 54) thus diagnosed *Amberleya*:—"Shell turrited, turbinate, apex acute; whorls flattened above, convex and nodulated beneath, the last whorl ventricose; aperture ovate, entire; inner lip thickened and nearly covering a small umbilicus; sutures deeply impressed; no columella."

The genus *Eucyclus* was constituted by J. A. Deslongchamps ('Bull. Soc. Lin. Norm.,' vol. v, p. 23 of separate copy) in 1860, being based on *Turbo ornatus*, Sowerby, and similar shells. The author alludes to *Aberleya* (*sic*). He considered that genus to have been established on bad specimens, and to have been imperfectly characterised. His own diagnosis of *Eucyclus* is comprehensive enough. It contains most of the points in the diagnosis which I offer below.

There can be no doubt that Deslongchamps' diagnosis was far more accurate and full than that of Morris and Lycett, which was little better than a description of one species. At the same time Deslongchamps, when he alluded to *Amberleya*, seems unconsciously to admit that his new genus might possibly be covered by that of the authors of the 'Great Oolite Mollusca.'

The late Professor Eugène Deslongchamps (' Notes Paléontologiques,' vol. ii, May, 1889, p. 70) could not be persuaded that *Amberleya* and *Eucyclus* were synonymous, and thus he maintained that *Amberleya nodosa*, M. and L., could not be a *Eucyclus*. The presence in that species of a slight umbilical excavation was one of his principal reasons for considering that *Amberleya* and *Eucyclus* are distinct genera. As so often happens, *Amberleya nodosa*, the type, is far from being a typical species, and it would have been far more satisfactory if *Turbo ornatus*, Sow., could be taken for the type, as was done by Deslongchamps in constituting his genus *Eucyclus*.

With regard to the relationship of *Amberleya*, some authors, like Fischer, admit that the various forms grouped under this genus have the appearance of *Tectarius*, *Echinella*, and *Littorina;* but Fischer considers that the alleged existence of a nacreous layer in the Jurassic Amberleyas proves their affinity with the Turbinidæ and the Trochidæ. Of course, if this is the case, the group of small shells which appear to be connected by so many links with *Amberleya* are wrongly named *Littorina ;* and that is why, as already stated, this term is only used in a conventional sense. It would save trouble if they were replaced under *Turbo;* and yet they certainly are not Turbos in the modern restricted sense, although they may belong to the Turbinidæ.

Many of the forms described in the sequel seem to run into each other. Moreover some of the species differ so much at different stages of their growth, especially in the character of the aperture, that one and the same species might well be placed under two distinct genera. (See description of *Amberleya ornata.*)

As regards arrangement, exception might be taken to the wide extension of the term *Amberleya* adopted in the subjoined classification of Inferior Oolite species. Unless we fall back upon *Turbo* and *Trochus*, I do not see how this is to be avoided. The distinction also between *Amberleya* and "*Littorina*" is admittedly not a very philosophic one.

If we attempt to deal with the *Amberleya-Littorina* group in sections, the first and most important section is that (1) of *Eucyclus*, where the shell is much turrited, the suture wide, the body-whorl ventricose, and one or more of the spiral belts exceedingly prominent. The *Trochus*-section (2) contains shells more or less trochiform, but with an ornamentation closely resembling that of *Eucyclus*. Through the more turbinate and finely ornamented forms of the *Eucyclus*-section, such as *Amberleya densinodosa*, a connection is established with (3) the *Turbo*-section, which presents some extreme forms. The shells of all three sections are rather thin, and exhibit a considerable resemblance in the general style of ornamentation, and frequently also in the changing character of the aperture.

In the fourth section (4) the shells are thicker, but do not attain to any size; these have been referred to "*Littorina.*" In the majority of cases they do not seem to have the *Purpurina*-like mouths exhibited in the early stage of many Amberleyas.

The following is the classification of the Inferior Oolite species described in the sequel, arranged on the principles already indicated.

Amberleya.

Eucyclus-section:

Amberleya capitanea, Münst.	
— *ornata*, Sow., typical	
— — var. *spinulosa*, Münst.	
— — var. *abbas*	
— — var. *horrida*	*Ornata*-group
— *gemmata*, Lyc.	
— *densinodosa*, sp. n.	
— *Meriani*, Goldf.	
— *cygnea*, sp. n.	
— *goniata*, Desl.	
— *Orbignyana*, sp. n.	
— *Murchisoni*, Münst.	*Goniata*-group
— *Obornensis*, sp. n.	
— *pagodiformis*, sp. n.	
— *generalis*, Münst.	

Trochus-section:

Amberleya species, cf. *Trochus anaglypticus*, Münst.
— *biserta*, Phil., A.
— — — B.

Turbo-section:

Amberleya Milleri, Wright, MS.
— *turbinoides*, sp. n.
— *Stoddarti*, Tawney.
— *elongata*, sp. n.
— *Dundriensis*, Tawney.

Littorina (? *Echinella* in part).

Littorina prætor, Goldf.
— *polytimeta*, sp. n.

Littorina Phillipsii, Mor. and Lyc.		
— *sulcata*, Héb. and Desl.		
— *Weldonis*, sp. n.		
— *œdilis*, Münst.		
— *Dorsetensis*, sp. n., A.		*Œdilis*-group
— — — B.		
— — — C.		
— (*? Trochus*) *pisolitica*, sp. n.		
— (*? Trochus*) *recteplanata*, Tawney.		
— (*? Trochus*) *triarmata*, Héb. and Desl.		

AMBERLEYA, *Morris and Lycett*, 1851.

Shell turbinate, more rarely trochoid, rather thin, imperforate or nearly so; sub-elongate, frequently turrited, sutural space wide; ornamented with spiral bands, usually spinulose or nodular, some of which are prominent (Eucyclus). *The interspaces are finely striated, the striæ being slightly oblique to the axis; sometimes these fine lines are strong enough to represent fine axial ribs. Base rounded, spirally ribbed, and marked by fine radial striæ.*

Aperture suboval, but varying according to age. In the early stage the columellar lip is nearly straight, and produced anteriorly so as to be almost reflexed at the extremity (*like* Purpurina). *In the adult the aperture is more or less rounded, so as to become suboval or subcircular; there is usually a considerable deposit of callus: outer lip thin and often crenulate.*

208. AMBERLEYA CAPITANEA, *Münster*, 1844. Plate XXI, fig. 12.

1844.	TURBO CAPITANEUS, *Münst.*	Goldf., Petref., pl. cxciv, fig. 1.
1852.	— — —	D'Orb., Terr. Jur., vol. ii, p. 341, pl. cccxxix, figs. 7, 8.
1863.	AMBERLEYA CAPITANEA (?), *Goldf.*	Lycett, Suppl., p. 95, pl. xli, fig. 1.
1884.	— — —	Beeby Thompson, Upper Lias of Northants, p. 309, pl., fig. 3.
	Non TURBO CAPITANEUS, *Münst.*	Morris and Lycett, Great Oolite Moll., pt. 1, p. 65, pl. ix, fig. 33.

Bibliography, &c.—The type is stated to be from the Inferior Oolite near Grötz. D'Orbigny says that the species occurs everywhere along with *Turbo subduplicatus* in the Toarcian. No locality in Calvados is quoted by him. The form from the Great Oolite, doubtingly referred by Morris and Lycett to Münster's species, was subsequently named by Lycett (Suppl., p. 19) *Amberleya Jurassi*, Lyc. This name is regarded by Cossmann ('Ét. Bathonien,' p. 243) as a synonym of *Amberleya* (*Turbo*) *Castor*, d'Orbigny. In the Addenda to the Supplement Lycett refers a small form from the Forest Marble of Laycock and Pound Pill to *Amberleya capitanea*. We may perhaps regard this as a case of atavism.

Description :

Length of full-grown shell . . .	30—35 mm.
Length of body-whorl to total height . .	50 : 100.
Spiral angle	55°.

Shell eucycloid, turrited. Whorls about seven, angular, narrow, and sloping outwards from the suture; sutural space wide.

In the whorls of the spire the ornaments consist of two centrally situated tubercular spirals forming a double belt; the cross-hatchings are fine and numerous, and fill up the interspiral spaces. The body-whorl is large, and the sides are similarly ornamented; in the base are four or five less prominent spirals, with tuberculations gradually diminishing in size anteriorly; cross-hatchings numerous.

Aperture ovate, with a tendency in the columellar lip to be produced anteriorly; outer lip thin and crenulate.

Relations and Distribution.—The differences between *Amberleya capitanea* and the numerous varieties or sub-species more intimately allied with *Amberleya ornata* are slight, but they are fairly constant, and occur for the most part on a certain horizon. The spinulose varieties of *Amb. ornata* are very near indeed, but they may be always distinguished by the presence of a third circlet of small tubercles on the upper margin of all the whorls, this circlet being less prominent than the other two, and also by the more elongate form of the tubercles, which in *Amb. capitanea* are very round.

Amberleya capitanea is interesting as the earliest member of the *ornata*-group in the British Jurassics. A fairly good specimen is figured by Mr. Beeby Thompson from the Lower *Cephalopoda*-bed at Preston Capes. This is presumably from the *Serpentinus*-beds, and is the earliest occurrence of which I have any knowledge, though there are other instances in the Upper Lias of the Midlands. In Dorsetshire, according to Moore ('Mid. and Up. Lias, S.W. England,' p. 78, pl. vi, figs. 1—4), *Amb. capitanea* occurs characteristically along with *Amm. bifrons* and *Amm. communis* in the Upper Lias at Compton.

The evidence in England is thus distinctly in favour of this being regarded as a Toarcian species, as had been already indicated by d'Orbigny for France. Moore (*loc. cit.*) goes on to say that on the uppermost horizon of the Upper Lias in the Cotteswolds *Amb. capitanea* occurs along with *Amm. variabilis*, &c. This is the horizon and locality whence comes the specimen figured in the present work.

It does not occur in the Inferior Oolite proper, and may on the whole be viewed as a Liassic form.

209. AMBERLEYA ORNATA, *Sowerby*, 1819. Plate XXI, figs. 13, 14, typical; fig. 15, var. *spinulosa*, Münst.; figs. 16, 17, 18, and Plate XXII, fig. 1, var. *abbas;* fig. 2, var. *horrida.*

1819. TURBO ORNATUS, *Sow.* Min. Conch., pl. ccxl, figs. 1, 2.
1844. — SPINULOSUS, *Münst.* Goldf., Petref., pl. cxciv, fig. 3.
1852. PURPURINA BATHIS, *d'Orb.* Terr. Jur., vol. ii, pl. cccxxx, figs. 6—8.
1854. LITTORINA ORNATA, *Sow.*, sp. Morris, Cat., p. 255.
1873. AMBERLEYA ORNATA, *Sow.*, sp. Tawney, Dundry Gasteropoda, p. 27 (19), pl. i, fig. 9.
Non TURBO ORNATUS, *Sow.*, sp. Goldfuss, *nec* d'Orbigny.

Bibliography, &c.—It would not be difficult, perhaps, to fill a page with references to "*Turbo*" *ornatus* under the heading *Turbo*, *Purpurina*, *Eucyclus*, or *Amberleya*. Owing to the very poor figures given in the 'Mineral Conchology' most foreign authors have been mistaken in their attempts to identify Sowerby's species. The *Turbo ornatus*, Sow., of Goldfuss is rather like an Oxfordian member of the *ornata* group described and figured by me in 1884 ('Geol. Mag.,' dec. 3, vol. i, p. 247, pl. viii, fig. 8) as *Amberleya clavata*, Bean, MS. On the other hand, the *Purpurina ornata* of d'Orbigny's identification ('Terr. Jur.,' vol. ii, pl. cccxxx, figs. 4, 5) is a well-known species characteristic of the Upper Division of the Inferior Oolite (vide *Amberleya Orbignyana*, page 285).

Mr. Tawney regarded *Turbo capitaneus* doubtfully as a synonym.

Description:

Length from about . . .	25—50 mm.
Height of body-whorl to total length .	say 50 : 100.
Spiral angle	50°.

Shell eucycloid, turrited. Whorls from seven to nine, angular and narrow, the slope of the posterior area broken by a slight spiral band near the suture; suture almost gaping.

The ornaments consist of three tuberculated spirals, of which the upper one recedes and is sometimes rather faintly developed. The tuberculations are drawn out spirally, and vary much in force. The interspiral cross-hatchings are fine and numerous. The body-whorl is large and angular, with two prominent tuberculated spirals and one posterior spiral, which is often only faintly crenulate. In the base are five spirals scarcely tuberculated, with fine and numerous inter-spiral striæ.

The aperture in the early stage is very like *Purpurina*, the anterior canaliculation being well marked. This feature is also seen in the middle stage, but disappears more or less completely in the big shells, where the mouth is subcircular, the shape of the aperture being materially modified, with considerable thickening of the inner lip (see especially Pl. XXI, figs. 16, 17, and 18).

Varieties. — The specimens from the type locality are of medium size. Pl. XXI, fig. 13, is probably one of Sowerby's types with the tuberculations worn off the spiral ridges, and the cross-hatchings almost obliterated by usage. Fig. 14 from the same locality is in very fair preservation, and probably shows the true character of the type form. The cross-hatchings are wide and coarse, the posterior spiral is very close to the suture, and there is some tendency to tuberculation on the spirals in the base of the body-whorl.

The variety *spinulosa*, Münst., Pl. XXI, fig. 15, which I consider synonymous with *Purpurina Bathis*, d'Orbigny, is a large, handsome, and richly ornamented form, which occurs rarely in the *Concavus*-bed at Bradford Abbas.

The variety to which I have given the name *abbas*, Pl. XXI, figs. 16, 17, 18, and Pl. XXII, fig. 1, is extremely common on the same horizon and at the same place. From well-preserved specimens of this most abundant form we gather that, although the spire is pointed on the whole, yet the apex is obtuse; the earlier whorls are extremely angular, and the third spiral is seen to be developed at a very early stage, already receding and less prominent than the others. In the more mature whorls of this variety the crenulations or tuberculations on the spirals become very faint, and in the very large shells disappear altogether. On the whole the var. *abbas* is rather more slim in shape and more delicate in ornamentation, though attaining to a much greater size than the type variety.

Relations and Distribution.—We may well regard this as nothing more than a modified descendant, on a higher horizon, of *Amb. capitanea.* Besides the differences already indicated, it may be worth while to point out that the spirals in the case of *Amberleya ornata* are but slightly tuberculated as compared with those of *Amb. capitanea.*

In Dorsetshire *Amb. ornata* is essentially a fossil of the *Concavus*-zone, and is probably the most abundant fossil on that horizon at Bradford Abbas. At Dundry one cannot say on what horizon it occurs, but probably below the *Humphriesianus*-zone. It is rare in the Cotteswolds, where specimens are usually small and poorly preserved. Small forms of *Amb. ornata*, showing a slight tendency to produce an intermediate keel in the body-whorl, occur towards the base of the Inferior Oolite at Lincoln. There are also small specimens in the Dogger at Blue Wyke, which may either be immature forms of *Amb. ornata* or varieties of *Littorina* (*Turbo*) *Phillipsii.*

Amberleya ornata, var. *horrida*. Plate XXII, fig. 2.

Description:

Length	30 mm.
Length of body-whorl to total height . .	52 : 100.
Spiral angle	56°.

Shell eucycloid, turrited. Whorls about six, angular, and increasing suddenly; suture wide. The ornaments are very coarse, consisting of three nearly equal spiral belts, rugosely crenulated, the upper one at some distance from the suture; cross-hatchings coarse and wide apart. Body-whorl ventricose in most cases, rather exceeding half the height of the shell; base with five spirals, moderately crenulate. Aperture as in other varieties of *Amberleya ornata*.

Relations and Distribution.—This form differs from other varieties of *Amb. ornata*, already described in the position and development of the posterior spiral belt, in having fewer whorls, and in the rugoseness of the ornamentation.

It occurs in the *Murchisonæ*-zone of Bradford Abbas, and is thus intermediate in time between *Amb. capitanea* and *Amb. ornata*, var. *abbas*.

210. Amberleya gemmata, *Lycett*, 1853. Plate XXIII, fig. 19.

1853. Turbo gemmatus, *Lyc.* Quart. Journ. Geol. Soc., vol. ix, p. 342, pl. xiv, fig. 7.

Bibliography, &c.—Lycett, in describing this species from the Lincolnshire Limestone of Ponton, points out in what respect it differs from "*Turbo*" *capitaneus*. I also agree with him that it is more slender than "*Turbo*" *ornatus*, Sow.; but the arrangement of the carinæ is practically the same.

Description:

Length	10 mm.
Length of body-whorl to total height . .	40 : 100.
Spiral angle	44°.

"Shell ovately turbinated, spire elevated, whorls (5) turrited, convex, biangulated, and ornamented with three tuberculated carinæ, of which the first carina is the smallest; the last whorl is large and ventricose; its base is convex and encircled with numerous small serrated carinæ; the aperture is ovate."

Relations and Distribution.—This is a micromorph of *Amberleya ornata*, which might almost be described as a variety. Besides being very much smaller, this form is less turbinate and more conical than *Amb. ornata;* the posterior spiral is rather more strongly developed, and the tuberculation generally somewhat larger proportionately. It is common in the upper beds of the Lincolnshire Limestone at Weldon, Ponton, &c. A somewhat similar form occurs in the Inferior Oolite of Hook Norton.

211. Amberleya densinodosa, sp. n. Plate XXII, figs. 3, 4, 5.

Cf. Littorina spinulosa, *Münst.*, sp. Héb. and Desl., Foss. Montreuil-Bellay, p. 56, pl. iii, fig. 4.

N.B.—There has been a tendency to regard the form now under consideration as the representative of *Turbo spinulosus*, Münster. It has some resemblance to the fossils figured by Hébert and Deslongchamps, but as the differences appear to be considerable it may be safer to describe it as a distinct species.

Description :

Length (three specimens) . .	23, 35, and 43 mm.
Length of body-whorl to total height .	48 to 52 : 100.
Spiral angle . . .	58°.

Shell turbinate, eucycloid, turrited. Number of whorls, eight or nine, convex and subangular; sutural space very wide. The ornaments consist of four finely tuberculated spirals; the uppermost of those near the suture consist of a circlet of closely-set rounded tubercles; the second spiral is a tuberculated belt, the tubercles being small and rounded; the third and fourth spirals constitute the principal carinæ, the third usually having the strongest tuberculations; the interspiral spaces are marked by closely-set interspiral striæ. The ornamentation of the matured whorls is generally finer than that of the earlier stages.

The body-whorl is almost ventricose and similarly ornamented, the number of finely-granulated spirals in the base being seven or eight. In the adult shell the aperture is subcircular, with a short, straight, columellar lip, forming a slight angle anteriorly. In the younger shells (fig. 5) the *Purpurina*-like character of the aperture is more obvious.

Relations and Distribution.—Distinguished from all varieties of *Amb. ornata* by a somewhat larger spiral angle and more turbinate whorls, and by the number and fineness of the ornaments. The variety from the Irony Nodule-bed of Burton Bradstock (fig. 3) is longer, narrower, and with a more gaping suture than specimens from the *concavus*-bed of Bradford Abbas, where *Amb. densinodosa* is somewhat sparingly distributed. A stout variety occurs at Dundry.

Amb. densinodosa serves to connect the more eucycloid species of *Amberleya* with the *Turbo*-section through such a species as *Amberleya Milleri.* Intermediate forms occur.

212. Amberleya, cf. Meriani, *Goldf.*, 1844. Plate XXIII, fig. 17.

1844. Turbo Meriani, *Goldfuss.* Petref., vol. iii, p. 91, pl. cxciii, fig. 16.

Bibliography, &c.—Goldfuss originally described *Turbo Meriani* as from the Upper Lias of Altdorf and the Inferior Oolite of Normandy. He also quoted it from the Oxford Clay of Dives. Subsequently it has been regarded mainly as an Oxfordian species. It seems, on the whole, to answer to one of those more or less recurrent forms which do occasionally show themselves on more than one horizon.

Description.—The form to which I now draw attention is evidently a member of the *ornata*-group, of moderate size and somewhat more elaborate ornamentation than the regular *Amb. ornata.*

Length about	20 mm.
Length of body-whorl to total height . .	60 : 100.
Spiral angle	46°.

The whorls have four spirals (the secondary spirals mentioned by Goldfuss not always to be seen), and the tuberculations are proportionately large. The aperture ovate, but with the columellar lip produced anteriorly (not rounded off as in Goldfuss's figure). The body-whorl is ventricose, and longer in proportion to the spire than is usual with members of the *ornata*-group.

Relations and Distribution.—There are smaller varieties which seem to connect with *Littorina Phillipsii*, which is probably nothing more than a variety. Occurs at Weldon and Ponton in the Lincolnshire Limestone, and in the Scarborough Limestone at Cloughton Wyke.

213. Amberleya cygnea, sp. nov. Plate XXIV, fig. 10.

Description:

Length, full size	35 mm.
Length of body-whorl to total height . .	50 : 100.
Spiral angle	46°.

Shell eucycloid, turrited. Spire pointed, but with an obtuse apex. Whorls seven or eight, sub-biangulate, suture wide. The first whorls on which ornaments can be traced are anteriorly bicarinate; in the next stage a posterior spiral is further developed; later still there are four spirals, of which the third forms the most salient carina; the spirals are more or less tuberculate; in the interspaces subordinate spirals may be detected.

The ornamentation of the body-whorl is very elaborate. There are five primary spirals, the fourth being the most salient, and constituting with the fifth a double carination. In the posterior spiral the nodules are nearly circular, the other spirals are serrated; there are about half a dozen deeply-serrated spirals in the base; the interspaces throughout are cross-hatched with coarse axial lines.

The aperture is ovate-elongate in the earlier stages, with a certain amount of anterior canaliculation, but becomes more round in the larger shells, as is usually the case with *Amberleya*.

Relations and Distribution.—This might almost be called *Amb. Meriani*, Goldf., var. *major*. The ornamentation, as shown in the enlargement of that author's figures, greatly resembles the ornaments of *Amb. cygnea*. But ours is a finer and more eucycloid form, which possesses peculiarities worthy of distinction. It differs still further from d'Orbigny's *Turbo Meriani* (T. J. ii, pl. cccxxxv, figs. 1—5).

The "Bastard-bed," in which this handsome member of the *ornata*-group occurs, lies at the base of the Lincolnshire Limestone, and just above the Ironstone at Lincoln. Here *Amb. cygnea* is fairly plentiful in a rough fawn-coloured matrix along with many other interesting Gasteropoda.

214. Amberleya goniata, *Deslongchamps*, 1860. Plate XXII, fig. 6 (juv.).

1860. Eucyclus goniatus, *J. A. Deslongchamps.* Bull. Soc. Linn. Norm., vol. v, p. 31, sep. copy, pl. xi, fig. 6.

1873. Amberleya ? goniata, *Desl.*, sp. Tawney, Dundry Gasteropoda, p. (20) 28, pl. ii, fig. 5.

The type occurs in the Inferior Oolite of Les Moutiers. The specimen figured by Tawney appears correctly identified with Deslongchamps' species, which is probably only a bizarre variety of the one described on the next page. Fig. 6 most likely represents the young stage. This form is found rarely in the *Parkinsoni*-zone of Burton Bradstock. It is more markedly angular and more coarsely ribbed than the commoner form next to be described, and has rather a wider spiral angle. All members of the *goniata*-group have a sharp spire with an obtuse apex (see enlargements of figs. 6 and 11).

215. Amberleya Orbignyana, sp. nov. Plate XXII, figs. 7, 8.

. Purpurina ornata, *d'Orbigny.* Terr. Jur., vol. ii, pl. cccxxx, figs. 4, 5.

Bibliography, &c.—There is no reference to *Purpurina ornata* in the text of the 'Terrains Jurassiques,' though we gather from the explanation to the plate that it is a fossil of the Inferior Oolite. *Purpurina ornata* is evidently an *Amberleya* (*Eucyclus*), and we at once recognise the form as common and characteristic of the *Parkinsoni*-zone of Dorset. The specific name "*ornata*" being preoccupied, it becomes necessary to bestow on this fossil a fresh appellation.

Description :

Length of well-grown specimens . .	35—45 mm.
Length of body-whorl to total height . .	50 : 100.
Spiral angle	45°.

Shell eucycloid, turrited. Whorls nine or ten, angular, and sloping flatly towards the dominating keel. The whorls of the spire are biangulated anteriorly; a faintly nodular spiral is developed close to the upper suture, then ensues the flat sloping area, marked by extremely fine striæ rather oblique to the axis ; the two principal keels or spirals are quite low down, the upper one having large tubercles, wide apart and spirally extended; in the lower keel the ornaments are usually less conspicuous.

The body-whorl is large, very angular, with the great keel strongly tuberculated ; there are five spirals in the base, these being slightly tuberculated. The aperture is ovate-elongate, with a straight columellar lip much produced anteriorly, as in *Purpurina.* This is the stage in which the shells are usually found. Larger specimens have the aperture more circular.

Relations and Distribution.—This may be regarded as the average form of the *goniata*-group. It occurs throughout the *Parkinsoni*-zone, principally in South Dorset, being especially abundant at Burton Bradstock, Loders, &c. It also occurs in the upper part of the *Humphriesianus*-zone at Louse Hill, and in the *Parkinsoni*-zone at Grove, &c. Casts of this form are found in the *Parkinsoni*- or *Martinsii*-zone of Midford. *Purpurina Belia,* d'Orb. (T. J, ii, pl. cccxxx, figs. 9, 10), is perhaps nearly the same.

216. Amberleya Murchisoni, *Münster*, 1844. Plate XXII, fig. 11.

1844. Turbo Murchisoni, *Münst.* Goldf., Petref., pl. cxciv, fig. 10.

Except that ours is a better specimen, showing the apical conditions, there seems no difference between the fossil from the *Humphriesianus*-zone of Bradford Abbas and the one figured by Goldfuss. No other British specimen is known to me. *Amb. Obornensis*, next described, is probably only a variety.

217. Amberleya Obornensis, sp. nov. Plate XXII, fig. 10.

Description:

Length	25—35 mm.
Length of body-whorl to total height . .	48 : 100.
Spiral angle	40°.

Shell eucycloid, turrited. Spire pointed, with an obtuse apex. Whorls nine or ten, sutures very wide. The apical whorls smooth, full, and flattened towards the summit (the enlargement of figs. 6 and 11 is also suitable for this species), the succeeding whorls sub-biangulate, spirally ornamented, with the principal keel almost median. Close to the suture is a posterior row of tubercles, which are rather small and wide apart; next succeeds the flat sloping area, with axial striæ, also rather wide apart; then the principal keel, which forms the angle of the whorl, the tuberculations being of moderate size; the lower median carina has the tuberculations still smaller and numerous; and below this, owing to the gaping of the suture, an additional carina, corresponding to the first spiral in the base, may frequently be detected.

The body-whorl is angularly ventricose, the keel being situated rather high up, so as to shorten the posterior area, which together with the rest of the shell is axially striated, the striæ being rather wide apart.

The aperture is ovate-elongate, with a straight columellar lip produced anteriorly, somewhat after the manner of *Purpurina*, with a tendency to become more circular in the larger and more mature specimens.

Relations and Distribution.—Amberleya Obornensis, which is at least a good local variety of *Amb. Murchisoni*, although clearly a member of the *goniata*-group, has certain affinities with the more elegant forms of *Amb. ornata*, var. *abbas*. To a certain extent, then, it may be regarded as intermediate between the *ornata*- and *goniata*-groups, though its relations are mainly with the latter.

This intermediate character corresponds with its stratigraphical position in the lower part of the *Humphriesianus*-zone at Oborne, where it is the most abundant and characteristic species of *Amberleya.*

218. AMBERLEYA PAGODIFORMIS, sp. nov. Plate XXII, fig. 9.

Description :

Length	40 mm.
Length of body-whorl to total height . .	48 : 100.
Spiral angle	48°.

Shell conical, eucycloid, turrited. The spire consists of about eight or nine whorls, the apical conditions being unknown. Whorls angular and distended by a large carina situated in the anterior region. In the earlier whorls of the spire two tuberculated circlets may be distinguished, connected by a kind of axial ribbing; the posterior circlet is close to the suture, the anterior one becomes more and more prominent, and in the later whorls the tubercles project like the teeth of a saw.

Body-whorl large, angular, and similarly ornamented; base rather flat, with about four finely-granulated spirals; the axial striæ are wide apart, and strongly marked throughout the shell.

Aperture almost trapeziform, with a short and very straight columella.

Relations and Distribution.—This form, it seems to me, helps to connect the eucycloid with the trochiform Amberleyas. The want of biangulation makes us regard it as a somewhat aberrant member of the *goniata*-group; whilst the flatness of the base, the wide space between the two spirals, and the trapeziform character of the aperture serve to connect it with *Amb. biserta.*

Occurs sparingly at Bradford Abbas, and probably in the *Murchisonæ*-zone.

219. AMBERLEYA, cf. GENERALIS, *Münster,* 1844. Plate XXIII, fig. 3.

N.B.—It must be borne in mind that the posterior portion of the last two whorls in our specimen has been stripped of all ornament.

The length of the figured specimen is 35 mm., the ratio between the length of the body-whorl and total height 48 : 100, and the spiral angle 40°.

Amongst other points of resemblance the serrated keel, anteriorly situated, is conspicuous. One can hardly say whether this species should be referred to the *Eucyclus*- or to the *Trochus*-section.

The specimen is unique. It occurs in a brownish ferruginous stone, partly ironshot, which resembles the matrix of the *Humphriesianus*-zone of Dundry.

220. Amberleya, sp.; cf. *Trochus anaglypticus, Münster.* Plate XXII, fig. 12.

1844. Trochus anaglypticus, *Münster.* Goldf., Petref., pl. clxxx, fig. 4.

It must be admitted that the details of ornamentation do not tally very well with those of Goldfuss's figure, though, making allowance for difference of artistic treatment, and of mineral conservation, there are some grounds for inviting comparison. Our fossil is unique from the "marl with green grains" at the base of the *Humphriesianus*-zone of the Sherborne district. It may be merely a sport of the very abundant *Amb. Obornensis.*

221. Amberleya biserta, *Phillips*, 1829, Section A. Plate XXII, figs. 13, 14; Section B, Plate XXIII, figs. 1, 2.

1829 and 1835. Trochus bisertus, *Phillips.* Geol. Yorks, pt. 1, pl. xi, fig. 27, 3rd edit. (1875), p. 259.
1884. The "Trochus" bisertus-group, *Hudleston.* Geol. Mag., dec. 3, vol. i, p. 248, pl. viii, figs. 9—11.

Bibliography, &c.—Phillips's type was from the Dogger, and appears to have been lost, but the original figure leaves no doubt as to what fossil is meant. Bean recognised a species belonging to the same group, which in the second edition of Phillips's work, p. 129, was quoted, without figure or description, as *Turbo unicarinatus*, Bean, MS., and in the third edition, p. 258, as *Littorina unicarinata*, Bean, MS.

We have actually in the present case four different forms to deal with. A form like Pl. XXII, fig. 13, was originally described by me as *Littorina biserta*, but I now consider it to be the earlier stage of *Amberleya* (*Trochus*) *biserta* (Pl. XXII, fig. 14). Those who have followed me thus far in dealing with *Amberleya* will be fully prepared to believe in the modification of the aperture from an ovate and almost *Purpurina*-like aperture (fig. 13) to a subcircular or almost trapeziform aperture (fig. 14). These two, then, are merely varieties of age, and constitute our Section A. That there is an analogous relationship between *Littorina unicarinata* (Pl. XXIII, fig. 1) and the larger form (Pl. XXIII, fig. 2) is also probable, though not quite so clear, owing to imperfectly preserved apertures, and to the slight flattening out of the smaller specimen. It might, perhaps, be possible to separate them specifically from the more typical forms of *Amb. biserta*, but at present it seems safer not to do so. This, then, constitutes our Section B, which includes the *Littorina* (*Turbo*) *unicarinata* of Bean.

Description, Section A :

Length of adults (*Trochus bisertus*) . .	25—30 mm.
Length of body-whorl to total height . .	54 : 100.
Spiral angle	55°.

Shell conical, trochiform. Spire pointed, with probably an obtuse apex; number of whorls about eight. The extreme apical whorls are smooth, convex, and without ornament; remaining whorls flat or slightly concave; sutural gutter very deep. The ornaments consist of two finely tuberculated circlets or girdles of nearly equal strength, one close to the posterior margin, the other, which forms a slightly salient keel, is situated near the anterior extremity. The whorls are richly ornamented by a system of deeply-cut axial striæ, which add much to the beauty of these shells.

In the body-whorl a similar system of ornamentation prevails, and the axial striæ are continued down to a third circlet, which is tuberculated. The base varies from moderately full in the early stage, where the columellar lip is straight and pointed at the extremity (fig. 13), to rather flat in the mature stage, where the aperture is subrhomboidal or subcircular (fig. 14); it carries four or five spirals, which are nearly plain.

N.B.—Specimens from Drympton, such as the one figured, have a flatter base and more trochiform aspect than those from the Dogger.

Section B.—The specimen of *Littorina unicarinata* (Pl. XXIII, fig. 1) has been somewhat distorted by compression, which has the effect of increasing the apparent width of the spiral angle. The points in which the *unicarinata*-variety differ from Section A are mainly those of ornamentation. The lower or keel girdle preponderates greatly over the other, which latter in some specimens is almost effete. This has the effect of making the shell more unicarinate and less trochiform in outline, and in the adult forms (fig. 2) recalls the *Eucyclus*-section.

Relations and Distribution.—*Amberleya biserta* and its varieties seem to form a group somewhat isolated. My reasons for not regarding it as a *Trochus* were given in the 'Geological Magazine.' Continental authors do not seem to have noticed it; nor can I find that d'Orbigny, who generally quotes Phillips' species, mentions it in the 'Prodrome.'

In England it is essentially a fossil of the *Opalinus*-zone or lower part of the *Murchisonæ*-zone, occurring sparingly in the Dogger at Blue Wyke, and in the Dorset-Somerset district at Drympton and Haselbury. Drympton is, on the whole, the best locality for these beautiful trochiform Amberleyas, and there are indications there also of the unicarinate variety.

222. AMBERLEYA (TURBO) MILLERI, *Wright*, MS. Plate XXIII, fig. 5.

Description:

Length	15—25 mm.
Length of body-whorl to total height . .	60 : 100.
Spiral angle	62°.

Shell conical, turbinate, rather thin. Number of whorls about eight; apicals rather convex and smooth, remaining whorls but slightly tumid; suture well impressed. In the whorls of the spire the ornaments consist of finely tuberculated spirals increasing in number up to about five; these are nearly equal in degree of salience, but in the penult the lower one slightly projects; fine axial costæ and striæ decussate the spirals.

The body-whorl has about seven spirals, the upper ones being usually the most spinulose; the two lower ones are more closely tuberculate, and constitute a slight double keel (sub-eucycloid). In the base are nearly a dozen spirals, slightly tuberculate and with fine intermediate axial striæ. Aperture subcircular, with a short and rather straight pillar lip.

Relations and Distribution.—Through *Amberleya densinodosa* this turbinate species is connected with the eucycloid Amberleyas, whilst, on the other hand, it has obvious relations with the species next described. Although there are forms figured by Goldfuss, d'Orbigny, and others which approach *Amberleya* (*Turbo*) *Milleri*, it seems to stand out with sufficient distinctness to be accepted as a species of *Amberleya* which still retains some trace of the eucycloid character.

It is fairly plentiful in the *concavus*-bed at Bradford Abbas.

223. AMBERLEYA (TURBO) TURBINOIDES, sp. nov. Plate XXIII, fig. 7 and ? fig. 6.

Description:

Length	25 mm.
Length of body-whorl to total height . .	48 : 100.
Spiral angle	44°.

Shell conical, subelongate, turbinate. Number of whorls about eight; those in the upper part of the spire are rather flat, but become angular towards the penult; suture wide and finally gaping.

The ornaments exhibit considerable variety; in the middle stage the whorls possess four or five finely tuberculated spirals, the lowest being the longest and most prominent, forming a kind of keel. In the penult the spirals become more numerous and variable, and, as the suture gapes very much, spirals are sometimes seen below the keels.

The body-whorl is globose, the spirals, including those in the base, being sometimes twenty in number. The sub-eucycloid character of the spire is more or less lost. The two posterior spirals are more strongly tuberculated than the others. Fine axial striæ are conspicuous in well-preserved specimens. Aperture ovate to subcircular, with a very short columellar lip.

Relations and Distribution.—This shell approaches *Amberleya* (*Turbo*) *Milleri*, which is more trochiform, has a wider spiral angle, and a less gaping suture. There is, however, in *Amb. turbinoides* an amount of irregularity such as tends to the suspicion that the name may represent a group of aberrant forms rather than a distinct species. It also has affinities with *Amb. densinodosa*. From *Turbo modestus*, Héb. and Desl., it is clearly distinguished by the irregularity of the whorls of the spire.

There are four specimens in my collection from Stoford and Bradford Abbas.

224. AMBERLEYA (TURBO) STODDARTI, *Tawney*, 1873. Plate XXIII, fig. 11.

1873. TURBO STODDARTI, *Tawney*. Dundry Gasteropoda, p. (29) 21, pl. ii, fig. 1.
Cf. . — MODESTUS, *Héb. and Desl.* Foss. Montreuil-Bellay, p. 57, pl. iii, fig. 2.

Bibliography, &c.—Mr. Tawney described his species from a single imperfect specimen in the Bristol Museum, smaller than the one figured above, and differing from it to a certain extent in the alternately stronger and fainter spirals. If the form figured in the plate is not fairly referable to *Turbo Stoddarti*, it may be accepted as an Inferior Oolite variety of *Turbo modestus*.

Description :

Length	30 mm.
Length of body-whorl to total height . .	55 : 100.
Spiral angle	56°.

Shell turbinate, thin. Number of whorls about eight, convex, and ultimately globose; suture distinct. The ornaments consist of about ten fine and evenly nodulated spirals of nearly equal prominence, the interspiral striæ being fine and regular. In some specimens are faint secondary spirals.

The body-whorl is rather more than half the height of the entire shell, ventricose, and has about ten spirals, of which two pairs, on either side of a line of tubercles in the centre, are slightly distinguished from the rest (sub-eucycloid). There are about fourteen finely granulated spirals in the very full and rounded base.

The aperture is wide, subcircular, with scarcely any trace of anterior canaliculation, though slightly flattened in front.

Relations and Distribution.—Differs from *Amberleya turbinoides* in its more globose character, and in its freedom from angularity in the whorls of the spire. Less trochiform, and with finer and more nodular ornaments than *Amb. Milleri.* The eucycloid character is almost at a minimum. Rare at Dundry, and not found elsewhere in England.

N.B.—Mr. Tawney relied upon the alternate arrangement of the markings to differentiate *Turbo Stoddarti* from *Turbo cyclostoma*, a well-known but much smaller Liassic species. It is not improbable that, after all, *Turbo Stoddarti*, as interpreted in the present instance, is to a certain extent little more than an amplification of a Liassic form. Lately Mr. Wilson has found some specimens of *Turbo cyclostoma* which show traces of the nacreous layer. Hence, though not really a *Turbo,* it is likely to be one of the *Turbinidæ.* The bearing of this upon *Amberleya* generally and associated forms must not be lost sight of.

225. Amberleya (Turbo) elongata, sp. nov. Plate XXIII, figs. 8, 9.

Cf. Turbo terebratus, *Münst.* Goldf., Petref., pl. cxciv, fig. 6.

Description:

Length, full size	60 mm.
Length of body-whorl to total height	45 : 100.
Spiral angle	36°.

Shell conical-elongate, turbinate, turrited. Number of whorls about nine, convex, widely separated by the suture; axial striæ fine and numerous.

Smaller Specimen.—Five spirals in the earlier whorls, six in the penult and body-whorl, the fourth being slightly the most prominent; base full and ornamented by numerous plain spirals. Aperture ovate-elongate, with a straight pillar-lip and indications of a shallow anterior canal.

Larger Specimen.—The penult has seven spirals, the body-whorl about eight, exclusive of the spirals in the base, which are numerous. The body-whorl is ventricose; aperture apparently subcircular.

Although the differences between the smaller and larger specimens are considerable, yet they may be regarded most probably as representing different stages of the same species. The rotund outline of the whorls, the elongate spire, and the character of the ornamentation are greatly similar. The spiral angle, too, is almost the same, if we exclude the ventricose projection in the body-whorl of the larger specimen.

Relations and Distribution.—This form is very rare, and would seem to represent the most extreme phase of the large and diverse series which I have ventured to group under *Amberleya.* Both specimens occur in the *Murchisonæ*-zone, the smaller one at Bradford Abbas, the larger one in the Pisolite at Longfords.

Pl. XXIII, fig. 10, represents a specimen from the *Murchisonæ*-zone of Stoford, which seems in some way to combine the characters of *Amb. turbinoides* and *Amb. elongata.* The specimen is unique, and I have not ventured to name it.

226. ? Amberleya (Turbo) Dundriensis, *Tawney*, 1873. Plate XXIV, fig. 11.

1873. Turbo Dundriensis, *Tawney.* Dundry Gasteropoda, p. 30 (22), pl. ii, fig. 2.

Description.—" Shell elongate, acutely conical. Whorls seven, angular, outline slightly convex above the keel, and then bending in towards a deep suture. Aperture angular, trapezoidal." The spiral angle is about 50°. The ornaments are fine; it is uncertain whether there are two or three spirals above the keel, the one nearest the suture having the most distinct nodulations; axial striæ conspicuous throughout. About nine spirals in the base.

Relations and Distribution.—Mr. Tawney refers to several shells from the Lias which come near this shape, such as *Trochus imbricatus-Suecicus*, Quenstedt; *T. concinnus*, Moore; *T. Gaudryanus*, d'Orbigny. He further says, " This and allied forms might form a distinct genus; they seem to differ from the recent *Turbo.*"

There can be no doubt that " *Turbo* " *Dundriensis* takes the place at Dundry of *Purpurina* (*Eucycloidea*) *bianor*, d'Orb., already noticed in this Monograph.[1]

At that time I was not aware that several of d'Orbigny's Purpurinas were really Amberleyas, and that the *Purpurina*-like mouth in many cases was merely a stage in the development of *Amberleya.* I should be now disposed, therefore, to withdraw *Eucycloidea* from its supposed relationship to *Purpurina.* Whether *Eucycloidea* should be retained or merged in *Amberleya* is at present uncertain. Since *Amberleya* is likely to become too large and comprehensive, *Eucycloidea* might, perhaps, be retained as a sub-genus for shells of this class.

[1] Page 95, *Purpurina* (*Eucycloidea*) *bianor*, d'Orb, Pl. II, figs. 5 *a—h.*

227. Amberleya, cf. pinguis, *Deslongchamps*, 1860. Not figured.

1860. Eucyclus pinguis, *Desl.* Bull. Soc. Linn. Norm., v, p. 145 (p. 30 sep. copy), pl. xi, fig. 7.

Mr. Tawney found an indifferently preserved specimen of *Amberleya* at Midford, which he referred to *Amb.* (*Turbo*) *princeps*, Römer. Recently Mr. Wilson has found another specimen, which is not calculated to throw much additional light on the subject. These fossils more resemble *Eucyclus pinguis*, Desl., than any other figured species. The calcareous beds at Midford are mainly within the *Parkinsoni*-zone. *Eucyclus pinguis* is quoted from the *primordialis*-zone.

There are one or two other ill-defined forms of *Amberleya*, which I have concluded not to notice on the present occasion.

Genus—Littorina, Férussac, 1821.

Shell turbinate, thick, pointed, few-whorled; aperture rounded; outer lip acute, columella rather flattened, imperforate.

Tectarius, *Valenciennes*, 1833. *Shell muricated or granulated, sometimes with an umbilical fissure; columella callous, partially toothed at the base.*

Echinella, *Swainson*, 1840. *Shell granulated, thick; base of the columella toothed.*

From what has already been said, the true affinities of the shells about to be described are somewhat uncertain. They differ from the Amberleyas principally in having a small and thick shell. Most of them seem to have more affinity with *Tectarius* or *Echinella* than with *Littorina*, nor can I in all cases strictly define the difference between *Amberleya* and *Littorina*. It must be understood that in the succeeding pages *Littorina* is used partly in a conventional sense.

228. Littorina (Echinella) prætor, *Goldfuss*, 1844. Plate XXIV, fig. 8.

1844. Turbo prætor, *Goldf.* Petref., pl. cxciv, fig. 8.

Cf. also Turbo Meriani, *d'Orb.*, non *Goldf.*, T. J., ii, pl. cccxxxv, fig. 5, non figs. 2—4.

Description:

Length	25 mm.
Length of body-whorl to total height . .	52 : 100.
Spiral angle	55°.

Shell pyramidal. Number of whorls about seven, flat, increasing under a regular spiral angle, and well separated by the suture. The ornaments consist of four serrated spirals of nearly equal prominence; in some cases the fourth spiral has a slight salience, and where the suture gapes a fifth spiral without tuberculations may be detected towards the bottom of the hollow.

The body-whorl rather exceeds half the height of the shell; it is slightly angular, and not ventricose; ornaments as in the whorls of the spire; base full with about six finely cut spirals. Throughout the shell the interspiral striæ are deep, and the serrations of the carinæ almost tooth-like and somewhat bent upwards; but there is considerable variety in the nature of the ornaments.

Aperture ovate with a straight pillar lip, in the earlier stage slightly reflexed anteriorly.

Relations and Distribution.—Our specimen is rather more conical than the one figured by Goldfuss, but there are others which correspond in almost every particular. In younger specimens which are free from matrix intermediate spirals of slight salience may be seen.

This is a sort of average form, which may be said to inosculate with others in the Jurassic rocks. The abundant *Littorina muricata* of the Corallians might be regarded as a micromorph on a higher horizon. Some varieties of *Amb. Milleri* are also near. On the other hand, the eucycloid varieties approach the *ornata*-group in many ways.

Littorina prætor is rare. My own specimens are mostly from the *Murchisonæ*-zone of Bradford Abbas. There is a specimen in the Woodwardian Museum stated to have come from Dundry.

The handsome shell, Pl. XXIII, fig. 4, may possibly represent a modification of *Litt. prætor* on a higher horizon, viz. the *concavus*-zone. In most shells of this class the pillar-lip is straight with a considerable deposit of callus. This specimen is the only one I have seen of the kind.

229. LITTORINA (*Tectarius* or *Echinella*) POLYTIMETA, sp. nov. Plate XXIII, figs. 12, 13.

Cf. TURBO DAVIDSONI, *Laube.* Gast. braun. Jur. Balin, p. 8, pl. ii, fig. 1, for this and the following species.

Description:

Length	15—20 mm.
Length of body-whorl to total height . .	60 : 100.
Spiral angle	62°.

Shell thick, conical; spire pointed. Number of whorls about seven, the apical ones being convex and smooth, the remaining whorls nearly flat, and marked off by a channelled suture. The ornaments are peculiar; they consist of three nearly equal, equidistant spiral girdles (in the penult usually a subordinate fourth), which are evenly and regularly serrated. The appearance is almost that of a coil of whipcord wound round a top.

The body-whorl considerably exceeds half the height of the shell; it is rounded, but not ventricose. There are four principal spiral girdles similar to those already described, and in the base about six spirals similarly ornamented, and of nearly equal prominence, but becoming less salient towards the point of the columella.

The aperture is subcircular, flattened anteriorly with a straight pillar lip and large callus, much thickened towards the centre, so as to form a kind of tooth; outer lip crenulated.

Relations and Distribution.—The regularity, prominence, and peculiar rope-like character of the spiral ornaments clearly distinguish this from any other species in the Inferior Oolite of England. Laube's species is near to it, but appears more eucycloid in character.

The figured specimens are both from Bradford Abbas, most probably from the *concavus*-zone. It occurs also on nearly the same horizon in the neighbourhood of Beaminster and at Stoford. There were three specimens without locality in Dr. Wright's collection. There is also a specimen in a ragstone matrix said to come from Cleeve Hill. Altogether about a dozen specimens are known to me.

Attention is here drawn to a shell (Pl. XXIII, fig. 14) which appears to be an *Amberleya* rather than a *Littorina*. The following are the dimensions:—Length 20 mm., length of body-whorl to total height 55 : 100, spiral angle 50°. The style of ornamentation is somewhat similar to that of *Littorina polytimeta*, but the serrations are rather finer, and there are four spirals in the whorls of the spire, and also the spirals in the base are more numerous. In conformity with the shape of the shell the aperture is more elongate, otherwise similar, and with a similar tooth-like thickening.

This form is rare in the "Base-bed" at Lincoln.

230. Littorina Phillipsii, *Morris and Lycett*, 1851. Plate XXIII, fig. 16.

1851. Turbo Phillipsii, *Morr. and Lyc.* Great Ool. Moll., p. 117, pl. xv, fig. 12.
1884. Littorina Phillipsii, *Morr. and Lyc.* Hudleston, Geol. Mag., dec. 3, vol. i, p. 242, pl. viii, fig. 1.

Description:

Length	12—18 mm.
Length of body-whorl to total height .	60 : 100.
Spiral angle	68°.

Shell thick, trochiform, sub-eucycloid. Spire pointed, but with an obtuse apex. Whorls about six, sutures moderately wide; each whorl furnished with three, or more often four, granulated spiral bands, the lowest being the most prominent.

The body-whorl is large relatively to the shell, and somewhat eucycloid, owing to the prominence of the two lowest spirals. Number of spirals in the base five; axial striæ moderately shown throughout.

Aperture widely ovate, slightly flattened in front and angular at the point. Outer lip thin and crenulated, inner lip very callous; indications in some specimens of an umbilical fissure.

Relations and Distribution.—This form passes by easy stages into others already named. *Turbo Davidsoni*, Laube, may be intermediate between this and the species last described. In another direction *Litt. Phillipsii* has affinities with *Amberleya* (*Turbo*) *Meriani* (Pl. XXIII, fig. 17), but is smaller, has a wider spiral angle, and is less turrited. Some Yorkshire specimens seem to connect this form with *Amberleya ornata*.

Typical specimens occur in the Grey Limestone of Cloughton Wyke and in the upper beds of the Lincolnshire Limestone at Weldon and Ponton; also in the *Humphriesianus*-zone at Milborne Port. Specimens which might be referred to this species occur in the Dogger at Blue Wyke and in the Pea-grit at Crickley.

231. Littorina, cf. sulcata, *Hébert and Deslongchamps*, 1860. Plate XXIII, fig. 15.

1860. Littorina sulcata, *Héb. and Desl.* Foss. Montreuil-Bellay, p. 55 (sep. copy), pl. iii, fig. 3.

Fig. 15 represents a unique specimen from the *Parkinsoni*-zone of Bradford Abbas. It is characterised by the richness of its ornamentation and the width of the interspiral spaces or furrows. The English specimen is more conical, and has a smaller spiral angle; the body-whorl also is relatively shorter and more angular than is shown in the type figure.

232. Littorina Weldonis, sp. nov. Plate XXIII, fig. 18.

Description:

Length	8 mm.
Length of body-whorl to total height . .	52 : 100.
Spiral angle	55°.

Shell conical, spire acute; whorls five or six, flat and well separated by the suture. The ornaments consist of three rather finely granulated spirals of equal prominence, with widish interspiral sulci where the axial ornamentation is well seen.

Body-whorl subangular, with five plain spirals in the base; aperture subovate. N.B.—The figured specimen has suffered considerably from usage.

Relations and Distribution.—Despite the very considerable difference of appearance, this is probably the representative in the Lincolnshire Limestone of shells not far removed from *Littorina sulcata.* Its perfectly conical form and freedom from turriting seems to distinguish *Litt. Weldonis* from *Amb. gemmata* or *Litt. ædilis.*

Rather abundant in the upper beds of the Lincolnshire Limestone.

233. LITTORINA ÆDILIS, *Münster*, 1844. Plate XXIV, fig. 1 and ? fig. 2.

1844. TURBO ÆDILIS, *Münst.* Goldf., Petref., pl. cxciv, fig. 9.
1869. — — — Brauns, Mittl. Jura, p. 180.
1873. LITTORINA ÆDILIS, *Münst.* Tawney, Dundry Gasteropoda, p. 23 (15).

Description:

Length	13 mm.
Length of body-whorl to total height . .	54 : 100.
Spiral angle	52°.

Shell ovately conical, turrited; spire acute. Whorls five or six, angular, widely separated by the suture. The ornaments consist of three prominent spirals decussated at the widely separated nodes by coarse axial costæ; in the gape of the suture a fourth spiral may sometimes be seen.

Body-whorl subangular and slightly ventricose; ornaments similar to those of the spire, with five rather fine spirals in the base; fine axial striæ throughout. Aperture ovate, pillar-lip produced in front.

Relations and Distribution.—There cannot be much doubt as to the correctness of Mr. Tawney's identification. A few specimens have been found at Dundry, and possibly such a form as fig. 2 may represent this species in the Lincolnshire Limestone.

Litt. ædilis is a sort of poor relation to the *ornata*-group, and is more or less intimately connected with numerous named forms. The species next described is probably only a local variety of polymorphous tendencies.

234. LITTORINA DORSETENSIS, sp. nov., or ? var. of *Litt. ædilis.* Plate XXIV, fig. 3 (A), fig. 4 (B), fig. 5 (C).

Cf. for B TROCHUS GRANARIUS, *Héb. and Desl.* Foss. Montreuil-Bellay, p. 53, pl. ii, fig. 8.

Description, A and B :

Length	. 14—17 mm.
Length of body-whorl to total height .	. say 50 : 100.
Spiral angle (convex) . .	. 60°.

Shell irregularly conical, spiral angle usually convex. Whorls seven, narrow, flattish, or slightly biangulated; suture well marked, rarely gaping. Within certain limits there is considerable variety, some shells being more trochiform, others more turbinate. Apex sub-obtuse, the two apical whorls being smooth and full; in the rest of the spire and body-whorl there are three nodose spirals, the nodes being rather wide apart, decussated by short, thick, axial ribs. The base is rather flattened, with five or six plain spirals. Fine axial striæ throughout.

Occasionally a fourth spiral is developed (fig. 4), in which case we seem to have the most characteristic features of *Trochus granarius*, Héb. and Desl.

Aperture sub-orbicular, with an extremely short and straight pillar lip, which is rounded off at the anterior extremity instead of being produced.

Variety C.—Shell thin, eucycloid; whorls biangulated, sutures rather gaping; spiral ornamentation much subdued, axial striæ conspicuous and very oblique. Pillar-lip rather longer than in vars. A and B, and the aperture less restricted in front.

In a large series of specimens every gradation between A, B, and C may be noted. There are also specimens which approach "*Turbo*" *centurio* (Goldf., pl. cxciv, fig. 7).

Relations and Distribution.—The group of shells which I have focussed under *Litt. Dorsetensis* is primarily related to *Litt. ædilis.* As a group given to sporting it helps to show how "*Littorina*" and *Amberleya* seem to wait upon each other, even to the thinning out of the shell-substance when the eucycloid character is assumed.

Extremely abundant in the *concavus*-zone at Bradford Abbas. A few very small specimens in the Pea-grit at Leckhampton.

235. LITTORINA (*? Trochus*) PISOLITICA, sp. nov. Plate XXIV, fig. 9.

Description:

Length	. 4—5 mm.
Length of body-whorl to total height .	. 56 : 100.
Opening of the spiral angle . .	. 70°.

Shell small, trochiform, spiral angle convex, sutures distinct. Number of whorls five, apex obtuse and smooth; remaining whorls convex, and ornamented by five spirals, decussated at the nodes by axial lines which produce a subreticulate structure; the anterior spiral slightly prominent.

Body-whorl large, subangular, with six spirals; base rather flattened, and with about seven nearly smooth spirals. Aperture subcircular, pillar-lip very short and with but little callus.

Relations and Distribution.—Failing to recognise any corresponding adult form, I am disposed to conclude that "*Littorina*" *pisolitica* is a variable micromorph, which seems to be related to species described under *Littorina*, but which may really be a *Trochus*.

Occurs in the Pea-grit at Crickley and Leckhampton.

N.B.—The two remaining species described under *Littorina* are cylindro-conical forms which resemble *Trochus*.

236. LITTORINA (*? Trochus*) RECTEPLANATA, *Tawney*, 1873. Plate XXIV, figs. 6 and 7.

1873. LITTORINA RECTEPLANATA, *Tawney*. Dundry Gasteropoda, p. 24 (16), pl. ii, fig. 6.

Description:

Length	. 13—20 mm.
Length of body-whorl to total height .	. 40 : 100.
Spiral angle . . .	. 40°—45°.

Shell cylindro-conical, spire pointed. Number of whorls probably seven, flat and well separated by the suture. The ornaments consist of four closely tuberculated spirals, of which the anterior is the strongest and forms a slight salience; sometimes a fifth spiral may be noted in the gape of the suture; axial costæ sharply defined throughout.

Body-whorl angular, with four or five spirals much tuberculated, the fourth spiral constituting a carina at the angle; base subconvex, with five almost plain spirals. Aperture trapezoidal, with a thick columellar lip.

Fig. 7 represents a specimen from the Cotteswolds in much better preservation than the type (fig. 6); this has also rather a smaller spiral angle, and has probably developed an additional whorl.

Relations and Distribution.—" *Littorina* " *recteplanata* seems generically related to certain cylindro-conical forms of *Amberleya* which are rather characteristic of the Lias. It is extremely rare. In the Inferior Oolite, besides the type, I know of one specimen from Dundry and two from the Pea-grit of Longfords. Cf. also "*Monodonta*" *imbricata*, Morr. and Lyc., 'Grt. Ool. Moll.,' pt. 1, p. 67, pl. xi, fig. 3.

237. LITTORINA (*? Trochus*) TRIARMATA, *Hébert and Deslongchamps*, 1860. Not figured.

1860. TROCHUS TRIARMATUS, *Héb. and Desl.* Foss. Montreuil-Bellay, p. 62 (sep. copy), pl. iii, fig. 5.

A single specimen of this well-marked cylindro-conical form has come under my observation; it is somewhat longer and narrower than the type, but possesses the characteristic ornamentation.

It is apparently from North Dorset, and not improbably from the *concavus*-zone of Bradford Abbas. In this case it may be an extreme " sport " of the polymorphous *Littorina Dorsetensis.*

THE SINISTRAL GROUP.

This group comprises a number of shells which have been described under *Cirrus*, *Hamusina*, *Scævola*, and perhaps *Tectus*, the three last-named genera having been constituted by Gemmellaro for the reception of species of this group which occur in the Lias-Oolite of Sicily. Besides the common feature of being sinistral, most of them are characterised by rugose ornamentation, by possessing a shell more or less trochiform or turbinate, and in the case of *Hamusina* rather thin. The aperture is circular, and there is scarcely any columella. Some species, such as *Cirrus nodosus*, Sowerby, have an enormous umbilical excavation, whilst in *Hamusina* the closure is complete. Nevertheless the presence or absence of an umbilicus is probably not of much generic importance, though we may make use of it for purposes of separating, for instance, *Hamusina* from *Cirrus.*

This group, to judge from Gemmellaro's work, is evidently well represented in the Lias-Oolite of Sicily. It is also fairly abundant in the lower division of the

Inferior Oolite in this country, and there occurs one species in the Upper Lias of Compton which may be regarded as a variety of *Cirrus Leachi.* This form seems to have been the first of the group in the British Jurassics, and its modified descendant, *Cirrus Leachi,* remained the demoid species of the Inferior Oolite. These would be classed under *Scævola* by Gemmellaro.

Whatever generic names are assigned to these rugose sinistral Gasteropods, as a matter of fact in this country they nearly all occur on one horizon, viz. the *Murchisonæ*-zone, and are, I suspect, pretty closely related to each other. It would not have been difficult, perhaps, to have folded them all under *Cirrus* had that genus been more fortunately constituted.

Bibliography of Cirrus.—In October, 1816, Sowerby gave his diagnosis of the genus, laying great stress upon the funnel-shaped umbilicus. "It is a curious genus, and would be considered a Turbo till modern discernment showed the necessity of nicer distinctions; having no columella, it represents the whorls of some tendrils called Cirri, or a curled lock of hair; I have therefore named it *Cirrus.*"

The sinistral character seems to have been lightly regarded by Sowerby. Accordingly ('Min. Conch.,' t. 141) he described, first, a dextral shell from the Carboniferous Limestone of Derbyshire as *Cirrus acutus;* this is referred by Morris to *Euomphalus.* The second figure on the plate is that of a sinistral shell which Sowerby named *Cirrus nodosus.* This is interesting as being the first of the group to which I am now referring that was ever figured. The specimen was picked up near Yeovil, and evidently came from the Inferior Oolite of Coker, Stoford, or Bradford Abbas. As Sowerby subsequently described a very different set of shells under the title "*nodosus,*" this form has been named *Cirrus intermedius* by J. Buckman.

In December, 1818, Sowerby ('Min. Conch.,' t. 219, figs. 1, 2, and 4) described *Cirrus nodosus,* No. 2, from specimens obtained at Dundry. It is more than probable that two distinct species are included in these three figures. A very imperfectly preserved fragment of a sinistral shell (op. cit., t. 219, fig. 3) was described as *Cirrus Leachi.*

In September, 1823, Sowerby (op. cit., tt. 428, 429) described four additional species of *Cirrus,* all dextral shells, and most probably Pleurotomarias, two being from the Chalk.

Thus we perceive that the *Cirrus* of Sowerby, regarded as a genus, includes three distinct genera, viz. *Cirrus* as restricted to certain sinistral forms, *Euomphalus,* and *Pleurotomaria.* It was held to extend from the Carboniferous Limestone to the Chalk inclusive. It will be necessary, therefore, in adopting the generic name *Cirrus* for a group of sinistral shells occurring in the Inferior Oolite to reconstitute and define the genus, and to eliminate as far as possible those sources of error which are so liable to attach to a name of which such an unfortunate use has been made.

All names apart, and simply stating the facts as they are presented to us in the Inferior Oolite of this country, we recognise three *sections* of sinistral shells, which, by way of a temporary arrangement, we might classify as A, B, and C. It is hardly necessary to say that these inosculate.

Section A consists of regularly conical forms, more or less turrited; the shell is thin, and entirely devoid of umbilicus. These we have no difficulty in assigning to *Hamusina,* and indeed the first specimen on our list I have ventured to identify as a variety of one of the forms named by Gemmellaro.

Section B corresponds in the main to *Scævola*, Gemm. The shells are somewhat thicker, and the general character is turbinate rather than trochiform. The spiral angle (measuring in the body-whorl) is more or less concave; the ornamentation is very rugose, with a tendency to produce varices; the umbilicus is well developed and tolerably deep. This section subdivides into the *Calisto*-group and the *Leachi*-group, of which the latter is by far the most abundantly represented. These shells form the bulk of the genus *Cirrus* as subsequently defined.

Section C consists of subdiscoidal forms of considerable variety, where the tendencies already manifested in Section B attain their maximum. The conical form has entirely disappeared owing to the abortion of the spire, thus making the spiral angle extremely concave, whilst the umbilicus is enormous. These forms may be all gathered under *Cirrus nodosus*, Sowerby. Some authors seem disposed to restrict the genus *Cirrus* to this species. I have already pointed out that this is not the original *Cirrus nodosus* of Sowerby, but it is the "*Cirrus nodosus*, Sow.," of authors and of collections, being *Cirrus nodosus*, No. 2, of the author of the 'Mineral Conchology.'

Accepting *Hamusina* as a near relative of *Cirrus*, and regarding *Scævola* as a synonym of *Cirrus* in part, I have concluded to arrange the sinistral shells of our Inferior Oolite under the two genera *Hamusina* and *Cirrus*.

Genus—Hamusina, *Gemmellaro*, 1878.

Shell thin, sinistral, conical, turrited, tuberculated, without umbilicus. Spire acute; body-whorl externally angular; base subconvex. Aperture circular; columellar side excavated and incrusted; lip simple and somewhat extended laterally. Growth-lines oblique.

It is difficult to share the opinion of Gemmellaro that *Hamusina* is related to

Amberleya, though its affinities may possibly be stronger with Liassic forms of that genus than my own experience enables me to recognise. Certainly one would say that the Oolitic Amberleyas differ widely both from *Hamusina* and from *Cirrus*, more especially in the character of the aperture. The most marked difference between *Amberleya*, as developed in the Inferior Oolite, and *Hamusina* is the shortness of the columellar area in *Hamusina,* a feature which it shares with *Cirrus*. The probable relations of *Hamusina* will be more conveniently discussed when we consider the possible position of *Cirrus* itself.

238. HAMUSINA DAMESI, *Gemmellaro*, 1878, var. "Babylonica." Plate XXIV, fig. 12.

1878. HAMUSINA DAMESI, *Gemmellaro.* Faune Giuresi, &c., p. 338, pl. xxvi, figs. 39—41.

Description (British variety):

Length	35 mm.
Height of body-whorl to total length . .	35 : 100.
Spiral angle	40°.

Shell sinistral, thin, conical, turrited, without umbilicus. Spire acute, consisting of seven or eight whorls, keeled towards the base, and slightly hollowed out towards the centre. The ornaments are somewhat rugose; close to the posterior margin in each of the more adult whorls is a zone of tuberculations; below this are some fine undulating spirals, their number increasing with each successive whorl; a little above the dominant keel is another zone of tuberculations, each tubercle being connected with a corresponding one in the posterior zone by a rugose axial rib sloping from right to left; these ribs are less strong in the penult, and are almost effete in the body-whorl; growth-lines, sloping from right to left, pervade the entire shell.

The body-whorl is angular, with a flattish base, becoming subconvex towards the aperture; the ornamentation is substantially as in the spire-whorls, but the fine, undulating spiral lines are more numerous; these decussate with axial striæ. So likewise in the base. The aperture is rounded on the columellar side, the columella being extremely short and incrusted, but the outer lip is angular, and drawn out laterally.

Relations and Distribution.—The details of ornamentation differ considerably from Gemmellaro's type, the principal difference being that in the English specimens the keel is more anterior. The smoothness of the base in Gemmellaro's specimen was most probably due to the accidents of conservation, since it is not probable that a shell whose sides are so rugose should possess a perfectly smooth base.

Nevertheless the more salient features of the British and Sicilian shells approximate sufficiently to justify our regarding the two forms as varieties of one species.

Our best specimens occur in the *Murchisonæ*-zone of Babylon Hill. Hence we might name this form *H. Damesi*, var. *Babylonica*. It is also found sparingly on the same horizon at Stoford and Bradford Abbas. Modifications of ornament induced by solvents are apt sometimes to produce rather puzzling results in this species.

239. Hamusina Oppelensis, *Lycett*, 1857. Plate XXIV, fig. 13 (Coker variety), fig. 14 (type refigured).

1857. Turbo Oppelensis, *Lycett*. The Cotteswold Hills, p. 127, pl. iii, fig. 8.
Cf. also Turbo Bertheloti, *d'Orbigny*. Prodrome, i, p. 248; and Terr. Jur., vol. ii, p. 337, pl. cccxxviii, figs. 7 and 8.

Bibliography, &c.—Lycett observes that this is a remarkable species, resembling *Turbo Bertheloti* in its general figure and sinistral spire, but the latter has a double row of tubercles, and is destitute of the transverse ribs. As the result of a careful examination of the only three available specimens from the Cotteswolds, I am forced to conclude that the strong transverse (axial) ribs shown in the original figure, and also in Pl. XXIV, fig. 14, of the present work, are not structural features. The real ornamentation is more truly depicted in the large shell from Coker (fig. 13); but the Cotteswold specimens show it more or less, though the ornaments have been variously modified by mineralisation and development from a hard and unkindly matrix. As so often the case, the "type" is an unfortunate specimen, calculated to mislead alike the author, the artist, and the reader.

The subjoined description of *Hamusina Oppelensis* is based partly on Cotteswold and partly on Coker specimens. It would seem to be a very general rule that species of Gasteropoda, as they are followed from Dorset-Somerset into the Cotteswolds, diminish greatly in size. The sinistral Gasteropods are no exception to the rule.

Description:

Length	30—50 mm.
Height of body-whorl to total length .	35 to 40 : 100.
Spiral angle about . . .	46°.

Shell sinistral, thin, conical, without umbilicus. Apical conditions unknown. Number of whorls about eight; these are somewhat convex towards the centre, and upon the convexity is a single row of tubercles; at the anterior extremity is a plain carina. The sutures are close. Fine spiral granulation is shown both in the flanks and base of some of the Cotteswold specimens.

Body-whorl angular and similarly ornamented; base rather flat, and probably spirally striated. Aperture subcircular; lip rounded and thickened on the columellar side, which is very short; outer lip slightly angulated.

Relations and Distribution.—The points wherein *H. Oppelensis* differs from *H. Bertheloti* have been already indicated. The Cotteswold shells may be said to differ from d'Orbigny's species more than do the Coker specimens.

The Cotteswold specimens occur in the Upper Pisolite of Longfords, in the Nailsworth district. This also is in the *Murchisonæ*-zone, but presumably somewhat higher than the Coker beds.

Genus—CIRRUS, *Sowerby*, 1816.

Re-defined as follows:—*Shell sinistral, irregularly conical to subdiscoidal, often turbinate; columellar area very short; more or less umbilicated. Spire acute; spiral angle more or less concave; whorls very irregular and variable, sometimes flat, sometimes more or less tumid; sutures rather close. Whorls rugosely ornamented; large and sometimes spinous tubercles occur at the intersections of the spiral and axial systems; varices sometimes occur, whilst the striæ of growth are conspicuous and oblique. Body-whorl ventricose; aperture circular, expanding, and adherent.*

The above diagnosis would include *Scævola*, Gemmellaro, which Fischer classifies along with *Cirrus* under the Delphinulidæ. Other authors, like Tate, place *Cirrus* under the Solariidæ. Sowerby thought that *Cirrus* and *Euomphalus* merged into each other, and that both were distinct from *Delphinula*.

It will be convenient to commence with those forms, which, from their more regular spiral angle and trochiform shell, most nearly approach *Hamusina*.

240. CIRRUS ETHERIDGII, *Lycett*, 1857. Plate XXIV, fig. 15.

1857. TURBO ETHERIDGII, *Lycett*. The Cotteswold Hills, p. 125, pl. vi, fig. 3.

Description:

Length	26 mm.
Height of body-whorl to total length	42 : 100.
Spiral angle	46°.

Shell sinistral, conical, moderately turrited; umbilicus contracted, spiral angle slightly concave, spire acute; number of whorls seven or eight, rather flat, and ornamented with about five rows of granulated spirals, more or less decussated by axial lines, thus producing a structure partly granular and partly reticulate.

Body-whorl subventricose with a rounded base, produced anteriorly, and ornamented by close and finely granulated spirals; the narrow umbilicus has a distinct row of granules encircling its edge; aperture round.

Relations and Distribution.—We may regard *Cirrus Etheridgii* as a somewhat aberrant form of the *Leachi*-group. It is, as far as I know, peculiar to the Cotteswolds. The only two specimens to which I have had access are said to come from the Gryphite-grit of Rodborough Hill, which is about the horizon of the *concavus*-zone at Bradford Abbas.

241. Cirrus, species or variety. Plate XXIV, fig. 16.

Attention may here be drawn to a very fine specimen of *Cirrus* belonging to Mr. Monk, which comes from Stoford or Bradford Abbas. It is not unlike *C. Etheridgii* just described, except in being a little broader and more ventricose, and in having the system of ornamentation more espaced and reticulate. The umbilicus also is larger. This form also is a member of the *Leachi*-group, though it differs in several important characters from that demoid species.

So fine a specimen as the one figured is unique; but here and there in the North-Dorset beds one finds fossils which are difficult to refer to *Cirrus Leachi*, and which have a certain resemblance to this one. These I distinguish temporarily as *Cirrus* "*reticulatus*." The fossil noticed by Mr. J. Buckman ('Proc. Dorset N. H. Club,' p. 139, pl., fig. 5) as *Cirrus pyramidalis*, Tawney, an altogether erroneous identification, bears some resemblance to the forms I call *Cirrus* "*reticulatus*."

242. Cirrus gradatus, sp. nov. Plate XXIV, fig. 17.

But cf. as possibly an immature specimen—
Cirrus intermedius, *J. Buckman*. Proc. Dorset N. H. Field Club, p. 138, pl., fig. 4.

Description:

Length	48 mm.
Height of body-whorl to total length . .	35 : 100.
Spiral angle	46°.

Shell sinistral, conical, turrited, deeply umbilicated. Spire acute; spiral angle moderately concave. The extreme apical conditions are unknown. Number of whorls about twelve; the earliest recognisable are flat without turriting, and ornamented by spirals decussating with numerous axial ribs, the most prominent spiral being a little below the centre (see enlargement of fig. 17). Presently the whorls of the spire are seen to be turrited in steps with a central keel, which is very salient and nodose, and a less conspicuous anterior keel, which forms a thin serrated border. In the matured whorls the strong axial ribbing of the earlier portions of the spire has a tendency to become faint; the growth-lines are numerous and fine.

The body-whorl is angular, subventricose, and bicarinate, but the lower keel representing the serrated border is apparently not salient or much tuberculated. The character of the base is not established with certainty (the specimen, fig. 17, is defective in this respect), but it is probably more or less marked by axial ribbing; umbilicus funnel-shaped and deep. Aperture circular, small, and adherent.

Relations and Distribution.—This elegant and conical species is a member of the *Leachi*-group, and there are so many intermediate forms (*? Cirrus intermedius*, J. Buckman) that one cannot doubt the one passes into the other. It is distinguished from the majority of specimens of *Cirrus Leachi* by a greater number of whorls, by its more conical figure, by the less concavity of the spiral angle, and the less ventricose figure of the body-whorl. On the whole, likewise, the ornamentation is less rugose, and the axial ribbing of the spire whorls less strongly developed, whilst the whorls themselves are more disposed in steps.

Occurs sparingly in the *Murchisonæ*-zone of Coker and Stoford.

As regards *Cirrus intermedius*, Buckm., if this really is the immature form of *C. gradatus*, then the older name would take precedence. But there seems to be so much doubt as to what *Cirrus intermedius* really is that I prefer to keep them distinct for the present.

243. Cirrus Leachi, *Sowerby*, 1818. Plate XXV, figs. 3, 4, and 5.

1818. Cirrus Leachi, *Sow.* Min. Conch., pl. ccxix, fig. 3, and ? fig. 1.
1866. — (T. Hörnesi or T. Bertheloti), *Moore.* Middle and Upper Lias S.W. England, p. 94, pl. vi, figs. 7, 8.
1879. — Leachi, *Sow.; sp.*, *J. Buckman.* Proc. Dorset N. H. Field Club, vol. iii, p. 137, pl., figs. 1 and 2.

Cf. for doubtful members of the *Leachi*-group—

1816. Cirrus nodosus, *Sow.* (No. 1)—Min. Conch., pl. cxli, fig. 2.
1879. — intermedius, *J. Buckman.* Op. et vol. cit., p. 138, pl., figs. 4, 4 *a*.

Cf. for more or less closely allied species—

1861. TURBO HÖRNESI, *Stoliczka.* Hierlatzsch., p. 176, pl. ii, figs. 14, 14 *a*.

1874. CIRRUS FOURNETI, *Dumortier.* Dépôts Jurass. Bass. Rhône, pt. 4, p. 146, pl. xxxvi, fig. 9.

1878. SCÆVOLA BUSAMBRENSIS, *Gemmellaro.* Faune Giuresi, &c., p. 341, pl. xxvii, figs. 1, 2.

Bibliography, &c.—We have now to consider the prevailing forms of *Cirrus*, which it is convenient to focus under the general term of *C. Leachi.* The upper row of spiniform tubercles mentioned by Sowerby as noted in the type are rarely seen in specimens, simply because they are not preserved. The type which was obtained at Dundry is now the property of the Bristol Museum. On comparing this fragment with numerous specimens from Coker, Stoford, &c., there can be little doubt as to its substantial agreement with the prevailing forms.

There is, of course, the usual difficulty about names. When Sowerby's attention was first drawn in 1816 to the sinistral Gasteropods of the Inferior Oolite he named the cast "which was picked up near Yeovil," *Cirrus nodosus.* It is necessary to put this *C. nodosus,* No. 1, out of court altogether. First, it is only a cast; secondly, it was imperfectly diagnosed; and thirdly, the name "*nodosus*" was two years later applied by the author to a very different species. I may also remark that the title "*nodosus*" is applicable to nearly all these shells.

Thus Sowerby, who had made a complete mess of his genus *Cirrus*, bequeathed us an evil inheritance in the awkward mixture of names for the two most abundant species. Was it this which led the late Mr. Tawney to state that there was sufficient material in the Bristol Museum to prove the identity of *Cirrus Leachi* with *Cirrus nodosus?* Why did he not go a step further and include *Cirrus Calisto*, since an excellent specimen of that very distinct form was found on the same tablet? Undoubtedly *Cirrus Leachi* is the central form which holds out its hand to all the others, but there are many named forms much nearer to *C. Leachi* than the subdiscoidal species we now recognise as *C. nodosus.*

Description.—(N.B.—Since there is so much variety in this species a considerable margin must be allowed in interpreting proportional dimensions.)

Length	35—40 mm.
Height of body-whorl to total length . .	40 : 100.
Spiral angle (mean)[1] . . .	56°.

Shell sinistral, irregularly conical, strongly turrited, more or less umbilicated. Spire acute, spiral angle very concave, sutures close. Number of whorls eight to ten; extreme apical conditions unknown; the earlier whorls flat, without

[1] The angle is measured so as to include the periphery of the body-whorl. Owing to the concave shape of the shell the difference between the opening of the spiral angle and the mean spiral angle amounts to about 20° in *Cirrus Leachi* and about 80° in *Cirrus nodosus.*

turriting, and ornamented by spirals decussating with numerous closely set axial lines. In the last three or four whorls of the spire the ornamentation becomes very rugose, but with considerable differences of development. The anterior half of the whorls is occupied by two keels, of which the upper one is grossly tuberculated; the lower keel is sometimes tuberculated, sometimes it is little more than a serrated band (as in *C. gradatus*). Axial ribbing extremely coarse and rather wide apart. In well-preserved specimens a system of reticulation between fine intermediate spirals and the oblique growth-lines may be seen. In specimens from Coker this feature is rarely preserved.

The body-whorl is largely ventricose, subangular, and rugosely bicarinate, but there are considerable differences; specimens from Dundry have a rounder and still more ventricose body-whorl, with ornamentation so irregular that the spiral is often overpowered by thick tubercular axial costæ. The base is full, subangular or rounded, and strongly costated; the umbilicus varies considerably in width and depth. Aperture circular, expanding somewhat, and adherent.

Relations and Distribution.—There is a strong temptation to make several species out of *Cirrus Leachi*, and indeed one might fill a quarto plate with figures of varieties. Firstly, we have—

a. The very wide angled and coarsely costate form with bicarinate and angular whorls from the *bifrons*-beds of Compton, which was figured by Moore; the ornamentation somewhat resembles that of *Turbo Hörnesi*, Stol., but the Compton fossils have a much wider spiral angle, and are umbilicated.

b. The prevailing form at Coker and elsewhere in the *Murchisonæ*-zone of Dorset is not unlike that of the Compton fossils, but the ornaments are not quite so rugose, and the spire is rather higher. This variety was well figured by J. Buckman. Fig. 3 of the accompanying plate represents a somewhat less angular form of this variety.

c. There is a smaller and somewhat less ventricose variety with finer and closer costæ from Bradford Abbas (see fig. 5).

d. Specimens from Dundry, in the Bristol Museum, are extremely ventricose, the body-whorl being both wide and high, and the bicarinate character becomes almost obliterated by rugose axial ornamentation. To a certain extent this variety is represented by *Cirrus Fourneti*, Dum. I am somewhat inclined to classify the very elegant specimen from Bradford Abbas, fig. 4, with this section. In this particular specimen the umbilicus is so restricted that I have distinguished it in my Collection as var. "*subumbilicata*."

Cirrus Leachi abounds at Coker and Stoford, but is not very common at Bradford Abbas. Fine specimens were formerly obtained at Dundry. One would expect some modification of the demoid species of *Cirrus* to occur in the Cotteswolds, but at present I am without reliable information on this point.

A single specimen, said to be from the Oolite Marl, may fairly be regarded as a member of the *Leachi*-group, but it would be going a long way in "lumping" to describe it even as a variety of *Cirrus Leachi.* No species of *Cirrus* has, to my knowledge, been found either in the Lincolnshire Limestone or in the beds of Inferior Oolite age in Yorkshire.

244. CIRRUS PYRAMIDALIS, *Tawney*, 1873. Plate XXIV, figs. 18, 19, types refigured; fig. 20, variety from the Cotteswolds.

1873. CIRRUS PYRAMIDALIS, *Tawney*. Dundry Gasteropoda, p. 37 (29), pl. ii, figs. 10 *a*, 10 *b*.
Non — — — sp., *J. Buckman*. Proc. Dorset N. H. Field Club, p. 139, pl., fig. 5.

Description:

Length	30 mm.
Height of body-whorl to total length . .	40 : 100.
Spiral angle (mean) about . . .	65°.

Shell sinistral, turbinate, moderately umbilicated. Spiral angle concave; apex acute, but extreme apical conditions unknown. Number of whorls about ten or eleven; the apical ones are nearly flat, but with the sudden increase in the width of the spiral angle become convex, with a basal keel moderately developed, below which the sutures have rather a tendency to gape. The ornaments consist of a number of fine wavy spirals, which decussate with very numerous closely-set oblique growth-lines. Rugose axial costæ extend from suture to suture in the earlier whorls, but fail quite to reach the anterior margin in the penult.

The body-whorl is very ventricose, with one strong keel at the angle of the whorl, which the axial costæ just fail to reach. Numerous fine undulating lines represent the spiral ornamentation, and one of these lines is sometimes of sufficient prominence to form a slight posterior keel. The base is rounded, and full of fine reticulate ornament, and the margin of the umbilicus is corrugated by low radial costæ not always perceptible. Aperture circular, expanding, and adherent.

Relations and Distribution.—It may be doubted whether this is anything more than a local variety of the species next described. The differences are mainly those of ornamentation, but in the form now under consideration the whorls are less turbinate, the body-whorl is more angular, the habit of growth smaller, and the spiral lines much finer and more close-set. Rare at Dundry. A variety (fig. 20) occurs in the Cotteswolds.

245. Cirrus Calisto, *d'Orbigny*, 1850. Plate XXV, fig. 1 (British variety).

1850. Turbo Calisto, *d'Orbigny*. Prodrome, vol. i, p. 300.
1852. — — — Terr. Jur., ii, p. 345, pl. cccxxxii, figs. 9, 10.
1879. Cirrus Calisto, *d'Orbigny*, sp., *J. Buckman*. Proc. Dorset N. H. Field Club, p. 139, pl., figs. 6, 6 *a*.
1884. Hamusina Calisto, *d'Orbigny*, sp., *Cossmann*. Ét. Bath., p. 249, pl. xiv, fig. 5.

Bibliography, &c.—Rather than make a new species on this occasion I prefer to follow the example of J. Buckman, and identify the Coker fossils with d'Orbigny's species. There are certain difficulties which present themselves with respect to "*Turbo*" *Calisto*. The type required some restoration, and thus it came to pass that d'Orbigny and Cossmann have differed somewhat as to the interpretation to be placed upon the fragments at their disposal. Moreover the French specimen is said to come from the Bathonian of Luc, whereas it is important to remember that no species of *Cirrus* or of *Hamusina* is known from the Great Oolite of this country, nor even from the Upper Division of the Inferior Oolite.

D'Orbigny's original diagnosis in the 'Prodrome' fits our specimens very well: "Magnificent sinistral species, whose convex whorls are striated spirally [*en long*] and ornamented with thick transverse undulations near the suture." The *Calisto*-group includes *Cirrus pyramidalis* and *Cirrus varicosus*, and appears to be connected with the *Leachi*-group through var. *d* of the latter species and its modifications.

Description:

Length	50 mm.
Height of body-whorl to total length . .	42 : 100.
Spiral angle	60°.

Shell sinistral, turbinate, umbilicated; apical conditions unknown. The number of whorls is conjectural, but the indications point to about ten, as there is every probability that the spire contracts with a concave spiral angle. The sutures of the lower whorls are wide, almost to gaping. The umbilicus is funnel-shaped, and of moderate width. There is no need to add further to d'Orbigny's description.

Relations and Distribution.—The differences which separate this species from *Cirrus pyramidalis* are little more than varietal, such differences being accentuated by change of matrix. What I have termed the British variety of *Cirrus Calisto* is not very uncommon at Coker, though generally much smaller than the figured specimen. These specimens bear considerable resemblance to each other, so that the figured specimen, though unusually fine, is thoroughly representative (I have one even larger). The French specimen, according to the figure in the 'Terrains Jurassiques,' has the whorls somewhat more angular than the Coker variety, but there does not seem anything in the author's description to bear out this feature. Some of the Coker specimens show the laminated structure due to the oblique growth-lines, which is also very conspicuous in the types of *Cirrus pyramidalis.*

Smaller specimens of *Cirrus Calisto*, crushed and badly preserved, occur in the Pea-grit at Longfords and at Crickley.

246. Cirrus varicosus, sp. nov. Plate XXV, fig. 2.

Description:

Length	20 mm.
Height of body-whorl to total length . .	44 : 100.
Spiral angle (mean)	62°.

Shell sinistral, turbinate, moderately umbilicated; spiral angle concave. Number of whorls probably ten; apical ones unknown. The whorls are convex, widely separated by the suture, and ornamented by numerous rugose spiral lines, whilst the traces of axial costæ are slight and confined to the posterior half of each whorl. About three stout varices are developed in each whorl, but not in regular sequence, and this kind of ornamentation is continued throughout the base to the margin of the umbilicus.

The body-whorl is moderately ventricose and without keel; aperture circular, adherent, and probably expanding.

Relations and Distribution.—There can be no doubt that this form is closely related to *Cirrus Calisto*, *i. e.* to the Coker variety of that species. But it cannot be regarded as merely the local representative of the Coker fossils, for we find exact micromorphs of these on the Pea-grit horizon. There is every reason to believe that *Cirrus varicosus* occurs in the Oolite-Marl, and thus represents the *calisto*-group on a somewhat higher horizon. Extremely rare.

247. Cirrus nodosus, *Sowerby*, 1818. Plate XXV, fig. 6.

1818. Cirrus nodosus, *Sow.* Min. Conch., pl. ccxix, figs. 2 and 4.
1879. — — sp., *J. Buckman.* Proc. Dorset N. H. Field Club, p. 137, pl., figs. 3, 3 *a*.
Non Cirrus nodosus, *Sow.* Min. Conch., pl. cxli, fig. 2.

Bibliography, &c.—It is unnecessary to repeat what has already been intimated with respect to this species when dealing with *Cirrus Leachi.*

Description.—The following are the proportional dimensions of the shell figured (spire restored):

Length (*i. e.* height)	32 mm.
Height of body-whorl to total length . .	50 : 100.
Ratio of height to width . . .	62 : 100.
Opening of the spiral angle . . .	30°.
Mean spiral angle of shell . . .	120°.

Shell sinistral, conical-depressed (subdiscoidal), widely and deeply umbilicated. The spire is conical-elongate, having towards its upper part an angle of 30°—35°. The precise apical conditions are unknown, but there is no reason to doubt that the earlier whorls are flat, as in *C. Leachi*, costate or reticulate, close and not turrited.

When this earlier stage is concluded, with an entire change of shape the nodose character of the whorls becomes more and more conspicuous. By sudden bounds the whorls begin to increase outside the apical angle, and the anterior whorls, including the body-whorl, expand into a broad discoidal shell with canaliculate sutures. The ornaments in this stage are somewhat variable, but the main feature is a central keel at the angle of each whorl, which is grossly tuberculated in connection with axial costæ.

The body-whorl expands greatly, so as partly to enclose the preceding whorl. It somewhat resembles a tube, angular externally, circular internally. Thick costæ occur at regular intervals on the upper surface; at the upper angle of the tube these costæ thicken into a series of knots which constitute the first or uppermost spiral; a short distance below this is a subsidiary spiral on the flank of the shell, and below this again the ribs cross a clear space until they reach another spiral, which is subsidiary to the row of nodosities (fourth spiral) at the lower angle of the tube. In the base is a fifth tuberculated spiral (row of nodes) at the edge of the umbilicus, which is enormous both in width and depth. The aperture is circular, adherent, and expanding considerably towards the peristome.

In the Coker specimens the finer ornamentation is rarely preserved, but we see traces of closely-set curved growth-lines decussating with extremely fine spiral lines.

Relations and Distribution.—This very remarkable species seems to stand alone, though probably its nearest relative is *Cirrus Leachi.* But I fail to detect in collections obviously intermediate forms. The short spire, discoidal aspect of the shell, and tubiform shape of the body-whorl will usually serve to distinguish *C. nodosus* from any other species of *Cirrus.* As far as appearances go, the form of this shell would seem to justify Sowerby's idea that there was a connection between *Cirrus* and *Euomphalus.*

Cirrus nodosus is very abundant at Coker—the most abundant species according to J. Buckman. It also occurs in the irony nodule-bed (*Murchisonæ*-zone) at Burton Bradstock, whence splendid specimens are sometimes obtained. It is also met with at Stoford, at Bradford Abbas, and at Dundry. I have not seen any representative of this species from the Cotteswolds.

Note on DISCOHELIX *and* STRAPAROLLUS.

I have already indicated that *Discohelix* may be regarded as a sub-genus of *Straparollus*, which, if we accept the views of d'Orbigny, is the same as *Euomphalus*, Sowerby. It is evident that *Straparollus*, as interpreted by d'Orbigny, included *Discohelix*. On the other hand, Mons. Cossmann ('Ét. Bath.') is inclined to refer most of the Bathonian species of *Straparollus* to *Solarium*.

There certainly does seem to be a sort of gradation between the flat and biconcave form of the most typical *Discohelix* through the several species of *Straparollus* into *Solarium*. But in the latter genus the whorls slope towards the apex, whereas in *Discohelix* and *Straparollus* they are more or less flat, like a strap-coil. Hence *Solarium* is more easily separated from *Straparollus* than the latter is from *Discohelix*.

In the following diagnosis of *Discohelix* and *Straparollus* the peculiarities of the Inferior Oolite forms have been more especially studied, and it is by no means pretended that such a diagnosis of *Straparollus* would be found wholly applicable to the Palæozoic species thus named.

I should be rather inclined to classify under one genus all the forms which, in the following pages, have been assigned to *Discohelix* and *Straparollus*. With this proviso the two following diagnoses are submitted.

Genus—DISCOHELIX, *Dunker*, 1847.

Shell discoidal, depressed, more or less biconcave; whorls arranged in flattened coils round a centre, squared at the periphery and furnished with two marginal keels, usually tuberculated; aperture quadrangular.

Genus—STRAPAROLLUS, *Montfort*, 1810.

Shell discoidal, more or less depressed; the under side largely excavated, the upper side flat, or with the spire slightly raised in steps; whorls coiled like straps, somewhat *flattened at the periphery, but more or less pinched in anteriorly, usually provided with two tuberculated marginal keels. Aperture quadrangular.*

As a rule in the species referred to *Straparollus*, the shell, even when there is no salience of the spire, is proportionately higher than in *Discohelix*. All the forms are rare.

248. Discohelix Cotswoldiæ, *Lycett*, 1850. Plate XXV, fig. 7.

1850.	Solarium Cotswoldiæ, *Lycett*.	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 419, pl. xi, fig. 2.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 80, pl. ii, fig. 2.
1854.	— — sp. Morris.	Catalogue, p. 279.
1857.	— — *Lycett*.	Cotteswold Hills, p. 40.

Description :

Diameter (large size)	12 mm.
Height	4 mm.

Shell discoidal, depressed, upper and under surfaces nearly equally excavated, but there is some difference in this respect, and also in the relative height of the specimens. Diameter ranges from 6 to 12 mm. The sides of the whorls are rather flattened, but having the margins rounded off; these latter are furnished both on the upper and under surface with numerous nodules of moderate size, rather close together. The smaller specimens show richer ornamentation than the larger ones, and in some specimens (like the one figured) there is a tendency for the nodes to die out towards the aperture.

All the whorls are ornamented by fine wavy spiral lines, and in the body-whorl this feature prevails both above and below and on the flank. Aperture quadrangular, spiral and axial diameters nearly equal.

Relations and Distribution.—There is considerable variety in the shells referred to *Discohelix Cotswoldiæ*. Moreover, in many instances, the specimens are by no means well preserved. Consequently we may in fact be dealing with more than one species. Morris suggested that *Solarium Cotswoldiæ* might be identical with *Euomphalus tuberculosus*, Thorent; but the differences are very considerable, as may be seen further on. Doubtless most of these forms are merely local varieties of some other form, but, on the whole, *Discohelix Cotswoldiæ* is sufficiently distinct from anything hitherto described to be entitled to rank as a separate species.

It occurs chiefly in the Oolite-Marl and Freestones of the Nailsworth district. I have small specimens from Crickley. Lycett also quotes it from Leckhampton.

249. Discohelix spinosus, *Wright*, MS. Plate XXV, fig. 8.

1859. Straparollus spinosus (name only), *Wright.* Quart. Journ. Geol. Soc., vol. xvi, p. 36.
1873. ? — sp., *Tawney.* Dundry Gasteropoda, p. 36 (28).
Cf. also — subæqualis, *d'Orbigny.* Terr. Jur., vol. ii, p. 311, pl. 322, figs. 8—11.

Description :

Diameter (fair size)	24 mm.
Height	8 mm.
Diameter of largest specimen known . .	46 mm.

Shell depressed, discoidal, upper and under surfaces nearly equally excavated. The whorls are subquadrangular, with sides almost perfectly flat, and the marginal keels are largely tuberculated at intervals. The spiral ornamentation is so fine as in many cases not to be detected; this is decussated with somewhat rugose striæ of growth, perpendicular or curved. In the larger shells the marginal tuberculation extends in ill-defined swellings or costæ right across the body-whorl. Aperture quadrangular, spiral and axial diameters nearly equal.

Relations and Distribution.—This species is by far the largest of any described under *Discohelix-Straparollus* from the Inferior Oolite of this country.[1] It most resembles *Straparollus subæqualis*, d'Orbigny, from the Inferior Oolite of Fontenay and Niort, both as to habit of growth and general character, but the marginal tuberculations present a considerable difference. It is also related to *Straparollus tuberculosus*, Thorent, but is truly biconcave and dextral. From all other British species of *Discohelix* and *Sraparollus*, except the one next described, it may be separated by the fineness of the spiral ornamentation. In many specimens this is so fine that the shells appear smooth, though this appearance, no doubt, is partly due to wear.

Discohelix spinosus occurs principally in the *concavus*-bed of Bradford Abbas, where it is rather rare.

250. Straparollus "tuberculosus-dexter." Plate XXVI, fig. 1.

1854. Euomphalus tuberculosus, *Thorent*, sp. Morris, Cat., p. 248.
Cf. — — — Mém. Soc. Géol. France (1839), vol. iii, pt. 2, p. 259, pl. xxii, fig. 8.

Bibliography, &c.—To a certain extent the specific name "*tuberculosus*" is applicable to all species of *Discohelix* and *Straparollus* described in this Mono-

[1] Owing to unequal enlargement, and to the selection of medium-sized specimens, this fact is not made sufficiently evident in the plates.

graph. Hence there is a sort of natural tendency to identify the British forms with Thorent's species from the Inferior Oolite of the Aisne. As regards the form of tuberculation, *Discohelix spinosus* more nearly resembles it. The fossils now under consideration merely represent a modified form of *Discohelix spinosus* on a higher horizon, but they are flat atop and not biconcave: hence, according to the distinction adopted, they belong to *Straparollus;* and thus in structure, and probably in habit of growth, they most nearly resemble the original *Euomphalus tuberculosus*. From the fact of Morris having quoted "Bridport" as the locality, I have very little doubt that he was referring to the form now under consideration.

Description :

Diameter	15 mm.
Height	5 mm.

Shell depressed, discoidal; under surface largely excavated, upper surface nearly flat or slightly concave. The whorls are quadrangular, with flattened sides, which exhibit a very slight tendency towards contraction anteriorly. The marginal keels are grossly tuberculated, both on the upper and under side; on the flanks of the body-whorl these tuberculations almost extend across. Spiral ornamentation very faint; striæ of growth conspicuous, perpendicular or curved. Aperture quadrangular, spiral and axial diameters nearly equal.

Relations and Distribution.—The affinities of *Str. tuberculosus-dexter* have already been partly discussed. It differs from the French fossil in its dextral habit, and to some extent in the shape of the tuberculations. There are no sinistral forms in the Inferior Oolite of this country, but *Straparollus sinister* makes its appearance in our Middle Lias precisely as it does in France. Hence it seems to me that a dextral habit in our shell is an important element of difference.

There are two specimens in my Collection from the *Parkinsoni*-zone of Burton Bradstock, besides one in the Jermyn Street Museum evidently in a similar matrix, and another from (?) Dundry. Small specimens from Hook Norton (C or upper part of B of Mr. Walford's classification) approach the Burton Bradstock fossils, though with a leaning towards *Solarium disculum*, Morris and Lycett. There is also a specimen from the Lincolnshire Limestone of Stoke Lodge, which in some respects has more resemblance to Thorent's figure than any previously examined.

251. Straparollus pulchrior, sp. nov. Plate XXV, fig. 9.

Description :

Diameter	20 mm.
Height	6 mm.

Shell depressed, discoidal; under surface largely excavated, upper surface flat or scarcely concave. The whorls are numerous, narrow, quadrangular, with flattened sides, which in some specimens exhibit more tendency towards contraction anteriorly than in others. The marginal keels are closely tuberculated, the tubercles being rather round and small. These tuberculations are of equal strength on both upper and under surface, but are scarcely connected by costæ across the flanks of the body-whorl. The entire shell is richly ornamented by a trellis-work of spiral lines decussating with growth-lines. Aperture quadrangular, the axial diameter considerably longer than the spiral.

Relations and Distribution.—This beautiful species is easily distinguished from those previously described by the narrowness of the whorls and the peculiar roundness and closeness of the nodes. In the character of the spiral lines it somewhat approaches *Discohelix Cotswoldiæ*, but differs greatly both in ornamentation and the shape of the whorls. To a certain extent our shell resembles *Str. pulchellus*, d'Orb. ('T. J.,' ii, p. 312, pl. cccxxiii, figs. 1—4), but that species is more depressed, and its whorls are triangular rather than square.

Straparollus pulchrior is essentially a fossil of the *Murchisonæ*-zone. I have specimens from Mapperton, Coker, and Bradford Abbas, at all which places it is very rare. Apparently it occurs also at Dundry.

252. Straparollus Dundriensis, *Tawney*, 1873. Plate XXVI, fig. 2.

1873. Straparollus Dundriensis, *Tawney*. Dundry Gasteropoda, p. 35 (27), pl. ii, figs. 9 *a*, 9 *b*.

Description:

Diameter	18 mm.
Height	9 mm.

Shell depressed, discoidal; under surface considerably excavated, upper surface nearly flat, or sometimes slightly raised. The whorls are numerous, quadrangular, narrow (spirally), deep (axially); the sides are flattened with a considerable amount of anterior contraction as shown in the body-whorl. The tuberculations on the upper marginal keel are very dense and round, and the effect is to raise the keel considerably, and thus produce a sulcation of the rest of the upper surface, which also has about four dotted spiral lines between the rows of tubercles.

The body-whorl is deep, its height being equal to half the total diameter of the shell, though there is some difference in this respect; ornamented on the flank with spiral lines, which decussate with curved growth-lines so as to produce a rich reticulate pattern. The upper angle is somewhat less than a right angle; its edge (upper marginal keel) is ornamented with numerous sharpish tubercles, decussated by spiral lines. The lower marginal keel is also provided with a number of sharp tuberculations set like a ring round the umbilicus. Ornaments of the lower or umbilical surface uncertain, though there are indications that they bear considerable resemblance to those of the upper surface. Aperture quadrangular, the axial diameter longer than the spiral.

Relations and Distribution.—The great depth of this shell, irrespective of its peculiar ornamentation, separates this species readily from any previously described in this work.

The best and most characteristic specimens are from Dundry. A variety occurs at Stoford, most probably in the *Murchisonæ*-zone. I also possess five specimens in a matrix similar to that of the *Murchisonæ*-zone at Coker, and there is one specimen belonging to the Jermyn Street Museum from the same locality. Altogether about a dozen specimens are known to me.

253. Straparollus exsertus, sp. nov. Plate XXVI, figs. 3 and 4.

Description:

Diameter	20 mm.
Height excluding spire	8 mm.
Height including spire	13 mm.

Shell depressed, subdiscoidal, widely umbilicate. Spire rather oblique, slightly trochoid, and sometimes equal to about one-third the entire height. Number of whorls about seven, narrow, subquadrangular, and arranged in steps. The tuberculations on the upper marginal keels are large, pointed, and wide apart, the tuberculations being drawn out spirally.

The upper angle of the body-whorl is nearly a right angle, but the flank is rapidly pinched in towards the anterior marginal keel so as to produce a subtrigonal shape of the whorl. The ornaments of the base or umbilical area are not known for certain, except that the edge of the umbilicus formed by the lower marginal keel is tuberculated. The aperture is quadrangular, the axial diameter being the longest, and the outer lip is somewhat produced anteriorly.

Relations and Distribution.—This species forms a step in the direction of *Solarium.* The bold and rather widely spaced tuberculation separates it from those varieties of *Str. Dundriensis* where the spire is somewhat salient. Of the forms previously described in this Monograph, the nearest in ornamentation and in the narrowness of the whorls is *Str. pulchrior*, but in that species the whorls are square rather than subtrigonal, and not nearly so deep, whilst the upper surface is always flat.

Straparollus exsertus is a fossil of the *Murchisonæ*-zone of Bradford Abbas and Coker, where it is extremely rare. Fig. 4 represents a more depressed variety from North Dorset, but the precise horizon and locality are unknown.

254. Straparollus, cf. altus, *d'Orbigny*, 1853. Plate XXVI, fig. 5.

1852-3. Straparollus altus, *d'Orb.* Terr. Jur., vol. ii. p. 314, pl. cccxxxii, figs. 5—8.

Description :

Diameter	11 mm.
Height	10 mm.

In the specimen under notice the width and height are nearly equal; spire about one-fifth the total height. The whorls externally (six) are subquadrangular to trigonal, flat atop, and occur in steps. The marginal tuberculations are well developed and rather close. The upper angle of the body-whorl is a right angle, but the flank rapidly contracts towards the umbilicus, which is of moderate dimensions and surrounded by a few large and pointed tubercles. Aperture trapezoidal and produced in front.

Relations and Distribution.—This form seems to be a further step in the direction of *Solarium;* though about three times the size of d'Orbigny's type from the Bathonian of Langrune, the resemblance is strong. A single specimen from the Inferior Oolite near Beaminster.

Note.—Besides the species of *Discohelix* and *Straparollus* enumerated above, we find here and there throughout the Inferior Oolite specimens which from imperfect preservation it is impossible to diagnose, *e. g.* below the *Opalinus*-bed at Burton Cliff. Again, there is a very thin form in the *Opalinus*-bed of the same locality: a similar form occurs in the blue stone at Duston.

Genus—Solarium, *Lamarck*, 1799.

Shell orbicular, conical-depressed, largely umbilicated; whorls subtrigonal and sloping; spire regular, nucleus oblique; umbilicus deep, the outer margin crenulated; aperture trapezoidal.

D'Orbigny seemed to entertain no doubt as to *Solarium* having been a Jurassic genus; and Cossmann would still further enlarge its scope, since the latter author refers several of the species described by d'Orbigny under *Straparollus* to *Solarium*. Fischer, on the other hand, expresses doubts, observing that "the numerous species [of *Solarium*] indicated in the Jurassic beds belong probably to the genus *Straparollus*." Morris and Lycett described two species of *Solarium* from the Great Oolite; one of these (*S. disculum*) is, according to my views, a species of *Straparollus*.

The small shells from the Inferior Oolite which I refer to *Solarium* constitute a fairly distinct group in that series; and one of them, *S. subvaricosum*, may fairly be regarded as a typical representative of the modern genus.

255. Solarium pisoliticum, sp. nov. Plate XXVI, figs. 6—8.

Description:

Diameter (average size) . . .	4 mm.
Height	2·75 mm.
Spiral angle	125°.

Shell greatly depressed, moderately umbilicated; nucleus oblique. Number of whorls in the majority of specimens about five; the earlier ones convex and orbicular at the periphery, but the body-whorl is flatter and slightly angulated at the periphery. As regards ornaments, the extreme apicals appear to have been rather smooth, but a rich radial ornamentation is early developed, and this in the body-whorl is slightly decussated spirally, so as to form a series of closely-set nodose costæ.

The body-whorl is relatively large and bicarinated, and the radial ornamentation is carried as far as the anterior keel, which, as a rule, is less nodose than the upper one. Base full, rounded, and produced; it is provided with fine reticulate ornaments, which are gathered into a ring of tubercles at the edge of the umbilicus.

Aperture trapeziform or subpentagonal.

Relations and Distribution.—This pretty little shell is easily distinguished from the majority of the species referred to *Straparollus* by its regular spire and sloping whorls, and also by the radial or axial character of the ornamentation.

The very small specimen from Crickley (fig. 7) is believed to represent the earlier stage, when the periphery is extremely orbicular. The very large one (9 mm. in diameter) from the Pea-grit of Cleeve Hill may, on the other hand, be regarded as a megalomorph, where another whorl has been added. The usual or average form is tolerably abundant in the Pea-grit at Leckhampton.

256. Solarium polygonoïdes, sp. nov. Plate XXVI, fig. 9.

Description :

Diameter	4 mm.
Height	3 mm.
Spiral angle	115°.

This rare form, although related to the species last described, differs from it in being somewhat less depressed; the radial costæ are wider apart, and more strongly developed towards the periphery, thus imparting a slightly polygonal outline, which is well seen in the body-whorl. The bicarination of the body-whorl is less pronounced, and the ring of tubercles at the margin of the umbilicus less distinct. [The conditions of preservation leave some doubt upon this point.]

Relations and Distribution.—From specimens of *S. polygonium*, d'Arch., in the Great Oolite of Minchinhampton this form is distinguished by the greater number and lesser salience of the angles of the periphery, and by other points of ornamentation. As a matter of fact, *S. polygonoïdes* would seem to occupy an intermediate position between *S. pisoliticum* and *S. polygonium*, and this accords with its stratigraphical position in the *Clypeus*-grit at Barrington. A single specimen.

257. Solarium diadema, *Lycett*, MS. Plate XXVI, fig. 10.

Note.—No publication has given me so much trouble and cause for perplexity as the paper by Lycett on the "Fossil Shells from the Inferior Oolite in Gloucestershire," which appeared in the first volume of the 'Proceedings of the Cotteswold Naturalists' Club' in 1853, and previously in the 'Annals.' In that paper (p. 80) Lycett describes "*Solarium*" *Cotswoldiæ* and no other species, although previously (p. 72) he had enumerated in addition three species of *Solarium*, one of which received the specific name "*diadema*."

Of mere names in a table I should not feel bound to take notice unless there was corroborative evidence on the point. It so happens that in Mr. Brodie's Collection there is a very pretty fragment marked "*Solarium diadema*," presumably on Lycett's authority. It is different from any other form, and seems worthy of distinction.

Description :

Diameter	7 mm.
Height	6 mm.
Spiral angle	100°.

The ornaments are somewhat similar to those of *S. pisoliticum*, but the proportions differ considerably, as this is a truly conical shell. It occurs in the Freestones of Leckhampton, and seems to be very rare.

258. Solarium subvaricosum, sp. nov. Plate XXVI, figs. 11, 12.

Description :

Diameter (large size)	13 mm.
Height	10 mm.
Spiral angle	90°.

Shell conical, moderately depressed, deeply but not widely umbilicated. The form is that of a true cone with a somewhat flattened apex; nucleus oblique. Number of whorls six, increasing under a regular angle, and rather concave; sutures distinct. The upper margin of each whorl has a circlet of fine, closely-set granulations, whilst the corresponding ornament at the base of each whorl consists of a circlet of stout tuberculations set widely apart. The interspaces are markedly rugose; axial lines inclined from left to right, and decussated by very fine spirals.

The body-whorl occupies somewhat more than half the height of the shell, and is markedly concave, with a blunt carinated margin studded with broad tubercles; the base is nearly flat, being only slightly raised towards the edge of the umbilicus, where the ends of the curved axial wrinkles are gathered into a ring of tubercles. The base is decussated throughout by a system of fine spiral and growth lines. Aperture subquadrate or trapezoidal.

Relations and Distribution.—This very typical species of *Solarium* is obviously related to *S. varicosum*, Morris and Lycett. It differs from the Great Oolite species inasmuch as the whorls are concave rather than angular. The umbilicus also in the Inferior Oolite shell is larger and more tuberculated at the margin, and the base less flat. It is also closely related to *Solarium formosum*, Terq. and Jourd., and to *S. serpentinum*, Terq. and Jourd., both from the Bathonian of Les Clapes. The Inferior Oolite species is less depressed.

The smaller specimen (fig. 11) is from the *Parkinsoni*-zone of Aston cutting; the larger specimen (fig. 12) probably from the Inferior Oolite of the Yeovil district, but the exact locality is doubtful. Six specimens are known to me. Those from the *Parkinsoni*-zone of Aston cutting differ somewhat from the shells of the Dorset-Somerset district.

PLATE XXI.

FIG.

1. *Pseudomelania procera*, Deslongchamps. Subulate and corroded specimen, showing striato-punctate structure. *Murchisonæ*-zone, Bradford Abbas. My Collection (Stephens). (Page 237.)
2. *Euspira*, cf. *coronata*, Morris and Lycett. Northampton Sand, Duston. Crick Collection. (Page 270.)
3. *Natica cincta*, Phillips, cast, $\times \frac{1}{2}$. Lincolnshire Limestone, ? Denton. British Museum. (Page 266.)
4. *Natica cincta*, Phillips, shell, $\times \frac{2}{3}$. Coombe Hill, Deddington, Oxfordshire. My Collection.
5. "*Phasianella*" *Leymeriei*, d'Archiac, var. *Lindonensis*. "Bastard" bed between the Northampton Sand and the Lincolnshire Limestone, Lincoln. My Collection. (Page 253.)
6. *Pseudomelania lævigata*, Morris and Lycett. $\times 2$. Scarborough Limestone, Cloughton Wyke. Figure compounded of two specimens, one in the British Museum (type), the other in my Collection. (Page 244.)
7. *Rissoina obliquata*, Sowerby. $\times 4$. Lincolnshire Limestone, Weldon. My Collection. (Page 272.)
8. *Rissoina obliquata*, Sowerby, var. *parcicostata*. $\times 4$. Lincolnshire Limestone, Ponton. My Collection. (Page 272.)
9. *Rissoina obliquata*, Sowerby, var. *inflata*. $\times 4$. Lincolnshire Limestone, Ponton or Barnack. British Museum. (Page 272.)

10 *a*. *Rissoina obtusa*, Lycett. $\times 4$. Pea-grit, Crickley. My Collection. 10 *b*. The same specimen, $\times 10$. (Page 273.)

11. *Rissoina gymnoides*, sp. nov. $\times 6$. Lincolnshire Limestone, Weldon. My Collection. (Page 273.)
12. *Amberleya capitanea*, Münster. *Jurensis*-zone, *variabilis*-beds, North Nibley. My Collection (Buckman). (Page 277.)
13. *Amberleya ornata*, Sowerby. Dundry. Bristol Museum; probably one of Sowerby's types—a worn specimen. (Page 279.)
14. The same. Dundry. My Collection (Wilson)—an unworn specimen from the same locality.
15. *Amberleya ornata*, Sow., var. *spinulosa*, Münst. (*Bathis*, d'Orb). *Concavus*-bed, Bradford Abbas. My Collection.
16. *Amberleya ornata*, var. *abbas*. *Concavus*-bed, Bradford Abbas. My Collection. Middle-sized specimen, showing the *Purpurina*-like mouth.

17, 18. Portions of more adult specimens of *A. ornata*, var. *abbas*, showing the modification of the aperture. Same locality and Collection. (Page 280.)

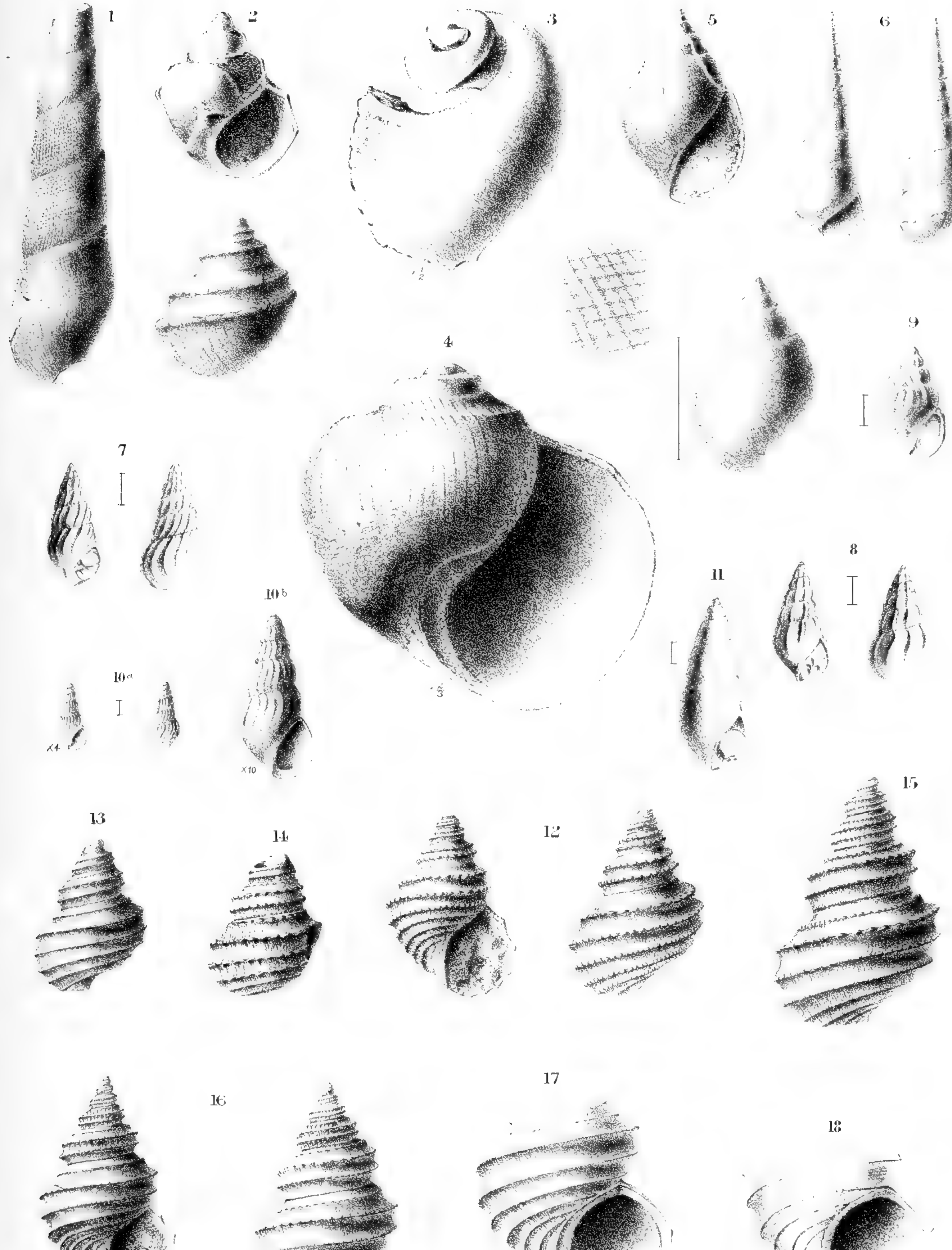
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PLATE XXII.

Fig.

1. *Amberleya ornata*, Sow., var. *abbas;* young form, showing the *Purpurina*-like mouth. $\times 1\frac{3}{4}$. *Concavus*-bed, Bradford Abbas. My Collection. (Page 280.)
2. *Amberleya ornata*, Sow., var. *horrida*. *Murchisonæ*-zone, Bradford Abbas. My Collection. (Page 281.)
3. *Amberleya densinodosa*, sp. nov. Burton Bradstock variety. Irony nodule bed, B. B. (*Murchisonæ*-zone). My Collection. (Page 282.)
4. *Amberleya densinodosa*, typical form. *Concavus*-bed, Bradford Abbas. My Collection (Stephens).
5. The same; young form, showing the *Purpurina*-like mouth. Same horizon and locality. My Collection.
6. *Amberleya goniata*, Deslongchamps, young form. *Parkinsoni*-zone, Burton Bradstock. My Collection. (Page 284.)
7. *Amberleya Orbignyana*, sp. nov. (*Purpurina ornata*, d'Orb., non Sow.). *Parkinsoni*-zone, Broadwindsor. My Collection. (Page 285.)
8. The same. *Humphriesianus*- or *Parkinsoni*-zone, Louse Hill. My Collection.
9. *Amberleya pagodiformis*, sp. nov. *Murchisonæ*-zone, Bradford Abbas. My Collection (Buckman). (Page 287.)
10. *Amberleya Obornensis*, sp. nov. Base of *Humphriesianus*-zone, Oborne. My Collection. (Page 286.)
11. *Amberleya Murchisoni*, Münster. $\times 1\frac{1}{2}$. *Humphriesianus*-zone, Bradford Abbas. My Collection. (Page 286.)
12. *Amberleya*, cf. *Trochus anaglypticus*, Münst. *Humphriesianus*-zone, Oborne. My Collection (Stephens). (Page 288.)
13. *Amberleya* (*Littorina*) *biserta*, Phillips (section A); young specimen, showing the *Purpurina*-like mouth. $\times 2$. Dogger, Blue Wyke. My Collection. (Page 288.)
14. The same, = *Trochus bisertus*, Phillips. *Opalinus*-zone, Drympton. My Collection.

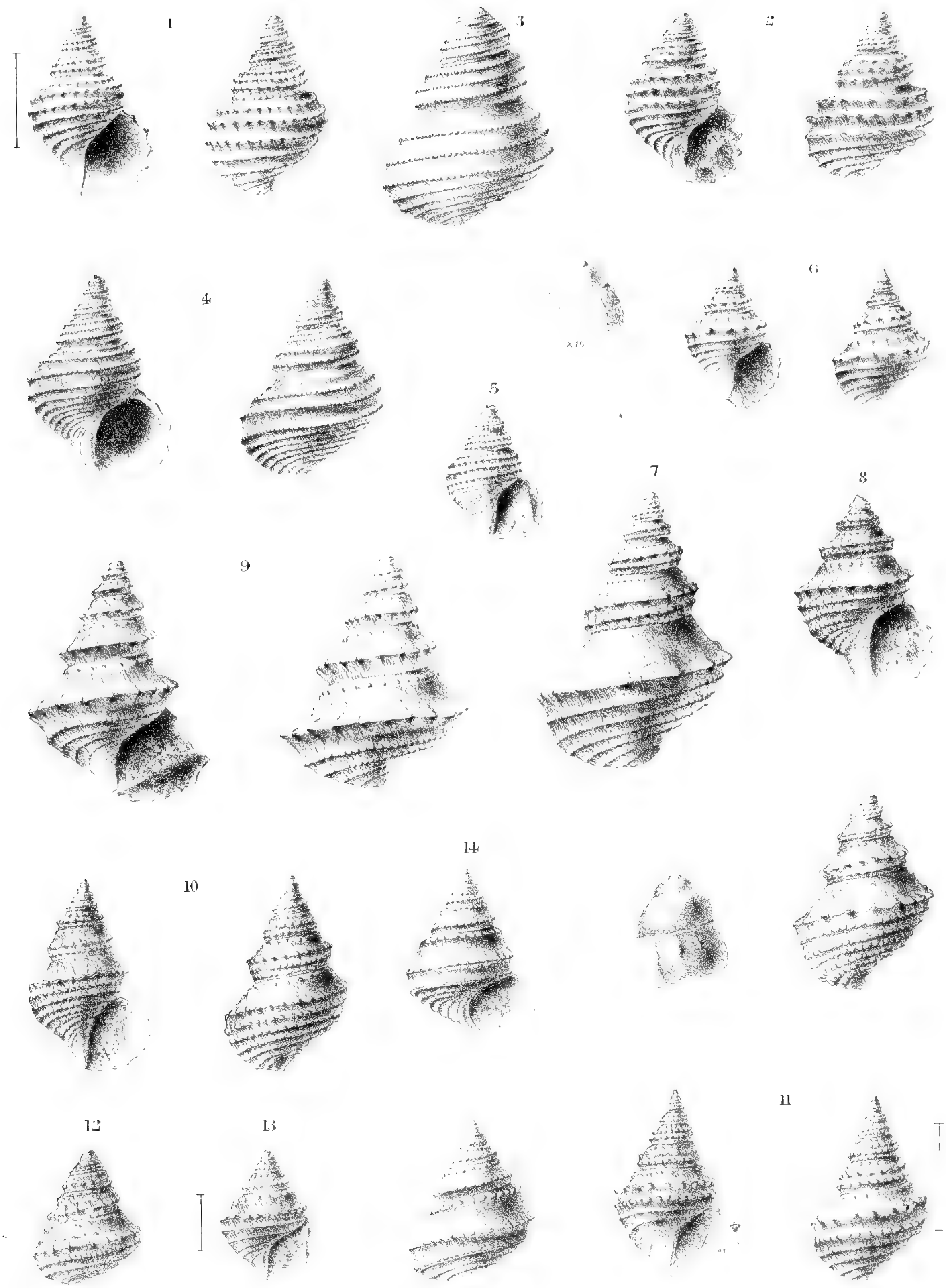

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PLATE XXIII.

FIG.

1. *Littorina unicarinata*, Bean. ? Young of *Amberleya biserta*, Phillips, section B. Dogger, Blue Wyke. Leckenby Collection. (Page 289.)
2. *Amberleya biserta*, Phillips, section B. Dogger, Blue Wyke. Jermyn Street Museum. (Page 288.)
3. *Amberleya generalis*, Münster. ? Dundry. My Collection (Buckman). (Page 287.)
4. *Littorina* or *Echinella*, species or variety. × $1\frac{3}{4}$. *Concavus*-bed, Bradford Abbas. My Collection. (Page 295.)
5. *Amberleya* (*Turbo*) *Milleri*, Wright, MS. × $1\frac{3}{4}$. *Concavus*-bed, Bradford Abbas. My Collection (Stephens). (Page 290.)
6. *Amberleya* (*Turbo*), between *Amb. Milleri* and *Amb. turbinoides*, but probably nearer to the latter. × $1\frac{3}{4}$. *Concavus*-bed, Bradford Abbas. My Collection (Stephens). (Page 290.)
7. *Amberleya turbinoides*, sp. nov. ? Stoford. My Collection. (Page 290.)
8. *Amberleya elongata*, sp. nov. *Murchisonæ*-zone, Bradford Abbas. My Collection. (Page 292.)
9. The same. ? A megalomorph. Pea-grit, Longfords. My Collection.
10. *Amberleya* or *Littorina*, species or variety. × $1\frac{3}{4}$. *Murchisonæ*-zone, Stoford. My Collection (Buckman). (Page 293.)
11. *Amberleya* (*Turbo*) *Stoddarti*, Tawney. Dundry. My Collection (Wright). (Page 291.)
12. *Littorina polytimeta*, sp. nov. × 2. *Concavus*-bed, Bradford Abbas. My Collection (Stephens). (Page 295.)
13. The same. Larger specimen, to show the increased thickening on the pillar-lip. × $1\frac{1}{2}$. Same horizon, locality, and Collection.
14. *Littorina* or *Amberleya*, species or variety. ? Allied to *L. polytimeta*. × 2. "Base-bed," Lincoln. My Collection. (Page 296.)
15. *Littorina sulcata*, Hébert and Deslongchamps. × 2. *Parkinsoni*-zone, Bradford Abbas. My Collection (Buckman). (Page 297.)
16. *Littorina Phillipsii*, Morris and Lycett. × 2. Lincolnshire Limestone, Weldon. My Collection. (Page 296.)
17. *Amberleya* cf. *Meriani*, Goldfuss. Lincolnshire Limestone, Ponton. My Collection. (Page 283.)
18. *Littorina Weldonis*, sp. nov. × 3. Lincolnshire Limestone, Weldon. My Collection. (Page 297.)
19. *Amberleya gemmata*, Lycett. × 3. Lincolnshire Limestone, Ponton or Barnack. British Museum. (Page 281.)

PLATE XXIII

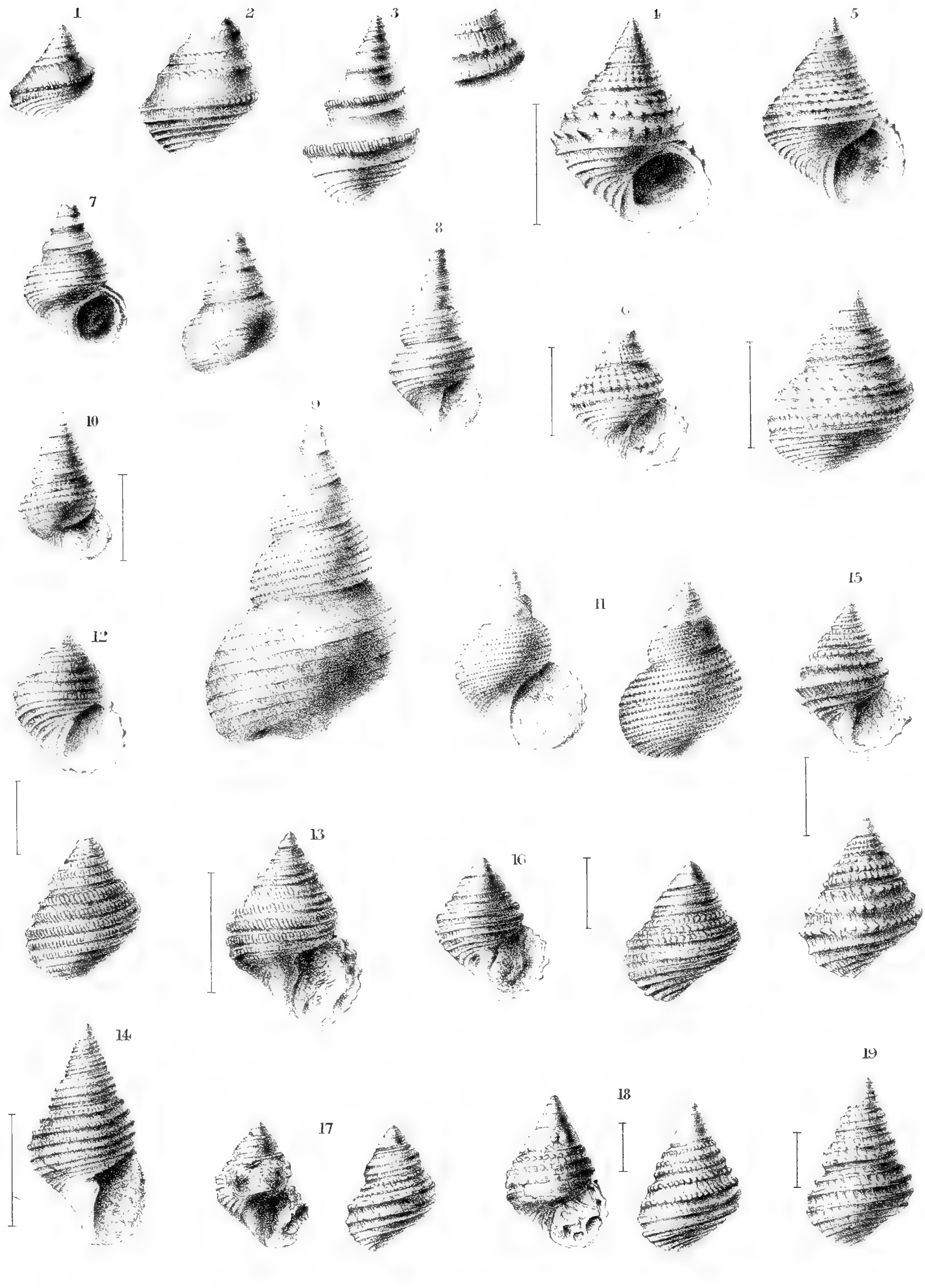

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PLATE XXIV.

Fig.

1. *Littorina ædilis,* Münster. × 2. Dundry. Bristol Museum. (Page 298.)
2. *Littorina ? ædilis,* Münster. × 3. Lincolnshire Limestone, Ponton or Barnack. British Museum.
3. *Littorina Dorsetensis*, sp. nov.—var. A, typical. × 2. (Page 299.)
4. The same, var. B, resembling *Trochus granarius,* Hébert and Deslongchamps. × 2.
5. The same, var. C, eucycloid variety. × 1½. All from the *Concavus*-bed, Bradford Abbas. My Collection.
6. *Littorina (? Trochus) recteplanata*, Tawney. × 1½. Dundry. Bristol Museum. (Page 300.)
7. The same. Pea-grit, Longfords. × 1½. My Collection. N.B.—Fig. 6 represents a worn specimen, fig. 7 a well-preserved and much larger one.
8. *Littorina prætor*, Goldfuss. *Murchisonæ*-zone, Bradford Abbas. My Collection (Buckman). (Page 294.)
9. *Littorina (? Trochus) pisolitica*, sp. nov. × 6. Pea-grit, Leckhampton. My Collection. (Page 300.)
10. *Amberleya cygnea,* sp. nov. (but cf. *Turbo Meriani*, Goldf.). "Base-bed," Lincoln. My Collection. (Page 283.)
11. *Amberleya (Turbo) Dundriensis*, Tawney. × 3. Dundry. Bristol Museum. (Page 293.)
12. *Hamusina Damesi*, Gemmellaro, var. *Babylonica*. *Murchisonæ*-zone, Babylon Hill. Whidborne Collection. (Page 304.)
13. *Hamusina Oppelensis*, Lycett, Dorset variety. *Murchisonæ*-zone, Coker. My Collection. This specimen shows the single row of nodules as distinguished from the double row in *Hamusina Bertheloti,* d'Orb. (Page 305.)
14. The same. ? Upper Pisolite, Longfords. Jermyn Street Museum. N.B.—Type refigured to show the supposed costæ which are really due to an imperfect and misleading surface.
15. *Cirrus Etheridgii*, Lycett. Nailsworth district. Jermyn Street Museum. × 1½. (Page 306.)
16. *Cirrus "reticulatus;"* may possibly represent *Cirrus Etheridgii* in the Dorsetshire beds, Bradford Abbas. Monk Collection. (Page 307.)
17. *Cirrus gradatus*, sp. nov. *Murchisonæ*-zone, Coker. My Collection. (Page 307.)

18 and 19. *Cirrus pyramidalis*, Tawney. Dundry. Bristol Museum. The types refigured. (Page 311.)

20. *Cirrus pyramidalis*, Tawney. Cotteswold variety. Longfords. My Collection.

PLATE XXIV.

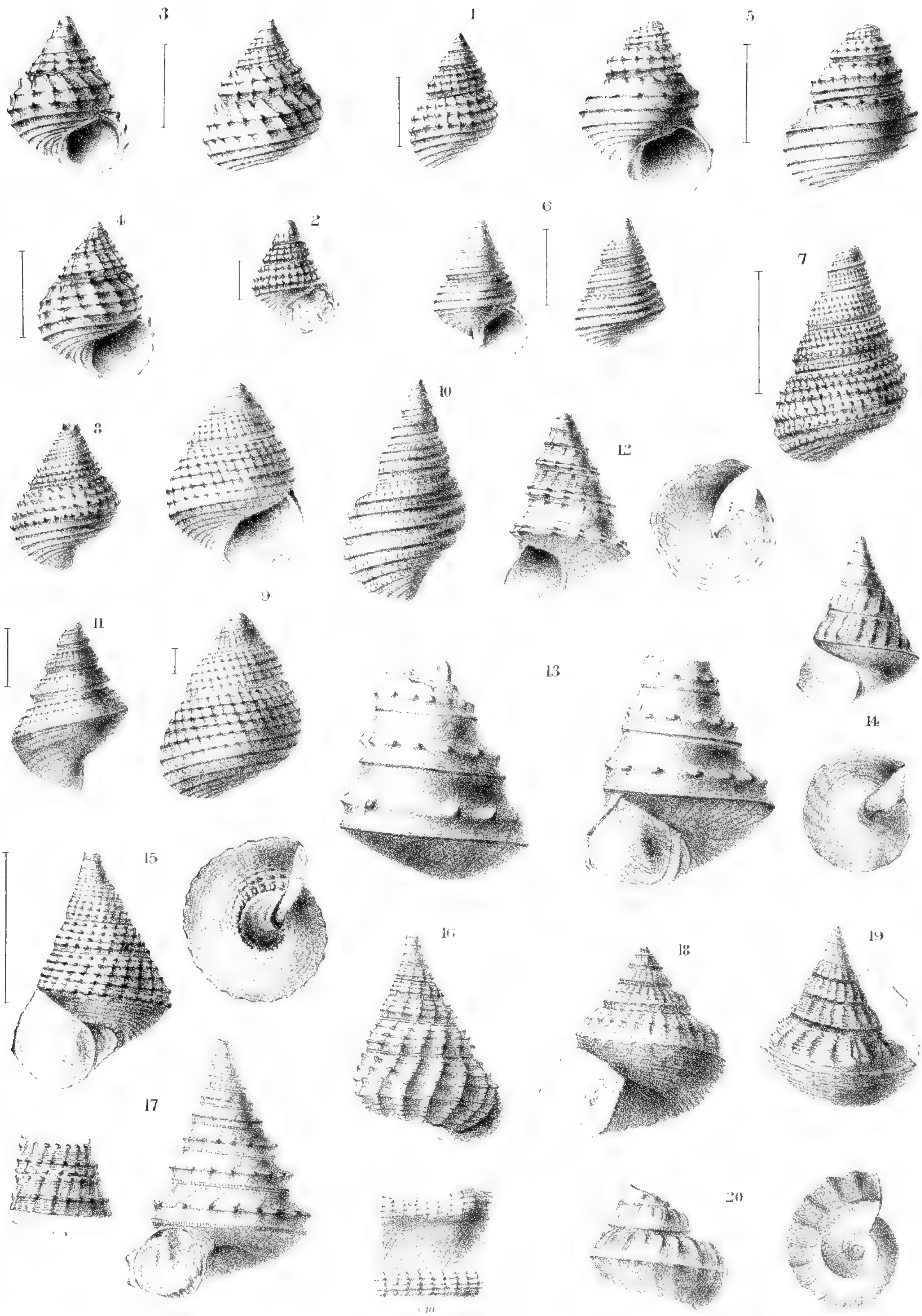

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PLATE XXV.

FIG.

1. *Cirrus Calisto*, d'Orbigny, *Murchisonæ*-zone, Coker. My Collection (Buckman). (Page 312.)
2. *Cirrus varicosus*, sp. nov. × $1\frac{3}{4}$. Oolite-Marl or Pisolite of the Nailsworth district. My Collection (Wright). (Page 313.)
3. *Cirrus Leachi*, Sowerby, rugose variety. *Murchisonæ*-zone, Mapperton. My Collection. (Page 308.)
4. The same. Variety with small umbilicus. *Murchisonæ*-zone, Bradford Abbas. My Collection.
5. *Cirrus Leachi*, Sowerby, ornaments finer and closer. *Murchisonæ*-zone, Bradford Abbas. My Collection.
6. *Cirrus nodosus*, Sowerby. *Murchisonæ*-zone, Coker or Stoford. My Collection. (Page 313.)
7. *Discohelix Cotswoldiæ*, Lycett. × 2. Oolite-Marl or Pisolite of the Nailsworth district. My Collection (Wright). (Page 316.)
8. *Discohelix spinosus*, Wright, MS. Slightly enlarged. *Concavus*-bed, Bradford Abbas. Woodwardian Museum. (Page 317.) N.B.—This species attains to a considerable size; one specimen in my Collection has a diameter of 44 mm., which is very much larger than any other species of *Discohelix* or *Straparollus* from the Inferior Oolite of this country.
9. *Straparollus pulchrior*, sp. nov. *Murchisonæ*-zone, Mapperton. My Collection. (Page 318.)

PLATE XXV

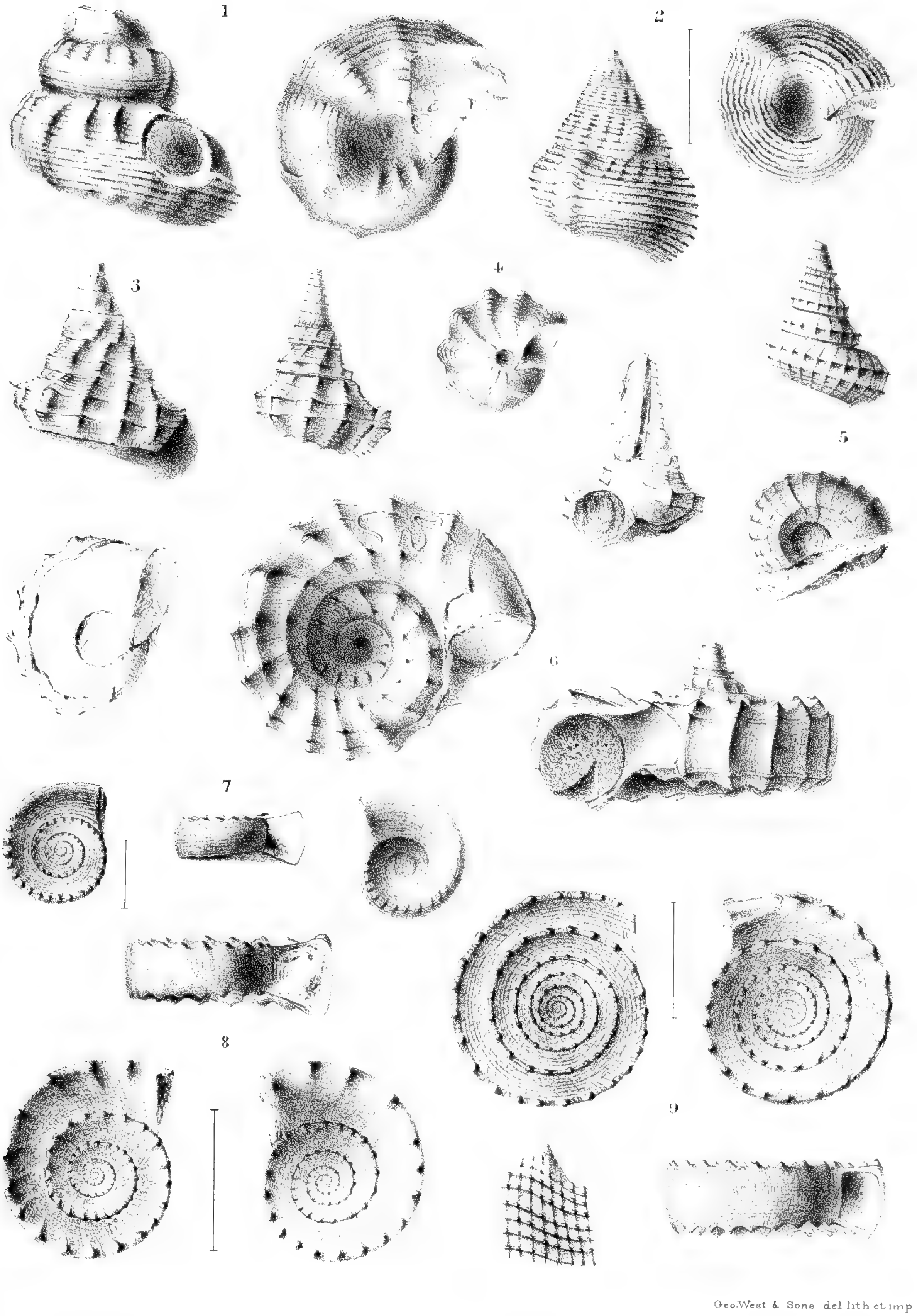

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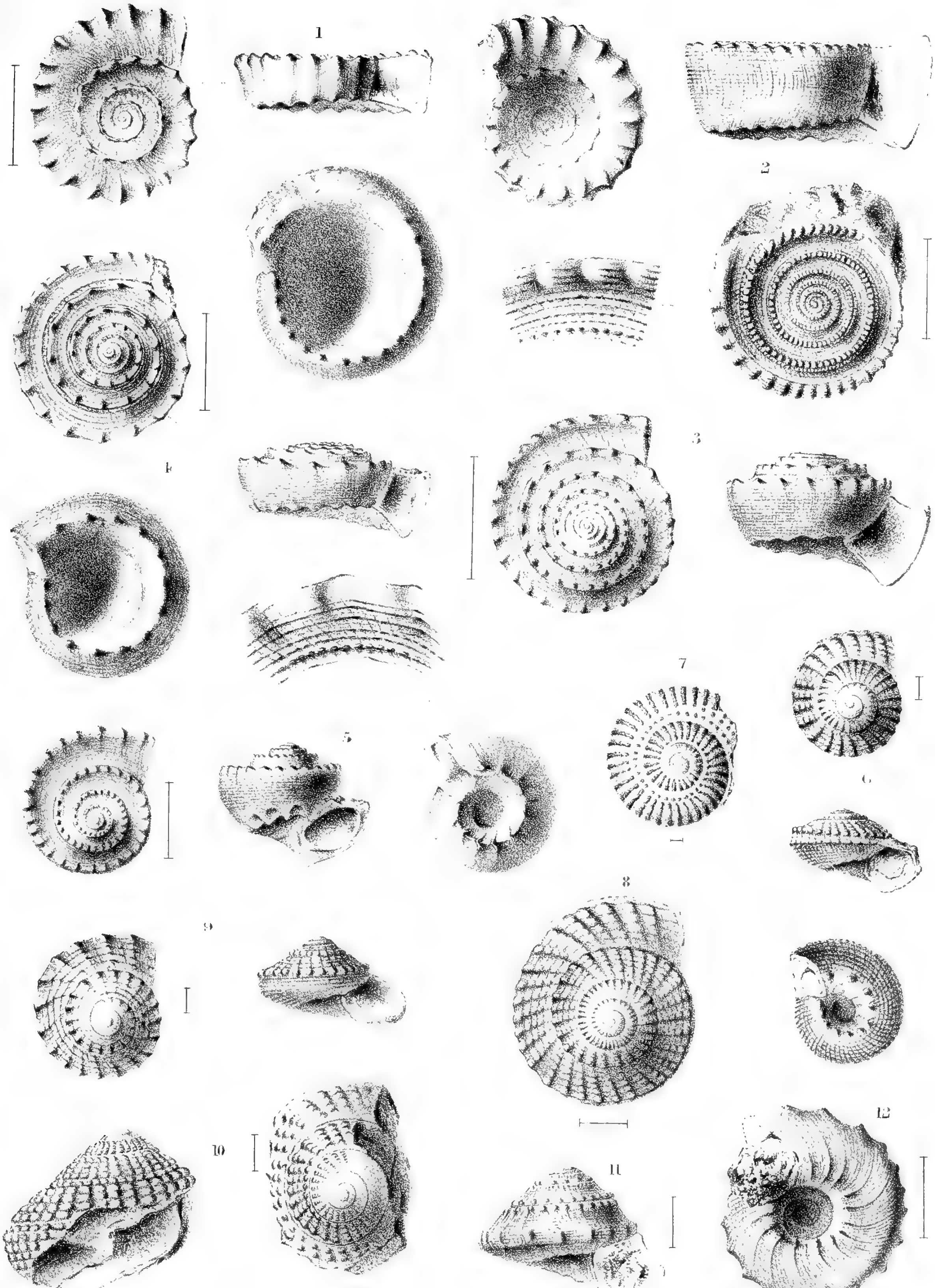
PLATE XXVI.

Fig.

1. *Straparollus* "*tuberculosus-dexter*," Thorent (dextral form). × 2. *Parkinsoni*-zone, Burton Bradstock. Jermyn Street Museum. (Page 317.)
2. *Straparollus Dundriensis*, Tawney. Dundry. × 2. Bristol Museum, type refigured. (Page 319.)
3. *Straparollus exsertus*, sp. nov. × $1\frac{1}{2}$. Bradford Abbas, ? *Murchisonæ*-zone. Monk Collection. (Page 320.)
4. Variety of *Straparollus exsertus*. × $1\frac{3}{4}$. The precise horizon and locality unknown; probably from the *Murchisonæ*-zone of Stoford. Woodwardian Museum.
5. *Straparollus*, cf. *altus*, d'Orbigny. × 2. *Murchisonæ*- or *concavus*-zone, neighbourhood of Beaminster. My Collection. (Page 321.)
6. *Solarium pisoliticum*, sp. nov. × $4\frac{1}{2}$. Pea-grit, Leckhampton. My Collection. This represents an average specimen. (Page 322.)
7. The same. × 8. Specimen from the Pea-grit, Crickley, showing the earlier stage. My Collection.
8. The same. × 4. Unusually fine specimen from the Pea-grit, Cleeve Hill. My Collection.
9. *Solarium polygonoïdes*, sp. nov. × 5. *Clypeus*-grit, Barrington. My Collection. (Page 323.)
10. *Solarium diadema*, Lycett. × $4\frac{1}{2}$. Freestones, Leckhampton. Brodie Collection. (Page 323.)
11. *Solarium subvaricosum*, sp. nov. × 4. *Parkinsoni*-zone of Aston cutting. My Collection. (Page 324.)
12. The same. × 4. ? Dorset-Somerset district. Woodwardian Museum (Walton Collection).

PLATE XXVI



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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1892.

LONDON:

MDCCCXCII.

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.

PART VII.

PAGES 313—344; PLATES LVII—LXXVI.

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1892.

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Sonnininæ (*continued*).

Genus—Sonninia, *Bayle*.

(Type—Sonninia propinquans, *Bayle*.)

— Harpoceras (pars) *auctorum*.
— Hammatoceras (pars) *auctorum*.
1878. Waagenia, *Bayle*. Explic. carte géol. France ; Explan. of pl. lxxxiv. (Non Neumayr.)
1879. Sonninia, *Bayle*. Bull. Soc. Géol. France, vol. vii, sér. 3, p. 92.
1885. Gruppe des Hammatoceras Sowerbyi, *Haug*. Beitr. Monogr. *Harpoceras ;* Neues Jahrbuch für Mineral., &c., Beil.-Bd. iii, p. 654.
1885. Gruppe des Hammatoceras Ogerieni, *Haug*. Ibid., p. 657 (pars).
1889. Sonninia, *S. Buckman*. Descent of Sonninia, &c., Quart. Journ. Geol. Soc., vol. xlv.

It is impossible to give any short and exact definition of this comprehensive genus. The biologically-earliest species belong to the spinous stage from early infancy (Pl. XLIX). In some cases the spinous stage persists to maturity, but generally it retrogrades to a costate stage in adolescence, or even in infancy. In biologically-later species the costate stage retrogrades to a striate in maturity, in adolescence, or even in infancy, and the spinous stage may be omitted from the ontogeny.[1] Roughly speaking inclusion and compression of whorls correlate with the amount of ornament—the most ornate species being the most evolute, and having almost circular whorls ; but the exactitude of the correlation varies in the different branches into which the genus splits up, and in one branch it is altogether falsified on account of a remarkable renewal of progressive development after a period of retrogression. The hollow carina is not always present, but it is the rule. In the extremely retrogressive forms of the genus, however, not only is the hollow carina absent, but the keel is altogether lost, and the ventral area becomes quite rounded in maturity.

The suture-line is an important feature. The lobes are generally narrow-stemmed, in some species exceedingly so ; the superior lateral lobe has a peculiar cruciform arrangement of its chief terminal branches, which are long and important ;[2] the first auxiliary lobe often has a slight twist towards the inferior lateral ; the inner end of the suture-line is not, practically speaking, dependent or retracted. In general the complexity of the suture-line increases in proportion

[1] To favour direct development, illustrating the law of the partial or modifying action of earlier inheritance.

[2] In some of the broad-whorled forms the symmetry is destroyed by an excessive growth of the outer lobule.

to the decrease of ornament, a feature similar to what may be noted in the case of *Amaltheus*.

From *Hammatoceras*, which parallels this genus very closely in retrogressive development—in some species particularly the likeness is very close—*Sonninia* may be known by the greater forward curvature of its ribs on the ventral area, the lesser proportionate depth of its saddles, and the absence of a strongly-retracted or dependent inner portion of the suture-line.[1]

From *Zurcheria* the genus *Sonninia* is distinguished by its carina and the different position of its spines; from *Haplopleuroceras* by not having two rows of spines.

From *Dorsetensia* the costate and less ornamented forms are separated by their more complex suture-line, with its peculiar cruciform superior lateral lobe. No unispinous species of *Dorsetensia* have yet been found.

From *Witchellia*, in general, the longer lobes with their narrower stems become the chief features distinguishing the present genus; but other matters will be noticed when that genus is described.

From "*Pleuroceras*" and *Amaltheus* the present genus is easily separable by the absence of a crenulate carina.

Some of the species which have retrograded so much as to have, practically speaking, lost all distinguishing ornament, become very like certain genera of the *Hildoceratidæ;* but they may be distinguished therefrom by the peculiar features of their suture-line, namely, the depth of the saddles, the somewhat cruciform arrangement of the superior lateral lobe, and the greater general complexity of the septa.

Like the other genera of the *Amaltheidæ*, *Sonninia* must be regarded as a cryptogenetic series at present. The species representing the progressive stages of development (p. 289) which preceded the spinous stage have not yet been discovered. From the fact of the spines being an embryonic feature the existence of a considerable series of spinous forms may be inferred; because, from analogy with the development of other groups, it may be argued that the spines were once confined to the adult, and that they have become embryonic by the law of earlier inheritance.[2] This alone implies a considerable and varied series of ancestors. Such spinous species would be, presumably, the highest forms of the progressive series, and the nearest approach to them is seen in *Sonninia multispinata*.

[1] "Descent of *Sonninia*," &c., 'Quart. Journ. Geol. Soc.,' vol. xlv.

[2] In all the species which have come under my notice the spines are solid, but in the *armatus*-group (*Deroceras*) the spines are hollow, that is, separated by a partition in the same way as a hollow carina (see p. 81, foot-note). The difference is most striking in the casts of spines of *Sonninia* and *Deroceras*.

This can hardly be an adult form. It is, presumably, only a youthful form of an unknown adult, but it is certainly the earliest, biologically, of the series; and it may be considered as the "morphological representation"[1] of an earlier adult of the phylogenetic series, in accordance with the law of earlier inheritance.

In the same way earlier inner whorls of *Sonn. multispinata*, so far as they can be seen, are a morphological representation of a still earlier ancestor of the genus; and this is confirmed by the inner whorls of other species.[2] Such an ancestor would be evolute, slowly-coiled, with a broad sulcate-carinate abdomen almost flat from spine to spine, and the spines themselves in a regular sequence. *Sonn. multispinata* shows the commencement of the change which produced a more gibbous and narrower abdomen.

Roughly speaking, with the exception of this species, all the *Sonniniæ* known are examples of retrogression[3] from the type of which *Sonn. multispinata* is the morphological representation; although there is, as it were, a certain want of decision about the retrogression of the earlier species. In fact, although there are many species[4] of the genus which are extremely retrograde forms, yet the

[1] It becomes absolutely necessary to employ a phrase of this kind in a definite manner in connection with the phenomena of earlier inheritance. In tracing a genetic series upwards the adult stage of an early species, say A, becomes adolescent in the later form, B, infantile in C, and so on. Therefore I wish to call the adolescent B the "morphological representation" of the adult A, and the infantile C the "morphological representation" of adolescent B or of adult A. In the same way adolescent C is the "morphological representation" of adult B. In reverse manner adult A may be spoken of as the "morphological prefiguration" of adolescent B, or of infantile C, and so on. We thus obtain, with a phrase of Hyatt's, three terms in regard to the relations of an individual. It is a "morphological prefiguration" in regard to the future, a "morphological representation" in relation to the past, and a "morphological equivalent" in comparison with the individuals of other series which have attained the same degree of development.

[2] The homologue of these and of some earlier inner whorls may be seen in Pl. XLIX, figs. 8, 8 *a*, and part figs. 8 *b*, 9, 9 *a*. A portion of fig. 8 seems to indicate a much earlier ancestral form, but the correctness of the ontogenetical record may have been falsified by the "partial or modifying action of earlier inheritance" (p. 289).

[3] In the various stages of retrogressive development the species of *Sonninia* are the morphological equivalents of the species of *Amaltheus*, only they are a much more comprehensive series.

[4] In treating of some forms of this genus in his 'Amm. Schwäbischen Jura' Quenstedt may be said to have used names to distinguish each different form, but he employed a combined trinomial and binomial system, e.g. *Ammonites Sowerbyi*, *Am. Sowerbyi ovalis*, *Am. Sowerbyi insignoides*, *Am. arenatus*. The generic name *Sonninia* dispenses with the frequent repetition of "*Ammonites Sowerbyi*;" in fact, it takes the place of this term, and something more; because while Quenstedt wrote *Am. Sowerbyi* and *Am. arenatus* without any indication whether *arenatus* was closely allied to *Sowerbyi*, or was, say, one of the *Humphriesianum*-group, I write *Sonninia arenata*, *Sonninia Sowerbyi*, and gain the advantage of at once showing the true relationship of the two forms. In the same way *Sonninia ovalis*, *Sonninia insignoides* show that these species belong to the *Sowerbyi*-group quite as effectually as the cumbrous *Ammonites-Sowerbyi*-formula. Further, it removes the false impression that these species are necessarily more closely allied to *Sowerbyi* than *arenatus* is.

retrogression was not a continuous decline; it was at times interrupted by what were evidently progressive periods, especially among the species of the *Concavum*-zone. These progressive periods appear more or less in the different genetic series, so that there are some curious homoplastic results; and there are in the different series distinct evidences of alternate progressive and retrogressive development.

In order to understand the differences which separate the various species, it is necessary to bear in mind that in retrogression all the various branches of *Sonninia* change—

1. From a spinous to a costate stage, and then to a smooth stage (irregularity of the spines indicates decline of the spinous stage).

2. From reclining to upright costæ.

3. From evolute to more and more involute whorls, or rather the coiling becomes quicker.

4. From thick to more and more compressed whorls.

If these changes always occurred in unison there would be only one genetic series, but such is not the case. In one series changes 1 and 2 make greater relative progress than 3 and 4; in another the opposite prevails, and so on. The differences between the various species, or rather morphological equivalents, of the different branches depend on the different proportionate development of these features in relation to each other.

The *Sonniniæ* may be roughly divided into two main groups:

1. The species of the *Concavum*-zone.

2. The species of the higher horizons.

The former are relatively the thicker in proportion to development when morphological equivalents of the two groups are compared. The genus is dominant in the *Concavum*- and so-called *Sowerbyi*-zones, is sparingly found in the *Sauzei*-zone, and is unknown in the *Humphriesianum*-zone proper.[1] The majority of the species are of large size. As several species of the companion genus in the *Concavum*-zone—*Hammatoceras*—are also known in the strata of Cap San Vigilio, it is curious to reflect that no *Sonninia* has been described from that locality, or in fact from any strata below the *Concavum*-zone. It is remarkable that the questions where are the progressive forms, and whence did these species come, must remain unanswered for the present; so that on these points

[1] The highest horizon in which *Sonniniæ* are found is the *Humphriesianum-Sauzei*-zone of Dundry. The following alterations, which the reader is requested to make in p. 293, foot-note, were accidentally omitted from the proof-sheets:—For *Sauzei*-zone, line 1, read *Humphriesianum-Sauzei*-zone. Opposite 7 place *Sauzei-Sowerbyi*-zone. In line 10, for "almost entirely absent" read "very sparingly represented." Just sufficient species have been found in bed 7 to show that it contains in part a slightly lower horizon than the *Sauzei*-zone of Oborne.

it is impossible to make any conjectures. This is the more curious because in regard to other groups these questions can be answered with some degree of success.

SONNINIA MULTISPINATA, *S. Buckman.* Plate L, figs. 11—13.

Discoidal, carinate. Whorls depressed, subcircular, ornamented each side with a single row of nearly equidistant spines placed almost on the edge of the lateral and ventral areas. Faint single ribs lead to the spines; and very indistinct ribs,[1] in twos and threes, lead from the spines, to be soon lost amid the ventrally-inclined growth-lines. Ventral area carinate-sulcate, broad, flat, but more gibbous the older the shell. The carina apparently hollow, dividing a noticeable depression, so that it is bordered each side by a sulcus. Inclusion just to the spines.

This peculiar species is, biologically, the earliest form of *Sonninia* with which I am acquainted. That the specimen figured is not mature, but is the young of a larger form, will probably be found to be the case: it is certainly not the young of any species now in my cabinet. Its broad, sulcate-carinate abdomen, its coronet of closely-packed, regularly-placed spines, and the extreme faintness of ribbing distinguish it from any other species. The specimen figured is unique. It came from the *Concavum*-zone of Bradford Abbas. Side and front views are represented in figs. 11 and 12 of Pl. L, and part of the suture-line in fig. 13. It will be noticed that the superior lateral lobe is outside the spine.

SONNINIA CRASSISPINATA, *S. Buckman.* Plate XLVIII, figs. 16, 17; Plate L, figs. 16—22; Plate LVII; Plate LXV, figs. 3—5.

1889. SONNINIA ACANTHODES, *S. Buckman.* Descent of *Sonninia;* Quart. Journ. Geol. Soc., vol. xlv, p. 658 (pars).

Discoidal, compressed, hollow-carinate. Whorls ornamented with strong spines; single ribs lead to the spines, and branches of two or three radiating ribs generally lead from the spines. The spines are persistent up to adult age, though they often fail in places, only single ribs being formed. Ventral area

[1] Rather too prominent where shown in the figure.

broad, somewhat flattened, the core with two faint sulci bordering a small carina; the test with a well-marked hollow carina, bordered by depressed zones. Inner margin scarcely defined, inclusion slight.

There are three marked varieties of this species:

α. Spines in adolescent age irregularly developed, and separated from each other by ribs (Pl. XLVIII, figs. 16, 17; Pl. L, figs. 16, 17). The adult of this form is not known, but presumably it acquired a regular series of spines as in the next form.

β. The period of irregular spines much shorter, followed by a period when the spines are very strong and very fairly regular; later the spines become irregular again (Pl. LVII). This form is a step in advance from *α*. The regular spines, indicating a renewal of progression, begin earlier than they could have done in *α*.

γ. More compressed and quicker-coiled than *α* or *β*. The period of irregular spines is succeeded by a period of regular spines. Inner margin becomes conspicuous. (This form is a descendant of *α* but not of *β*, though in some respects it is more advanced than *β*.) (Pl. LXV, figs. 3—5.)

The form *α* I described in the 'Quarterly Journal of the Geological Society' (see synonyms) as the young of *acanthodes*, not at the time sufficiently appreciating the difference in the size and irregularity of the spines. When, however, I found among some specimens of my father's collection the form called *crassispinata β*, I saw that I had made a mistake. *Crassispinata β* shows the same features in its inner whorls as *crassispinata α*, though they do not last so long. For all practical purposes, therefore, it represents the adult of *crassispinata α*, though, strictly speaking, it is a little further in advance. *Crassispinata β* retained its spines throughout life, while *acanthodes* lost them before maturity. There are also minor differences—for instance, the bifurcate ribbing of adult *crassispinata*, and the single ribs of adult *acanthodes*.

That *crassispinata* is not the adult of *multispinata* may be seen by the irregularity and coarseness of the spines in the inner whorls of the former. Its inner whorls (Pl. L, figs. 19, 20), which are a reduced edition of *multispinata* with the commencement of the irregularity of *crassispinata*, show exactly the derivation of the latter from the former.

Sonn. crassispinata is a rather scarce fossil belonging to the *Concavum*-zone of Bradford Abbas.

In Pl. XLVIII, figs. 16, 17, is shown an immature form of *crassispinata α*, in which the spines are not regularly developed. Fig. 16 of Pl. L gives two views of a smaller specimen showing the same character, and fig. 18 is part of its suture-line. Figs. 19—22 of the same plate illustrate the young of *crassispinata*. In fig. 1 of Pl. LVII the side view of a fine adult example is shown (its suture-line, fig. 2). The regular spines begin about the commencement of the last whorl, and continue for about three-fourths of its length. The last two spines shown are separated by a rib, and this kind of ornamentation is continued on the other side, ten ribs bearing only four spines, a spine being last. The bifurcate ribbing demands notice in connection with later species.

Fig. 3, Pl. LXV, gives a side view of *crassispinata* γ reduced one-half, showing regular, succeeding irregular spines; and fig. 4 is a section of the whorl of natural size. Fig. 5 of the same plate is a section of the whorl of *crassispinata* β at the same diameter.

SONNINIA ACANTHODES, *S. Buckman.* Plates LVIII—LX; LXIII, fig. 1.

1889. SONNINIA ACANTHODES, *S. Buckman.* Descent of *Sonninia,* &c., Quart. Journ. Geol. Soc., vol. xlv, p. 658 (pars) (not pl. xxii, figs. 6, 7, 22, 23).

Discoidal, evolute, hollow-carinate. Whorls subcircular till nearly mature, ornamented with arcuate, reclining, ventrally-inclined ribs, carrying strong median spines, at first fairly regularly, later irregularly placed. In maturity whorls becoming more subquadrate, the spines replaced by obtuse, elongate knobs, and finally the arcuate ribs are left plain, the ribs being better defined, especially on the inner area, as the spines decrease in size. Ventral area broad, somewhat flattened, the test having a small hollow carina, bordered each side by a shallow depression; the core, slightly carinate, and the depressions more marked. Inner margin not defined till late, then rather flat. Inclusion barely one-fourth, leaving a space between the spines and the succeeding whorl.

When I described this species in the 'Quarterly Journal' I gave it a wide range. The description then given of the immature stage was taken from what I now separate as *crassispinata* α (p. 318); but the remarks on the change which the mature shell showed were made from observation of what I have had for some years labelled as the type-specimen, the example now depicted in Pl. LX.

Two forms of *Sonn. acanthodes* are figured:

α. The type, an evolute form with rounded whorls (Pl. LX).

β. Not so evolute as α, the whorls rather more compressed, the spines lasting longer, the ribs stronger (Pls. LVIII, LIX, fig. 1).

The differences between the two forms are—α has retrogressed more as regards the spines; β less as regards spines, but more as regards involution and compression.

The two forms are really cousins derived from *multispinata*, and they may have come through an adult form, of which the adolescent *crassispinata* α is the morphological representation. The immature form (Pl. LIX, figs. 2, 3) shows that this is very probable. It differs from *crassispinata* α (Pl. XLVIII, figs. 16, 17) in having much coarser spines in the inner whorls; that is to say, the coarser-spine-period of *crassispinata* has been forced further back in this form by earlier inheritance. *Sonn. acanthodes* α (adult) shows the further operation of the same law, for practically it omits the irregularly spinous stage which should separate the two regular spinous stages.[1]

These forms of *Sonn. acanthodes* are not derived from *crassispinata* β, because in the adult stage of that form the bifurcate spinous ribs are associated with a whorl flatter-sided than that which accompanies the same ornamentation in either of the "*acanthodes*" forms. From *acanthodes* α a short separate branch can be traced; but I must leave it until I have described the more important *crassispinata*-stock.

Sonn. acanthodes occurs in the *Concavum*-zone of Bradford Abbas, Dorset. The type-form of the species is figured in Pl. LX, side view, and in Pl. LXIII, fig. 1, front view. In Pl. LVIII the side view of the form β is shown, and the back view with its coarse prominent ribs is depicted in Pl. LIX, fig. 1. Two views of a young form of the species are given in Pl. LIX, figs. 2, 3. What the younger stages of this species were like can be gathered from the figures of the early stages of *crassispinata* (Pl. L, figs. 19—22).

Sonninia irregularis, *S. Buckman.* Plate LXI.

Discoidal, compressed, hollow-carinate. Whorls compressed, subquadrangular, rather flattened laterally, ornamented, when adult, with nearly upright, ventrally-inclined ribs, sometimes carrying median spines, beyond which the ribs often bifurcate. Ventral area broad, hollow carina well-marked. Inclusion one-fourth.[2] Inner margin well-marked, deep, and very slightly convex.

There are three varieties of this species:

α (Pl. LXI). With nearly upright ribs.

β. Spines end earlier; reclining ribs.

γ. A more involute form, with an overhanging inner margin. Its ornamentation is much less pronounced, though its irregular spines are persistent to a fairly late age. Its ribs are slightly reclining.

[1] Compare the various specimens of *crassispinata* for the shortening of the intermediate irregular stage and the tendency to join the regular stages.

[2] This does not agree with the side view; but the plate is drawn from a photograph, and it illustrates the difference between monocular and binocular vision. The reason for the incorrectness of the photograph will be apparent to anyone conversant with the action of a lens.

Both α and β are descendants of *crassispinata* β, though β retains the reclining style of ribbing, while in α the ribs become upright. The early adolescent stage of α is the exact morphological representation of adult *crassispinata* β.

The form γ is evidently an involute development of *crassispinata* γ. It is so different from the others that it deserved delineation, but space does not allow a figure.

The "irregularity" of ornament is the chief distinction of *irregularis.* Its more compressed, flatter-sided, more quickly-coiled whorls, with marked inner margin, separate it from the foregoing species. In addition, the more upright ribs distinguish the form α, and the earlier cessation of the spines the form β from the previous species. It is impossible to confound γ with any of them, for in spite of its spines it is much more retrogressive than any others. It is a marked retrogression of the least progressive form of *crassispinata*, namely γ.

Sonninia irregularis is commoner than the species hitherto described, and, by an almost perfect series of gradations, I can connect it with the succeeding form. It occurs in the *Concavum*-zone of Bradford Abbas, Dorset.

Taken in consideration with the remarks just made, the specimen figured in Pl. LXI represents the characters of the species. It is one of the largest examples of the species in my possession, and shows in a marked degree the "irregularity" which was a prelude to loss of spines. With a certain allowance for the "unequal action of the law of earlier inheritance," the young stages of *crassispinata* (Pl. L, figs. 19—22) will illustrate the young forms of this species. It may be noted that in this species any representation of the first irregular spinous stage—that of *crassispinata* α—has been omitted from the ontogeny. I should remark that the opening description (previous page) applies to the type-form only.

Sonninia marginata, *S. Buckman.* Plates LXII, LXIII, fig. 2; Plates LXIV, LXV, figs. 1, 2.

Discoidal, compressed, hollow-carinate. Whorls compressed, sub-quadrangular, ornamented with direct, nearly upright, ventrally-inclined ribs, and, in youth only, with spines, at first regularly on the ribs, afterwards missing some. Ventral area rather broad, hollow-carinate; the core slightly carinate, bordered by slight depressions. Inclusion about one-third.[1] Inner margin well marked, upright, slightly convex.

Fine growth-lines run parallel to the ribs. In old age the ribs become larger and further apart.

[1] See, however, footnote 2, p. 320.

This species may be said to be fairly uniform, as it varies but little, except in the direct genetic line. It is the descendant of *Sonninia irregularis*—to be very precise, it comes from a form exactly between *irregularis* α and β. I could figure every gradation between the two species, each gradation showing the gradually earlier and earlier change from the spinous to the costate stage. In the figured specimen of *irregularis* the last spine is produced when the shell is nine inches (228 mm.) in diameter; in the figured example of this species the last spine appears at a diameter of about $5\frac{1}{8}$ inches (54 mm.).

Thus the costate stage is the prominent feature of the fossil, a fact which effectually separates it from any of the species previously figured. The nearest morphological equivalent is *Sonn. acanthodes* α; but the earlier disappearance of the spines, the flatter, more compressed whorls, and the nearly upright ribbing of *marginata* show that the present species is a much further retrogression in a somewhat different direction. In the aged specimen (Pl. LXIV) it should be noticed in reference to future developments that the ribs become proportionately larger and more distant. Something of the same feature may be seen in the specimen shown in Pl. LXII. The senile stage of the aged specimen should be the morphological prefiguration of the adult of the next species.

Sonn. marginata owes its name to its well-marked inner edge, though it shares this feature with other species. It occurs in the *Concavum*-zone of Bradford Abbas, Halfway House, &c.

A typical specimen of the species is figured in Pl. LXII, showing that the irregularly-spinous stage of *irregularis* has become a youthful feature. A front view of this fossil is given in Pl. LXIII, fig. 2. In Pl. LXIV a grand aged example of the species is figured, reduced two-thirds of natural size, illustrating the acquirement of coarser, more distant costæ in old age. Fig. 2 gives an outline of the aperture similarly reduced; while in fig. 3 the last suture-line is depicted of natural size. The branching of the superior lateral lobe is somewhat unusual and irregular.

In Pl. LXV are figured two views of an immature specimen of this species in order to compare with the figured examples of *crassispinata* and *acanthodes* of the same age. The side view is given in fig. 1; the front view in fig. 2.

Sonninia dominans, *S. Buckman.* Plates LXVI; LXVII, figs. 1 and 2; Plate LXIX; and, an intermediate form, Plate LXVII, figs. 3—5.

Discoidal, compressed, hollow-carinate. Whorls, in section, sub-quadrangular, oblong, ornamented with direct, upright, ventrally-inclined ribs, which in the central whorls only bear a few irregularly placed spines. Ventral area rather broad and flat, carina hollow,[1] distinct but not very conspicuous, bordered by depressed zones. Inner margin well-marked, upright, slightly convex. Inclusion about one-third. Umbilicus becoming excentric[2] in very large examples. Suture-line with superior lateral lobe tripartite, the outer lobule rather more developed than the inner one.

This species is exactly the next descendant of *Sonninia marginata.* The spines do not end very much earlier, about half a whorl generally; but there is in the following stage a reduction of the ribbing correlating with a slightly smaller umbilicus. This may be regarded as the further retrogression of the early costate stage of *marginata.* In the later costate stage of *marginata* there appeared to be progression, the ribs becoming larger and more distant; and the same feature is seen in *dominans* commencing at an earlier age.

Of this species there may be said to be certain varieties which no doubt owe their origin, really, to less-marked forms of *marginata*, of which forms they have accentuated the differences sufficiently to be noticeable. Among the chief forms there are—

α. The type, Pl. LXVI.

β. The umbilicate form.

γ. The close-ribbed form, Pl. LXIX.

δ. The thick-whorled, wide-ribbed form.

The last two are the more-ribbed, the former two the less-ribbed forms. At least two distinct sub-series take their rise from the above varieties, and probably more may yet be detected by careful work.

Sonn. dominans is one of the commonest of the *Concavum*-zone species of the genus. Its characters are fairly well-marked; and, though it can easily be connected by intermediate forms with *marginata*, it is not difficult to recognise it from that species on account of the general reduction in ornament.

It is also the largest species of the genus in the *Concavum*-zone, its only rival being the large *marginata* figured. I have in my collection three large specimens of *dominans*, which illustrate three different phases of development. The first is a rather costate form which, roughly speaking, may be said to connect the large *marginata* with the large type *dominans*. It is 318 mm. in diameter, thus surpassing *marginata*. It possesses what appears to be the mouth,[3] the test being much

[1] In this and other species crystallisation often obscures the structure of the carina, so that a hollow carina may easily be overlooked.

[2] *Umbilicus excentric* :—the body-chamber becomes narrower, causing the inner margin to recede from the normal line of coil, and so the umbilicus is suddenly widened.

Umbilicus concentric :—when a normal and regularly-increasing mode of coiling is maintained.

[3] A broken specimen in my collection, about 260 mm. ($10\frac{1}{4}$ inches) in diameter, shows an unmistakable mouth possessing good test on the ventral lappet. The mouth is quite plain, appears

thickened, and making a considerable constriction on the core; but, if it be the mouth, the body-chamber is very short, only three-eighths of a whorl.

The second of the large fossils is the type of *dominans*, figured, 302 mm. in diameter. The third is a form which links the type, or more correctly *dominans* β, with *modesta* β (see next page). It is 312 mm. in diameter, incomplete, with only a quarter-of-a-whorl body-chamber. It has a very excentric umbilicus, 129 mm. in diameter, but at one whorl back only 47; yet the excentricity does not begin so early as in *modesta*. It is rather smooth till nearly adult, and then shows somewhat coarse distant ribs, which, however, are not large.

This species has been obtained from Bradford Abbas, Halfway House, &c., in North Dorset, and from Chideock in South Dorset. In Pl. LXVI are shown the side view and outline front view of a splendid specimen, reduced about two-thirds. Pl. LXVII, figs. 1, 2, illustrate the two views of a young form to compare with young *marginata*. In Pl. LXIX the very distinct close-ribbed variety is delineated. A form intermediate in certain respects between *marginata* and *dominans* is illustrated in Pl. LXVII, figs. 3, 4, 5.

Sonninia revirescens, *S. Buckman*. Plate LXX, fig. 1.

Discoidal, compressed, carinate. Whorls, in section, sub-oblong, ventrally-convergent, ornamented with inconspicuous, closely-set, undulate, direct, upright, ventrally-inclined ribs,[1] followed by distant, coarse ribs, which increase considerably in size with age. Ventral area subacutely arched, bearing a small carina.[2] Inner margin fairly upright, well-marked, subconvex. Inclusion about one-fourth. Umbilicus becomes excentric in correlation with the larger ribs.

This is not merely a smaller edition of *dominans* α—it is more than that. The ornaments of the inner whorls are somewhat less pronounced, while the coarse ribs begin much earlier, are more distant, and attain a larger size. Not even in the costate forms of *dominans* do the adult ribs become so large; and those forms certainly do not show such a difference in the ribbing of the inner and outer whorls.

Reduction of ornament is a feature of the genetic series from *crassispinata* onwards. This reduction is manifest in the individual earlier and earlier as the species are followed up, and it is succeeded by an elaboration which begins with

to have been parallel to the ribs and growth-lines, and the ventral lappet is obtusely rounded. The body-chamber in this case is half a whorl in length.

[1] A few rudimentary spines are irregularly placed on the ribs of the central whorls.

[2] The carina is apparently not hollow in the adult; possibly it is in the young.

marginata. The inheritance of this elaboration appears to be affected by the preceding reduction. It is not the mere size of ribs that must be considered, but the amount of contrast between the effects of the reduction and the effects of the elaboration. It may be seen that in *revirescens* the contrast between reduction and elaboration, or between the retrogression and progression, is greater than in *marginata* or *dominans*, and that it is manifest earlier.[1]

It can scarcely be doubted that *Sonn. revirescens* is a development of the type of *Sonn. dominans*, for, as regards its earlier whorls, the same changes in relation to *dominans* are continued as distinguish *dominans* in relation to *marginata.* In its outer whorls the coarse distant ribs attain a larger size. The renewal of progression, so far as the ribs are concerned, has induced me to distinguish the form by the name "*revirescens*." It is a very rare form—this is the only large example in my collection. It came from Bradford Abbas.

Fig. 1 of Pl. LXX illustrates a portion of the specimen reduced to one-half the natural size. The drawing is a copy of a photograph showing the essential features—the change in ribbing and the umbilicus. In comparing this figure with that of the large *dominans* in Pl. LXVI, it must be remembered that both are reduced—this one the most.

Sonninia modesta, *S. Buckman.* Plates LXVIII, LXX, fig. 5.

Discoidal, compressed, hollow-carinate. Whorls, for the most part, smooth or feebly ribbed—only the central part of the umbilicus bearing a few rudimentary spines irregularly placed on small ribs. Ventral area rounded, divided by a small but well-marked, and cleanly-separated, hollow carina.[2] Inner margin broad and conspicuous, upright, flat. Inclusion in youth one-half, decreasing to about one-third in older specimens. Umbilicus regularly graduated—becoming excentric with age. Suture-line of the general *Sonninia*-type, but the outer lobule of the superior lateral lobe rather excessively developed on account of the greater breadth of the whorls.

The specimen depicted in Pl. LXVIII is not a typical form of the species, because it exhibits a peculiar character not observable in the other examples to anything like this extent, even when they are much older. I refer to the ribs of the last quarter-whorl, which are almost tubercled at their middles. These ribs might have been produced by a process of development similar to that which elaborated the enlarged ribs in senile *dominans* and in *revirescens;* and in that case I should

[1] Compare remarks on umbilicus, p. 327.

[2] The carina loses the "hollow" character with age.

regard this example—if confirmed by others—as distinct from the typical *modesta*-forms, which do not show any feature like this at this size. But there are signs of injury to the ventral area of this example—a slight displacement of carina; and it seems to me, upon the present evidence, that this specimen is an example of *modesta* which has become thus remarkably costate owing to injury—in fact, a pathological case of accelerated development.

The type form (α) of *modesta* agrees exactly in general outline with this example, and only differs from it in having, throughout life, very small, rather closely-set ribs, which show only a slight tendency to become more distant with age. The bend of the umbilicus is, in all respects, similar to that of the example depicted.

There is another form (β) which I have classed under the same specific name for the sake of convenience. It is more umbilicate, and is certainly smoother—in fact, it appears almost destitute of ornament, except just in the central whorls, and except for a few irregularly-placed obscure ribs on the outer whorls.

It is obviously a development of the umbilicate form of *dominans*,[1] which I have no doubt could be traced back to some more umbilicate and less costate form of *marginata*, so that it would really belong to a distinct genetic series. The type-form is probably descended from *dominans* α, but there is a considerable distance between it and that form.

Sonn. modesta is a common species in the *Concavum*-zone of Bradford Abbas. It may be recognised from any *Sonninia* hitherto figured by the deficiency of ornament; and it illustrates in a remarkable manner the retrogression to which the series has attained, the rudimentary umbilical spines being the only evidence of the *crassispinata*-forms. In fig. 1, Pl. LXVIII, is depicted an example which is somewhat abnormal, so far as the last quarter-whorl is concerned, presumably on account of injury. An outline of its front view is shown in fig. 2. In fig. 5 of Pl. LXX the suture-line of a normal *modesta* α is delineated, illustrating the tendency in the broader-whorled forms to unduly elaborate the outer lobule of the superior lateral lobe.

Sonninia simplex, *S. Buckman*. Plate LXX, figs. 2—4.

Discoidal, compressed, partly sub-carinate. Whorls oblong in section, marked only with very fine, sub-direct, ventrally-inclined growth-lines.[2] Ventral area convex, divided, only during immaturity, by a very rudimentary carina about the size of a pencilled line. At early maturity the ventral area (when the test is

[1] I could figure all the gradations between *dominans* β and *modesta* β (see p. 324).

[2] On the core of the body-chamber are some irregular bulgings due to irregularity in thickness of test. They make no impression on the outside of the test.

present) is quite rounded (in the example figured at a diameter of 145 mm.), but there is a very faint keel-mark on the core. Inner margin well-defined, deep, upright, flat. Inclusion varying with age, the umbilicus markedly excentric. Suture-line with a superior lateral lobe longer than the siphonal, unsymmetrically trifurcate on account of development of the outer lobule; the inferior lateral and auxiliary lobes fairly symmetrically trifurcate, their lobules divergent, giving them a cruciform appearance; the inner part of suture-line little dependent.

This species is an example of very pronounced retrogression. If there be any spines or ribs they are of the most rudimentary description, and they would only be observable in the very centre of exceptionally preserved specimens. None have been detected.

Sonn. simplex is an extremely retrogressive development of *modesta* α, with which it is absolutely connected by examples in my possession. Yet this form is perfectly distinguished from *modesta* by almost complete absence of keel, entire want of ornament, and by its more excentric umbilicus more occluded centrally. The difference in the coiling of the umbilicus in the two forms is the character most likely to attract attention, and it is best illustrated thus:

	modesta.		*simplex.*
Total diameter measured off .	180 mm.	...	180 mm.
Umbilicus . . .	59 „	...	60 „
„ 1 whorl back . .	25 „	...	21 „
„ 2 whorls back . .	12 „	...	8 „

This excentric umbilicus of *Sonn. simplex* is a feature worth attention. In the development of the genetic series I have noted the tendency to contract the umbilicus; and this tendency can be traced throughout. But, first noticeable in aged *dominans* as an adult feature, is a tendency to widen the umbilicus; and this tendency is also traceable onwards, appearing sooner in each form—in *dominans* at about 160 mm., in *modesta* about 120, in *simplex* about 90 mm. diameter. The tendency to widen is thus preceded by the tendency to contract; so that the higher the form in the genetic series the smaller the umbilicus in the inner whorls. The tendency to widen has therefore to make up, so to speak, more and more leeway the higher the form. Part of this leeway is made up by beginning earlier the higher the form; part by the greater and greater tendency to be more umbilicate in maturity. Thus the umbilicus tends to become in the higher, or rather the most retrogressive, forms more and more excentric (see p. 311).

Sonn. simplex is the terminal of the present genetic series, the entire loss of the carina being an extremely retrogressive feature. As yet the suture-line is considerably complicated—it has, in fact, been increasing in complication as the whorls become broader; but any further retrogression would cause the sutures to become simpler.

In extremely retrogressive forms like *Sonn. simplex*, which have lost every ornament by which the genus was distinguished when at the acme of progressive development, the suture-line becomes almost the only feature to indicate the generic relationship of the species standing by itself.[1] I have, therefore, been at some pains to remove the test of a specimen by means of acid and a file. The suture-line has, no doubt, suffered slightly as regards its minor details; but its character and its agreement with the sutures of other broad-whorled *Sonniniæ* may be seen (Pl. LXX, fig. 4).

In my collection I have associated with *Sonn. simplex* certain specimens which possess just the same features of coiling, &c., but are a trifle more carinate, and have a sharper upper edge to the inner margin. It is just possible that I may be mistaken in so doing, and that they belong to another genetic series of *Sonninia*. There are also in my collection specimens more concentrically umbilicate—the central part more slowly coiled and showing a few spines, the only ornament they possess. Such forms are evidently smoother developments of *modesta* β, and deserve a separate name. They might be distinguished as *sub-simplex*.

All these forms occur at Bradford Abbas; but there are still some others in the *Concavum*-bed which might easily be mistaken for *simplex*. I shall, however, be able to show that they are really the terminals of other genetic series of *Sonninia*, and are reached by very different routes. There are also forms in the "*Sowerbyi*-zone" which are terminals of other genetic series. One of these is *Sonninia fissilobata* (Waagen),[2] to which *simplex* has much resemblance; but that form really differs in numerous points—the suture-line, the carina, the bend of the striæ, and the umbilicus—especially the slower coiling of the inner whorls.

As it is without ornament, and in order to economise space, only a portion of this very interesting form (*Sonn. simplex*) has been figured in Pl. LXX, fig. 2; but the figure illustrates the characteristic coiling of the umbilicus. An outline of the aperture shows the characters of the ventral area (fig. 3). The suture-line is depicted in fig. 4.

The *submarginata*-stock.

The species of the genus hitherto described—omitting *acanthodes*—have been arranged in one genetic series with two terminal branches, *revirescens* and *simplex*; though careful work would, as I have pointed out, lead to further division. Those

[1] Without the suture-line the generic position can only be known by tracing the genealogy step by step from the acmic forms; but for this research a very great number of specimens is required.

[2] 'Zone *Am. Sowerbyi*,' Geogn. Pal. Beiträge, Bd. i, Heft 3, pl. xxvii (4), fig. 1, 1867.

species—which may be known as the *dominans*-stock—are separable one from another by very distinct characters; for the six species belong to three distinct stages of ornamentation, thus :

Spinous.		Costate.		More or less smooth.	
crassispinata,	*irregularis,*	*marginata,*	*dominans,*	*modesta,*	*simplex.*

The species which I am now going to describe are quite as easily separable one from another in direct genetic line; but the matter is not so easy in regard to their respective relations to the forms of the *dominans*-stock. It would seem as if the subseries took its rise from *marginata*, and produced homoplastic forms analogous to *dominans*, *modesta*, *simplex*. These forms may, however, be distinguished by the following characters :

In proportion to the development attained, i. e. *to the degree of retrogression, the forms of the* submarginata-*series are thinner and more umbilicate than are their morphological equivalents in the* dominans-*stock.*

The relative thickness is a character more noticeable in handling the specimens than in the most carefully-drawn plates; but the persistently larger size of the umbilicus will be brought out, and is quite sufficient distinction.

Sonninia submarginata, *S. Buckman.* Plate LXXI, figs. 1—3.

Discoidal, compressed, hollow-carinate. Whorls, in section, oblong. The sides in the costate stage much flattened. The ornamentation begins with regular spines, changing, at about 20 mm. diameter, to ribs and occasional spines, and then the numerous, rather small, direct, upright, ventrally-inclined ribs of the costate stage are assumed early in life (at about 40 mm. diameter). Ventral area arched, divided by a distinct, rounded, hollow carina. Inner margin well-marked, smooth, upright, flat. Inclusion about one-third. Umbilicus open, rather flattened; the centre deeper and spinous.

This form is distinguished from *marginata* by its flatter whorls more finely ribbed. It is nearest to *dominans* γ, Plate LXIX, but may be known by its wider umbilicus, slower coiling, and less pronounced spines ending earlier.

It comes from Bradford Abbas, but is rare. A portion of a very well-preserved specimen is depicted in fig. 1, Plate LXXI ; the outline of its aperture is given in fig. 2 of the same plate; and its suture-line in fig. 3. The drawings are all of natural size.

Sonninia subcostata, *S. Buckman.* Plate LXXI, figs. 4, 5.

Discoidal, compressed, carinate. Whorls, in section, compressed oblong, ornamented with small, closely-set, direct, upright, ventrally-inclined ribs. (The spinous stage is very rudimentary, and evidently ended at about 20 mm. diameter.) Ventral area narrow, arched, divided by a small, rounded, presumably-hollow carina. Inner margin conspicuous, smooth, upright, flat. Inclusion about two-fifths. Umbilicus regularly graduated.

This shell seems to me exactly the development which might be expected from *submarginata*, from which it differs by being much more finely ribbed, and by its rudimentary spinous stage. It is the morphological equivalent of *Sonninia modesta α*, but is thinner and possesses a larger umbilicus, which the following measurements will indicate:

	modesta.		*subcostata.*
Diameter . . .	129 mm.	...	129 mm.
Umbilicus . . .	34 ,,	...	46 ,,
Umbilicus, one whorl back .	16 ,,	...	20 ,,
Umbilicus, two whorls back .	7 ,,	...	10 ,,

This form occurs at Bradford Abbas, but is rare. A side view is shown in fig. 4, Plate LXXI, and the aperture in outline, fig. 5.

Sonninia substriata, *S. Buckman.* Plate LXX, figs. 6, 7; Plate LXXI, figs. 6—8; and an intermediate form, Plate LXXII, figs. 1, 2.

Discoidal, compressed, partly carinate. Whorls, in section, oblong, only those of the centre ornamented with small, direct, ventrally-inclined costæ, the spinous stage being absent. Outer whorls marked only with sub-direct, laterally and ventrally-inclined growth-lines. Ventral area rounded, divided by a small keel, which becomes more and more rudimentary with age, and is entirely lost at about 135 mm. ($5\frac{1}{2}$ inches) diameter. Inner margin well-marked, flat, becoming more sloping with age. Inclusion, in youth one-half, decreasing to about $\frac{3}{8}$ in older shells. Umbilicus with a slight excentric tendency.

This form is the descendant of *subcostata*, from which it is easily distinguished by the loss of ribs, loss of carina, and smaller umbilicus. It is the morphological equivalent of *simplex*, but is distinguished by its slower-coiled centre, more concentric umbilicus, by possessing ribs to a later date, and by being thinner. The difference in the coiling of the umbilicus is a very marked feature, rendered more apparent by the thinner form of *substriata*. It may be illustrated thus:

	substriata.			*simplex.*	
Diameter . .	156 mm.	190 mm.	...	156 mm.	190 mm.
Umbilicus . .	52 ,,	68 ,,	...	49 ,,	63 ,,
Umbilicus, one whorl back	21 ,,	27 ,,	...	16 ,,	22 ,,
Umbilicus, two whorls back	10 ,,	12·5 ,,	...	7 ,,	9 ,,

Sonn. substriata occurs at Bradford Abbas, and is represented by several specimens in my collection. There are also some examples which are intermediate between it and *subcostata*, and of these a young one is depicted in figs. 1, 2 of Plate LXXII. In the centre of the umbilicus it has small irregularly-placed spines, the rudiments of the spinous stage. It is slightly more costate and slightly more carinate than *substriata* (type), which is represented in Plate LXXI, figs. 6—8, and a young example, Plate LXX, figs. 6, 7.

The *acanthodes*-stock.

From *acanthodes a* (p. 319) it is possible to trace a genetic series of costate forms which in their developments are analogous to the *dominans*-series. They are separable from one another in direct line without much difficulty. In *acanthodes* the spinous stage is an important feature; in *ptycta* the greater part of the fossil is taken up with the costate stage; in *cymatera* the whole fossil is practically taken up with the costate stage, the spinous stage being quite rudimentary; in *obtusiformis* the whole fossil also belongs to the costate stage, but early in life the costæ are elaborated in a remarkable manner.

It is always more difficult to distinguish morphological equivalents than to separate the steps of a genetic series; but the forms of the *acanthodes*-stock may be known from those hitherto described by the following.

In proportion to development, the forms of the acanthodes-*stock are more umbilicate, have whorls more laterally inflated, and retain their reclining ribbing longer.* That the combination of these features makes more and more difference between the two series of the *acanthodes*- and *dominans*-stocks may be seen by comparing the morphological equivalents, *obtusiformis* and *virescens*. The separation from the forms of the *dominans*-stock, of *ptycta* and *cymatera*, as descendants of *acanthodes* and ancestors of *obtusiformis*, is of importance biologically.

Sonninia ptycta,[1] *S. Buckman.* Plate LXXIII, fig. 1.

Discoidal, compressed, carinate. Whorls, in section, gibbous-sided, subquadrate, ornamented for the most part with direct, reclining, ventrally-inclined ribs, but the central part of the umbilicus ornamented only with strong spines (to 40 mm. in diameter), later with spines separated by ribs,—the intermediate ribs at first single, afterwards more numerous. Ventral area broad, laterally-gibbous, median portion somewhat depressed, bearing a strong, rounded, presumably hollow carina. Inner margin not defined till late, then nearly upright, but upper edge much rounded. Inclusion very little—about one-fifth. Umbilicus with gibbous whorls. Termination, adult, a mouth with merely a plain, thin edge parallel to the ribbing and growth-lines.

This form is the morphological equivalent of *Sonninia marginata*, to which it certainly bears considerable resemblance; but its whorls are more tumid, and the markedly reclining ribs give to them and to the umbilicus a twisted appearance not seen in *marginata*. It also lacks the pronounced inner margin.

It bears to *acanthodes α* the same relationship as *marginata* bears to *irregularis*, namely, in adolescence it is the morphological representation of the adult *acanthodes*. It retains the same reclining ribs. It is true that the same feature is seen in *irregularis γ*; but that form has, like *marginata*, a peculiarly angular appearance due to the laterally-flattened whorls and the marked inner margin; it is also spinous a much longer time.

In order to economise space, I have only given a very reduced figure of this shell. It should be possible for anyone, taking the figure of the morphological equivalent *marginata*, and bearing in mind the differences noted above, to recognise the species, remembering its genetic position in relation to *acanthodes*. The reduced figure gives a curious result,—the adult, *ptycta*, *reduced to about one-quarter*, is wonderfully like the young *cymatera* (its descendant) *drawn of the natural size*. A better illustration of the law of earlier inheritance could hardly have been devised.

Sonn. ptycta is a rare form obtained from the *Concavum*-zone of Bradford Abbas. It is depicted about one-quarter of natural size in Pl. LXXIII, fig. 1, the drawing being a copy from a photograph.

Sonninia cymatera,[2] *S. Buckman.* Plate LXXIII, figs. 2, 3.

Discoidal, compressed, carinate. Whorls, in section elliptical, ornamented for the most part with well-marked, direct, somewhat reclining, ventrally-inclined

[1] Πτυκτός = folded.

[2] Κυματηρός = waved.

costæ, some of which, in the central part of the umbilicus, carry a small spine. Ventral area broad, laterally-gibbous, somewhat flattened in the middle, with a distinct, rounded, presumably hollow carina. Inner margin ill-defined. Inclusion about one-fourth.

This description is from the small example figured. In comparison with its ancestor, *ptycta*, it is very distinct on account of the very small spines, which fail altogether at a much earlier period.[1] In comparison with the next species, its descendant (*obtusiformis*), the costæ are much smaller—in other words, the larger costæ appear earlier in *obtusiformis* than in *cymatera*. This is confirmed by a larger specimen in my collection, which, judging by its inner whorls, is exactly intermediate between *ptycta* and *cymatera;* it has spines larger than the latter, but smaller than the former, while the ribs on its outer whorls (both core and test) are decidedly more distant than in *ptycta*, and appear much later than in *obtusiformis*.

Sonn. cymatera is the morphological equivalent of *dominans* and of *submarginata*, but differs from both in having larger, more reclining costæ, and in wanting a defined inner margin. Its inner whorls are much less elaborately ornamented than those of *marginata*. The costæ reclining at this rather advanced stage of retrogression—shown by the rudimentary state of the spinous stage—indicate that it belongs to the *acanthodes*-stock; and the early appearance of the costate stage reveals its position in the series. Further, in early adolescence it is the morphological representation of adult *ptycta*, as the figures so plainly prove (see p. 332).

Sonn. cymatera is from the *Concavum*-zone of Bradford Abbas. A side-view of a young example is shown in Pl. LXXIII, fig. 2, the outline of its aperture in fig. 3; both of natural size.

SONNINIA OBTUSIFORMIS, *S. Buckman*. Plate LXXII, figs. 3—5.

Discoidal, compressed, hollow-carinate. Whorls, in section, gibbous-sided, elliptical, ornamented with undulate, direct, reclining, ventrally-inclined ribs, which become less reclining and considerably larger the older the shell, until they resemble large waves. Ventral area broad, laterally-gibbous, the middle depressed into a well-marked hollow, which is divided by a thick, rounded, hollow carina, so that the area is carinate-bisulcate. Inner margin not actually defined,

[1] In comparing with *ptycta* it must be remembered that the figure of that fossil is an adult reduced *one-fourth*, and that the spines and ornaments, which appear of about the same size as those of the young *cymatera*, must be enlarged four times.

but the inner part of whorl steeply sloped. Inclusion very slight, about one-fifth. Umbilicus rather depressed, mostly costate, but the central part with a few rudimentary spines. Suture-line with a narrow-stemmed superior lateral lobe of which the lateral lobules are fairly balanced.

This remarkable and very distinct form is singularly like *Asteroceras obtusum* of the Lower Lias—hence the name I have given to it, although the term is equally applicable to its general dimensions. In outward aspect, even to the sulcate-carinate ventral area, it simulates *Ast. obtusum* so closely that it is only to be distinguished therefrom by having reclining and not inclining costæ; but its suture-line at once tells a different tale; in that respect, there is not the least similarity between the two forms.

Sonninia obtusiformis is, in nearly all respects, a morphological equivalent of *Aster. obtusum.* The spinous central whorls of the latter show it to be a costate retrogression from an ancestor which belonged to the spinous stage; the spinous inner whorls of the former point to exactly the same facts. Yet the analogy is not quite complete, because the distant ribs which render *obtusiformis* so like *obtusum* are due to a renewed progressive development of the costate stage, but the distant ribs of *obtusum* are due to less-marked retrogression of the costate stage.

The renewal of progressive development in *obtusiformis* is a very remarkable feature. The larger-sized ribs are noticeable, but not to any great extent, in the adult *ptycta;* the same feature appears more marked and rather earlier in *cymatera;* but in *obtusiformis* this development is a pronounced feature of the early adolescent stage—in fact, the feature appears nearly two whorls earlier in *obtusiformis* than in *ptycta.*

It may be noticed that a morphologically-equivalent development of ribs is shown in the *dominans*-stock (*revirescens*). In the present case, however, renewed progressive development is even more pronounced, for it is correlated with a noticeable inflation of the whorls and with sulcation of the ventral area, both these being progressive features which had presumably accompanied the progressive development of the *Sonninia*-ancestors.

Sonninia obtusiformis has every appearance of being anything but a decadent form, yet I cannot at present point to any species which might be regarded as its descendant. The branch-stock comes to an end with this species so far as I am aware; yet it is not a terminal like *simplex* and *substriata.*

Of the species of *Sonninia* which I have described *marginata* is the only one which *obtusiformis* is at all like; but the present fossil has reclining ribs nearly twice as distant and certainly twice as large, is practically without any spines, has considerably inflated whorls, and a markedly sulcate ventral area.

This fossil is unique. It was obtained by my father probably as many as twenty years ago, and it has attracted my attention for considerably more than half that period. It has always been regarded as a very rare and distinct form; and I can certainly confirm its rarity, for had there been any duplicate among the thousands of specimens which have come under my notice I should certainly have detected it—its peculiar form could not fail to attract my attention.

The specimen came from the *Concavum*-zone of Bradford Abbas—from that justly-celebrated opening at East Hill which, by its long association with my father, came to be known as "Professor Buckman's quarry."

The side view of the upper half of this grand fossil has been depicted in Plate LXXII, fig. 3; the front view in fig. 4; part of the suture line in fig. 5.

Sonninia spinifera, *S. Buckman.* Plate L, figs. 14, 15. Plate LXXIV, figs. 4—6.

Discoidal, compressed, carinate. Whorls, in section, sub-elliptical,[1] ornamented first with regular spines, later with spines parted by one, two, or more ribs,[2] later still with direct, much reclining, not prominent ribs, for the most part lost on the outer third of the whorl, which carries only ventrally-inclined growth-lines. Ventral area arched, divided by a small, presumably hollow, carina. No inner margin. Inclusion about one-third. Suture-line with an unsymmetrical superior lateral lobe, the outer lobule being rather exaggerated.

The strongly-reclining ribs bring this species into connection with the *acanthodes*-stock; but from the small size to which it attained, the small spines, and the want of elaboration of the ribbing, it does not seem possible to derive it from members of that group. Looking at the specimen figured in Plate LXXIV, figs. 4—6, as an adult form, a separate derivation from *multispinata* seems more probable, the ornaments and the shape of the young (Plate L, figs. 14, 15) certainly supporting this view. Should it, however, be found that *spinifera* is the young of a much larger fossil, derivation from *acanthodes* or from *ptycta* might appear possible; but at present there is the evidence of one feature at least against such derivation, namely, in *spinifera* the obsolescence of the ribbing on the outer third of the whorl. This character seems to separate it altogether from the members of the *acanthodes*-stock.

[1] In youth, ventrally-expanded, subquadrate—that is, somewhat of quadrate shape, but the ventral side broader than the dorsal. The fig. 15 of Pl. L represents this at the bottom; but the aperture is not quite correct, and the extra matrix on one side gives a false impression. The aperture is rather too long; and from spine to spine the ventral area should be broader and flatter.

[2] Up to about 44 mm. diameter.

Sonn. spinifera is nearest to *Sonn. cymatera*, and is the morphological equivalent thereof. It may be distinguished, however, by a more pronounced spinous stage and a decidedly less-marked costate stage, by the ribs being more reclined, and failing on the outer third of the whorl, the whorls being rather more gibbous and being without any inner margin. The spines taking up more of the umbilicus, and the much smaller size of the ribs, are the features most noticeable in this form compared with *cymatera.*

This species is certainly not the young of *ptycta;* it is more slowly coiled, has very much smaller spines which yield to the costate stage very much earlier; its costæ are less strongly marked, and it is evidently more compressed.

It is not a young form of any species of either the *dominans-* or *submarginata-*stocks because of its strongly-reclining ribs; they give a noticeable twisted appearance to the shell.

The young example figured in Plate L, figs. 14, 15, is a well-preserved fossil with some of its spines complete, and it is a form by no means unknown in the *Concavum*-zone of Bradford Abbas. Its exact agreement with the inner whorls of the specimen shown in Plate LXXIV, figs. 4—6, proves that the latter is an older example of the same species. This specimen, so far as my evidence goes at present, is presumably an adult form.

The *costata*-stock.

Properly speaking, the series only consists of two common Bradford-Abbas species, namely—

Costata, the costate stage throughout life, the spinous stage very rudimentary.

Parvicostata, the spinous stage extremely rudimentary, the costate stage confined to the inner whorls, the outer whorls smooth except for some obscure, irregularly-placed, undulate costæ.

These two forms illustrate two phases of retrogression; and *parvicostata* looks like a terminal of a series. There is some variability among the specimens of the two forms, and they shade one into the other.

Their descent is a matter of considerable uncertainty. At first glance, *costata*, especially the example figured, looks like a reduced and compressed edition of the large *marginata* (p. 321, Plate LXIV). It may be a descendant therefrom; and yet it may be questioned whether, as the descendant of *marginata*, it would have lost its spines so much, have become so compressed, and yet be so evolute.

Still it must be noticed that, as regards suture-line, *costata* has a very considerable agreement with the large *marginata;* for the superior lateral lobe is wide-stemmed, and its lateral lobules are not greatly developed.

On the other hand, there is a form which it is necessary to consider in this connection: I have called it *spinicostata*. It is somewhat remarkable for being so umbilicate and yet so much compressed; but it is most noticeable for possessing, in conjunction with these characters, spines for so long a period. Omitting the spines, its general shape seems to bring it into line with the *costata*-forms; it has the peculiar four-sided, somewhat angular whorl which distinguishes the series. If it be the ancestor of *costata*, examples of several intermediate stages must be missing; because the spines, which remain in *spinicostata* from youth to adult, are a very youthful feature of *costata*. If it be not the ancestor of *costata*, it must be presumed that no descendants of *spinicostata* have yet been found.

If *spinicostata* be included in the *costata*-stock, it might be said that the series can be distinguished from those hitherto described by being thinner and more umbilicate, the compression of course becoming more pronounced and the umbilicus smaller in proportion to development. There is another feature noticeable in the higher forms: the narrow ventral area is rather flat and angular, and, considering the retrogression, shows the vestiges of furrows rather plainly.

SONNINIA SPINICOSTATA, *S. Buckman*. Plate LXXIII, figs. 4—6.

Discoidal, compressed, carinate. Whorls, in section, nearly quadrate, ornamented with direct, somewhat reclining,[1] ventrally-inclined costæ, of which in the inner whorls about every other one is decked with a fairly prominent lateral spine, and in the outer whorls nearly every rib is, in the middle, drawn up into an obtuse knob.[2] Ventral area obtusely arched, divided by a small (hollow?) carina. Inner margin fairly defined, steep. Inclusion about one-fourth. Umbilicus shallow and open.

The preservation of the specimen leaves something to be desired—the central whorls are wanting, and the outer whorls are somewhat damaged in places.

The specimen was evidently spinous to within about three inches of its aperture. In the inner whorls the spines are larger, but irregularly placed; in the outer whorls smaller, but placed on nearly every rib.

The species differs from all the forms I have described, except *irregularis*, *acanthodes*, and *crassispinata*, by the persistence of the spines.[3] From *irregularis*

[1] Towards the last, upright.

[2] The body-chamber is without test, but the knobs on the core indicate that the test was evidently spinous.

[3] See note in Explanation of Plate.

it differs by more regular, less profuse ornamentation, and a wider umbilicus; from *acanthodes* and *crassispinata* α and β by more flatly-sided whorls, especially in the umbilicus, and by less ornament; while it is only to *crassispinata* γ that it bears any great likeness. From that form it is separated by its less reclining ribs, its spines more marked in the umbilicus and less marked on the outer whorls, its slower coiling, the want, for the most part, of the space between the spines and the inner margin, and the absence of that declivity in the same place which is so marked in *crassispinata*, *acanthodes*, &c.

S. spinicostata is not the adult of *multispinata;* sufficient of the inner whorls, with their flat sides and irregularly-placed coarse ribs, is left to show that. Its inner whorls are the morphological representation of a flat-sided adult form ornamented like *crassispinata* α, of which such form may have been the cousin.

The specimen figured is the only example in my collection, and it came from the *Concavum*-zone, Bradford Abbas. Its side view is depicted two-thirds the natural size in Pl. LXXIII, fig. 4, and an outline of the aperture similarly reduced in fig. 5. The suture, fig. 6, is of the natural size.

Sonninia costata, *S. Buckman.* Plate LXXIV, fig. 1; Plate LXXV, figs. 1, 2.

Discoidal, compressed, carinate. Whorls, in section, compressed, oblong, ornamented only with direct, nearly upright costæ, inclined but obscure ventrally. Ventral area flattened, fairly defined, possessing a small solid carina, bordered by very obscure sulci. Inner margin well-marked, slightly sloped, the upper edge rather angular. Inclusion about one-third. Umbilicus concentric and regularly graduated. Suture-line with a broad-stemmed superior lateral lobe, of which the lateral lobules are unimportant. Termination of adult evidently perfectly plain, parallel with the ribs and growth-lines.

The ribs of this species are, in size, rather irregular. There is sometimes more or less of a tendency to produce rather coarse, more distant ribs in the adult, as in the figured example; in other specimens this is not so noticeable, and the ribs tend to be obsolete in old age. The ribs are rather obscure on the ventral area, and in the forms which connect the species with the next (*parvicostata*) they tend to be obscure on the outer third of the whorl as well, though fairly marked and distant on the inner two-thirds.

Besides the examples which connect this and the next species, I have distinguished two principal forms as *costata:*

α. The type, thin and umbilicate (Pl. LXXIV, fig. 1).

β. Thicker, less umbilicate.

The flattened sides and ventral area, and the prominent inner margin give to this species a peculiarly angular appearance. The irregular, well-marked ribs, the absence of spines,[1] and the large umbilicus make the species very distinct from other *Sonniniæ* of the *Concavum*-zone. It has no morphological equivalent in either the *dominans*- or *submarginata*-series, for in both of those genetic series the spines persist until the ribs are much more reduced in size. In certain respects it may be considered a morphological equivalent of *obtusiformis*, because that is a wholly costate, non-spinous form; but the least comparison as to the shape of the aperture and the size of the ribbing will show what great differences exist between the two shells.

Though not much like any other species of its own genus, *Sonn. costata* has considerable resemblance to *Dumortieria grammoceroides* (page 262); but, besides the differences in the suture-line—the inner portion less retracted, and yet with larger lobes—which are of generic value, this species is more quickly coiled, less umbilicate, and much more carinate. The typical form of *costata* is also nearly twice as thick as *Dum. grammoceroides;* but the forms between *costata* and *parvicostata* are not very much thicker, though in the other points of difference the separation is quite as marked. Considering that these species belong to two different families, the points of superficial resemblance are very interesting.[2]

This is a common and well-known fossil at Bradford Abbas. It is one of the characteristic species of the *Concavum*-zone; and it attracts more than its due share of attention, because it is so easily identified. In Pl. LXXIV, fig. 1, is shown (two-thirds natural size) a fine example of the form *a*, rather more costate than in the usual run, perhaps. The outline of its aperture is delineated in fig. 1 of Pl. LXXV; and its suture-line, of natural size, in fig. 2 of the same plate.

Sonninia parvicostata, *S. Buckman*. Plate LXXIV, figs. 2, 3; Plate LXXV, figs. 3—5.

Discoidal, compressed, carinate. Whorls, in section, compressed, oblong, for the most part smooth, but in infancy and early adolescence ornamented with direct, upright, ventrally-inclined costæ, which, later on, give place to some obscure irregular bulgings. Ventral area rather flat and fairly defined, divided by a small,

[1] I do not mean to say that no rudimentary spines can be detected in exceptionally well-preserved specimens—in fact, irregularly-placed spines may be seen in some examples to about 12 mm. diameter; but in the ordinary run of by no means ill-preserved examples no spines are seen, and for all practical purposes the species may be called non-spinous. I wish this remark to apply in other cases among the *Sonnininæ*. The spines, however rudimentary, are interesting as a proof of descent.

[2] *Dumortieria* did not reach a spinous stage. There are no spines in the inner whorls of *Dum. grammoceroides*. See also description of *ontogeny*, p. 265.

rounded carina. Inner margin smooth, well-marked. Inclusion about two-fifths. Umbilicus regularly graduate, centrally costate. Suture-line with a rather broad superior lateral lobe, of which the lateral lobules are not very prominent.

This is a well-known Bradford Abbas fossil, and specimens have lain in my cabinet for more than twelve years under the name *parvicostata*. It is undoubtedly a further retrogression of *costata* a, and has just the same peculiar, compressed, angular whorls; but its thinner form and deficiency of ornament, especially when adult, render it easily distinguishable from that species.[1]

Among the examples of *parvicostata* there is no very noticeable variety. There is a slight difference in costation and in thickness, and the inner margin, which is usually upright, may be somewhat sloped. It should be noted that the inner margin is flat, with a rather angular upper edge, that the whorls are nearly flat, and the centre without spines, because there are forms of *Sonninia*, not unlike *parvicostata* in general appearance, in which these characters are different, the inner margin subconvex, the whorls somewhat laterally-gibbous, the centre spinous. In my opinion they belong to another genetic series.

Sonn. parvicostata is nearly the morphological equivalent of *Sonn. substriata*, but is not quite so retrogressive a form. Its umbilicus is larger and more concentric, its ventral area flatter and more carinate, especially in adults, which also show irregular though rather obscure ribs not found in *substriata*.

This is a common and characteristic fossil of the *Concavum*-zone of Bradford Abbas.

In Pl. LXXV, fig. 3, is represented a portion of the side-view of an adult shell; an outline of its front view is given in fig. 4; and a suture-line from another specimen is shown in fig. 5. In Pl. LXXIV a specimen illustrating the involute

[1] I mentioned (page 339) in connection with *Sonn. costata* the resemblance of that species to *Dumortieria grammoceroides*. During the progress of this sheet through the press a chance find showed that the superficial resemblance between the species of the *costata*-stock and *Dumortieria* was more remarkable than I had imagined.

In a case of specimens belonging to the collection made by Mr. Darell Stephens, F.G.S., I found an Ammonite which had escaped my notice in previous examinations. Its resemblance to *Sonninia* struck me, but sufficient of the suture-line was exposed to show that it could not belong to this genus. At first its generic position puzzled me, but clearing the test from the suture showed a species of *Dumortieria*—evidently an involute, senescent development of *Dum. grammoceroides*. The specimen is extremely interesting in connection with my surmise that there ought to be descendants of *grammoceroides* (page 266); but it is chiefly remarkable for the fact that while *grammoceroides* and *costata* are superficially alike, this development of *grammoceroides* is curiously like the development of *costata*. In general shape, and in ornamentation obsolescent with age, the two forms are very similar; but the development of *grammoceroides* is less carinate, more compressed, and has reclining ribs in its inner whorls. The suture-line, especially the dependent inner portion, is the striking feature of contrast.

I shall give a figure of this species when opportunity presents, and when I have fully investigated certain matters in connection with other species. It appears to me that this chance discovery will afford a very interesting illustration of complicated convergence in regard to several species.

costate shape of the young is drawn—side view fig. 2, and front view fig. 3. It possesses the test in a very complete state of preservation, and shows, in its inner whorls, spines of the most rudimentary description. It is very instructive to compare this example with spinous forms of the genus, and to note the advance of the costate stage in regard to earlier inheritance.

The *magnispinata*-stock.

The forms which comprise this series are distinguished by possessing noticeably reclining ribs. This feature brings them into connection with the *acanthodes*-stock; but they are separable therefrom by being more compressed in proportion to development. The reclining ribs which give the shells a twisted appearance prevent their being confounded with species of those stocks which are characterised by upright or nearly upright ribs.

From one another the forms of the series may be easily known, thus: *magnispinata*, an elaborate spinous stage in adolescence; *semispinata*, mostly costate, costæ well marked; *brevispinata*, mostly costate, costæ feebly developed.

As regards the derivation of the group, the size of the spines in *magnispinata* shows that a considerable distance separates it from *multispinata*—in fact, only the central whorls can be considered the morphological equivalent thereof. It is possible for *magnispinata* to have come from *multispinata* direct, through a series of forms which constantly enlarged their spines; or there may have been an intervening series of irregularly-spinous forms—the morphological equivalents of *crassispinata* α; and all traces of them may have disappeared owing to the law of "elimination of dissimilar stages," which appears to be the case in regard to *acanthodes* α. Certain differences in ribbing and shape of whorls in the costate stage prevent *magnispinata* being regarded as the descendant of *acanthodes* α; but there cannot be much mistake in thinking that the two forms are by no means distant relations, sprung from a common spinous stock.

Sonninia magnispinata, *S. Buckman*. Plate LXXVI, figs. 1—6.

1881. Harpoceras Sowerbyi, *S. Buckman* (non *Miller*). Inf. Ool. Ammonites; Quart. Journ. Geol. Soc., vol. xxxvii, p. 602 (pars).

Discoidal, compressed, hollow-carinate. Whorls, in section, subcircular to elliptical, and to almost oblong,[1] ornamented with large, regular spines, later with

[1] This indicates the changes which can be seen, and their order; the subcircular whorl gradually

reclining, ventrally-inclined ribs occasionally bearing spines, later with ribs only. Ventral area obtusely arched, carrying a fairly prominent hollow carina. Inner margin flat, high, but conspicuous only in the costate stage. Inclusion about one-third. Umbilicus with large spines. Suture-line with cruciform superior lateral lobe.

This is a noteworthy species, chiefly remarkable for the large size of its spines, and for a certain resemblance to *Am. Sowerbyi*, Miller.

When I began the study of Inferior Oolite Ammonites I found that it was usual to dispose in a very summary fashion of the species now known by the generic name *Sonninia*—the large-spined as *Am. Sowerbyi*, the small-spined and costate as *Am. variabilis*. Under the name *Sowerbyi*, too, various spinous species of *Hammatoceras* were ranged; and in many of our Museums have I noted this wonderfully extensive range of this trivial name.

Though quite unable to agree with this method of nomenclature, yet I was sufficiently influenced by it to group this and one or two similarly-ornamented shells under the name *Sowerbyi*, especially as I had not seen any example of the true species.

Since then I have had the opportunity of studying the original *Am. Sowerbyi* in the Bristol Museum, and older examples, by the kindness of Mr. E. Wilson, F.G.S. I find that Sowerby's is a very faithful drawing, and that the present species is very distinct, being more inflated, larger-spined, narrower-whorled, and more umbilicate. Throughout life there are many differences of ornamentation,[1] and the adult forms of *Sowerbyi* and *magnispinata* differ considerably in this respect.

How important geologically is absolute palæontological correctness may be learnt from the results of incorrectness. Because it was, and often is now, thought to be unreasonable to insist on what, especially in figures, seem to be small differences, *magnispinata* and other forms were considered "sufficiently near" *Sowerbyi* to be regarded as the same species. As a consequence the *Concavum*-zone of Bradford Abbas was of course regarded as "*Sowerbyi*-zone;" it was described by that name; and it retained that name for some years, as the early pages of this Monograph show. Although this has now been corrected, yet there can be little doubt that it will often be a cause of confusion and of difficulty.

The size of the spines places this species near to *acanthodes* and *crassispinata*, but the earlier age at which the costate stage commences effectually separates it.

becomes elliptical with age, and later still is almost oblong. The special meaning attached to the word "to" used in the above and in subsequent diagnoses should be noted.

[1] In *magnispinata* there are two or three coarse costæ proceeding from the spine on the outer area, in *Sowerbyi* four or five fine ribs. In the inner whorls the spines of *magnispinata* are close, regular, and not separated by ribs; in *Sowerbyi* they are distant, irregular, and separated by ribs.

In the same way, from those species in which the costate stage commences as early, *marginata,* &c., the almost disproportionate size of the spines in regard to the costæ distinguishes *magnispinata,* not to mention the reclining ribs. From *ptycta,* the much larger and more regular spines, and, in the costate stage, the flatter-sided whorl with distinct inner margin, are the chief points of difference.

Sonn. magnispinata is a rare form from Bradford Abbas and Halfway House. In Pl. LXXVI, figs. 1—3, I have fully illustrated the typical example; and an older specimen to show the costate stage is drawn in figs. 4, 5 of the same plate; its suture-line, fig. 6.

SONNINIA SEMISPINATA, *S. Buckman.* Plate LXXVII, figs. 1, 2.

Discoidal, compressed, carinate. Whorls, in section, oblong, ornamented with regular spines, then with spines and reclining ribs, later with direct, reclining, ventrally-inclined ribs, which tend to become more upright and obscure with age. Ventral area somewhat angular, divided by a small carina. Inner margin well marked, nearly upright, flat. Inclusion about three-eighths.

The general shape of this fossil and its reclining ribs suggest that it is the descendant of *magnispinata,* though there are certainly some links missing. On the other hand, it lacks the strong keel of that species, though this might be a feature correlated with the development. It differs from *magnispinata* altogether in reduction of ornament and the earlier appearance of the costate stage. It is less spinous, flatter-whorled, and more costate than *ptycta,* more spinous and flatter-whorled than *cymatera;* and, besides, its costæ become smaller with age, but those of *cymatera* larger. From *spinifera* it differs by being flatter-whorled, more angular, and in having a pronounced inner margin.

From morphological equivalents in the *dominans*- and other stocks, the reclining ribs and the twisted appearance of the umbilicus will be found the chief points of separation, although there are also differences in shape of whorls, costation, &c.

This is a rare form from the *Concavum*-zone of Bradford Abbas. It is illustrated in Pl. LXXVII, figs. 1, 2.

SONNINIA BREVISPINATA, *S. Buckman.* Plate LXXV, figs. 6—8.

Discoidal, compressed, carinate. Whorls in section oblong, ornamented first with regular spines, later with spines parted by reclining ribs,[1] still later with direct reclining ribs which presently become more upright. Ventral area narrow,

[1] To about 27 mm. diameter.

divided by a small but well-marked, hollow carina. Inner margin well-marked, upright, flat. Inclusion about three-eighths. Suture-line with a somewhat equally-balanced superior lateral lobe.

This species is easily separable from *semispinata* by its shorter spinous stage, less marked costæ, more compressed form, and more elevated carina. It is, however, in general appearance exactly a reduced edition of *semispinata* except in one feature—the carina is more elevated. It has, however, just the same style of spinous stage, and just the same reclining ribs, becoming more upright and obscure with age. It has the same flat-sided whorl and marked inner margin, so that, in spite of its keel, I feel compelled to consider it a dwarf development of *semispinata*.

From *spinifera* or *cymatera* it is easily distinguished by its flat whorls, distinct inner margin, smaller umbilicus, &c. From its morphological equivalents in the *dominans*- or *submarginata*-stocks it is separable by its reclining ribs, which give a twisted appearance to the umbilicus. This is presumably an adult form, for I have from the Bradford-Abbas beds sundry examples, about this size, agreeing in general character with the specimen which I have selected as the type, figured in Pl. LXXV, figs. 6—8.

The *biplicata*-stock.

The forms which comprise this series are easily separable from those hitherto described by a peculiar feature of the costate stage, namely, that the ribs are arranged in irregular pairs, separated by one or more somewhat obscure ribs; and then, later on, there tends to be an alternation of obscure and prominent single costæ.

There are four forms which exhibit this peculiar style of ornamentation. They are easily separable one from another, and seem to belong to two slightly distinct genetic series; yet I shall for the present describe them under only two names, thus:

Ribs (or growth-lines) ventrally inclined:

S. biplicata α. For the most part costate with the ribs in pairs; later, ribs alternately prominent and obscure.

S. alternata α. Ribs less prominent; the "pairing" less marked, the "alternation" well shown. Whorls flatter-sided and broader.

PLATE LVII.

Concavum-zone.

Figs. 1, 2.—Sonninia crassispinata, *S. Buckman.*

Fig. 1.—Side view of an adult specimen, showing the persistence of the spines.[1] Bradford Abbas, Dorset. From my father's Collection. (The plate is a copy of a photograph, an enlargement from a quarter-plate negative, and is of the exact size of the original fossil. For outline section of penultimate whorl[2] see Pl. LXV, fig. 5.) (Page 317.)

Fig. 2.—Suture-line showing the cruciform superior lateral lobe. The letters *a*, *a* indicate the positions of the spines.

[1] There are ribs and spines on other side of part shown as matrix (see text).

[2] The inner whorls are evidently nearly circular, the penultimate is nearly quadrate, and the shape changes to gibbous-sided oblong during the last turn.

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PLATE LVIII.

Concavum-zone.

SONNINIA ACANTHODES, *S. Buckman.*

Side view of an adult specimen showing the persistence of the spines to the beginning of the last half-whorl, and the large reclining ribs[1] which follow. Bradford Abbas, Dorset. From the Collection of Mr. Darrell Stephens, F.G.S.; now in my cabinet. The specimen is drawn the natural size. (Page 319.)

[1] No doubt some of these ribs would be spinous if the test were present.

Gawan del et lith

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Mintern Bros imp

PLATE LIX.

Concavum-zone.

Figs. 1—3.—Sonninia acanthodes, *S. Buckman.*

Fig. 1.—Back view of specimen depicted in Pl. LVIII, showing the large ribs, and the slight sulcus on each side of the carina. Natural size. (Page 319.)

Fig. 2.—Side view of a young example. (The spines should be more prominent in the last part of the whorl.) Bradford Abbas, Dorset. My Collection.

Fig. 3.—Front view of the same specimen. The letter *c* marks the infilling of the hollow carina, the letter *b* the hollow carina complete.

Plate LIX

Fig. 1

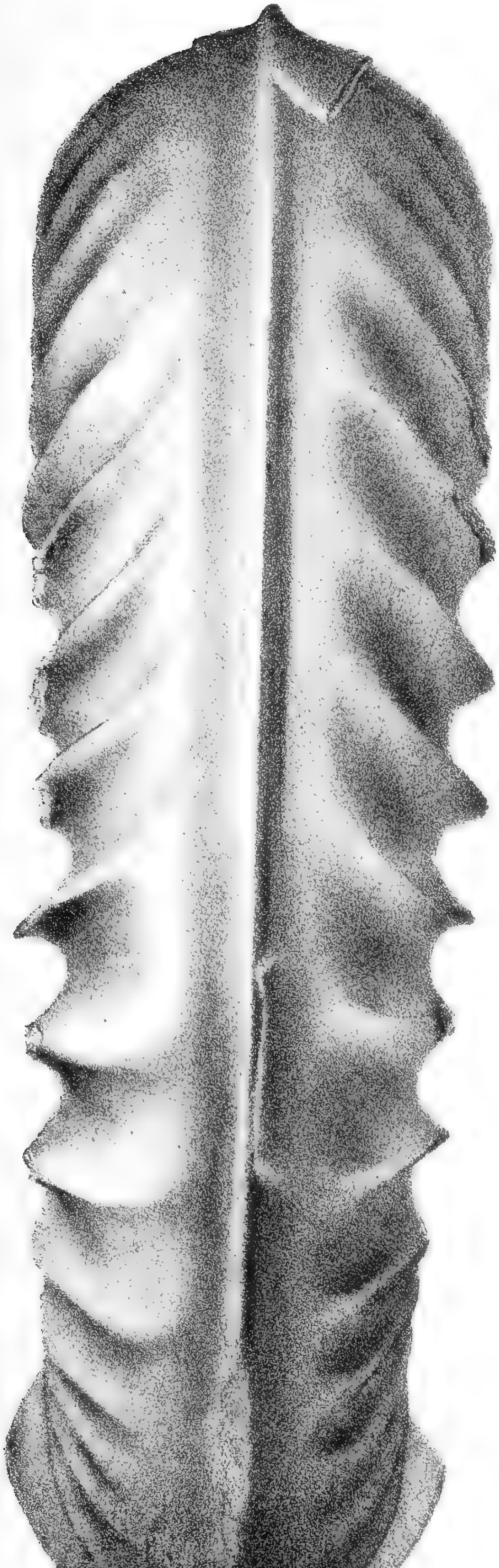

Fig. 2

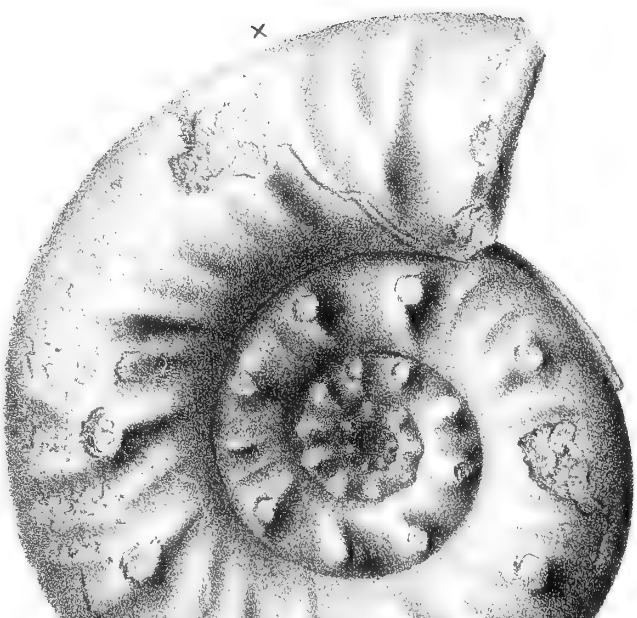

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PLATE LX.

Concavum-zone.

SONNINIA ACANTHODES, *S. Buckman.*

Side view of the typical example of the species, showing the spines ending at the beginning of the last whorl, and followed by reclining ribs more or less covered with test. (The inner margin is drawn much too conspicuous in the last half-whorl.) Bradford Abbas, Dorset. From my father's Collection. (Page 319.)

(The plate is a copy of a photograph, and is within a fraction of natural size, being 210 mm. [$8\frac{1}{4}$ inches] as against 225 mm. [$8\frac{5}{8}$ inches], the diameter of the fossil.)

A. Gawan del. et lith.

PLATE LXI.

Concavum-zone.

Figs. 1, 2.—SONNINIA IRREGULARIS, *S. Buckman.*

Fig. 1.—Side view of an adult specimen showing persistence of spines to a late date, followed by nearly upright ribs. The last half-whorl is body-chamber. Bradford Abbas, Dorset. From my father's Collection. (Page 320.)

(The plate is a copy of a photograph, and is within a fraction of natural size, namely, 246 mm. ($9\frac{11}{16}$ inches), as against 266 mm. ($10\frac{1}{2}$ inches), the diameter of the fossil.)

Fig. 2.—Outline of the aperture. Natural size.

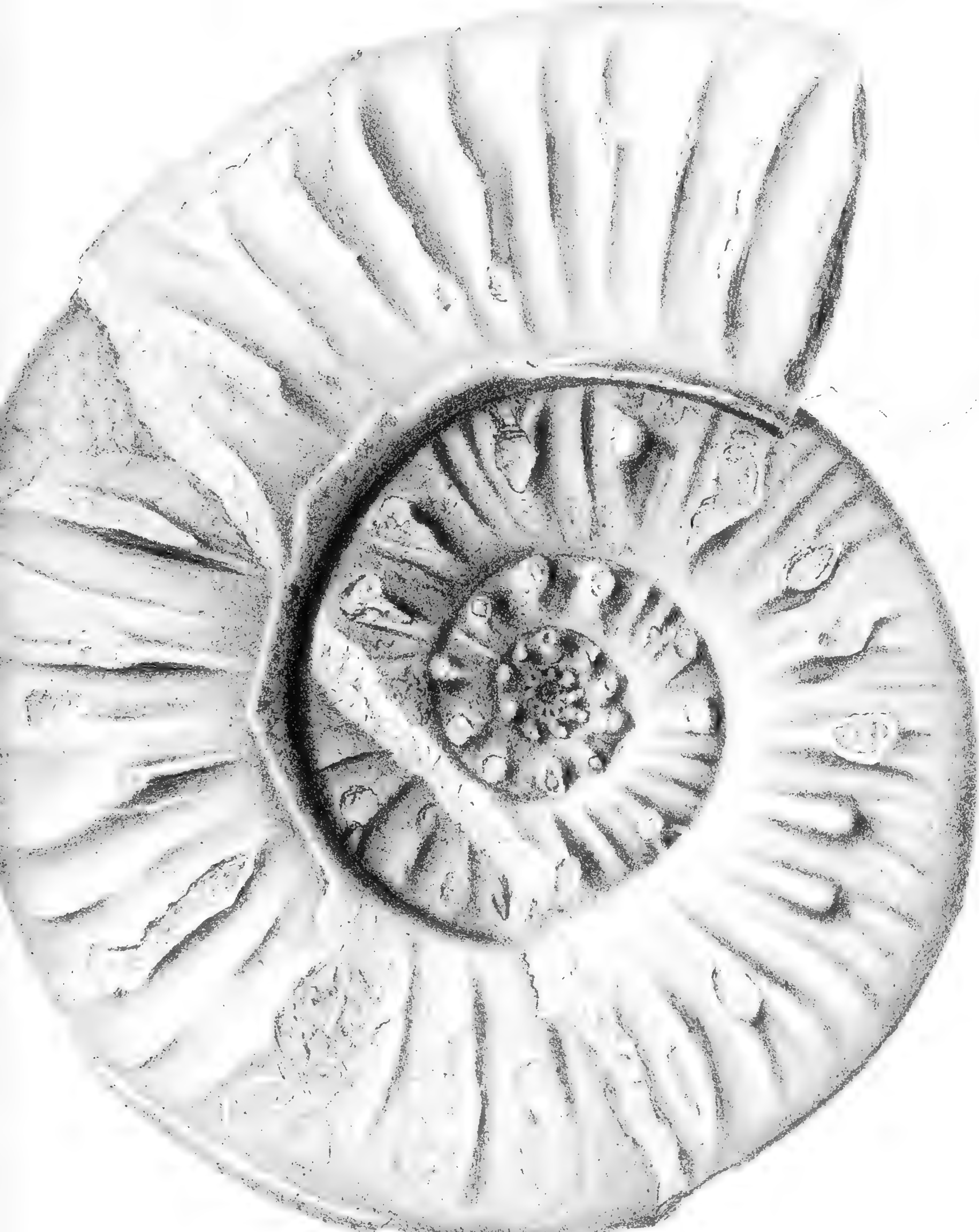

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PLATE LXII.

Concavum-zone.

Sonninia marginata, *S. Buckman.*

Side view of a specimen showing spines in the inner whorls, followed, on the last two whorls, by nearly upright ribs. Bradford Abbas, Dorset. My Collection. (Page 321.)

(The plate is a copy of a photograph the exact natural size of the fossil.)

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PLATE LXIII.

Concavum-zone.

Sonninia acanthodes, *S. Buckman.*

Fig. 1.—Front view of the specimen depicted in Pl. LX. (Page 319.)

Sonninia marginata, *S. Buckman.*

Fig. 2.—Front view of the specimen depicted in Pl. LXII. (Page 321.)

(The plate is a copy of an enlarged photograph, and is within a fraction of the natural size, but the aperture of fig. 2 has been corrected, and the dotted lines show the projection of the ribs.)

Fig 1

Fig 2

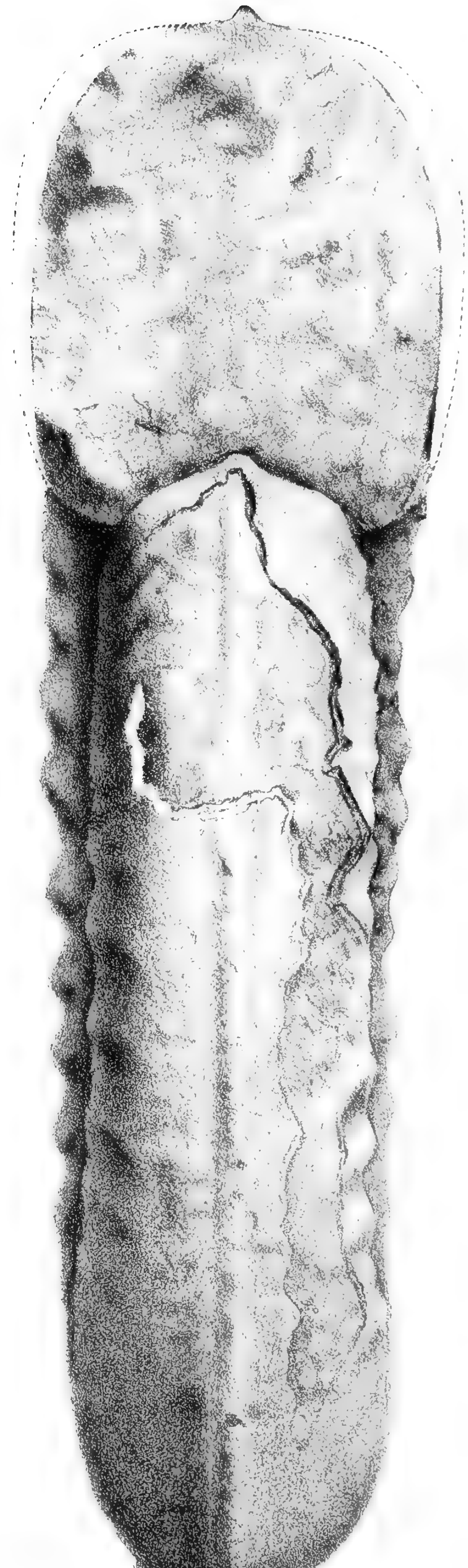


PLATE LXIV.

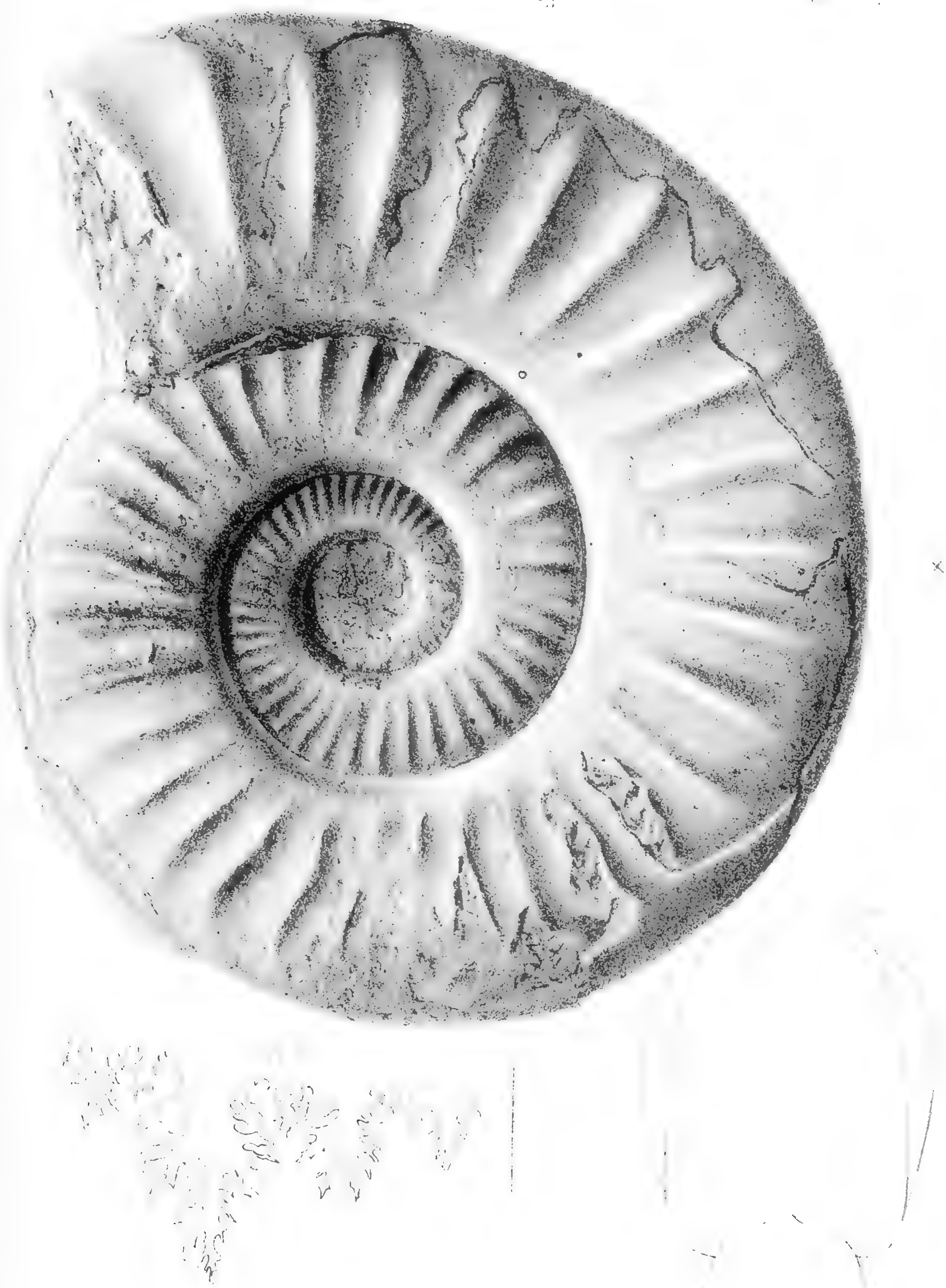
Concavum-zone.

Figs. 1—3.—SONNINIA MARGINATA, *S. Buckman.*

Fig. 1.—Side view of a well-preserved and very large example, showing the increase in the size of the ribs on the last part of the whorl. (The ribs are somewhat too much reclined in the inner whorls.) Bradford Abbas, Dorset. My Collection. (The figure is a copy of a photograph, and is rather less than two-thirds of the original, namely, 201 mm. [$7\frac{29}{32}$ inches] against 312 mm. [$12\frac{9}{32}$ inches], the diameter of the fossil.) (Page 321.)

Fig. 2.—Outline of the aperture, two-thirds natural size.

Fig. 3.—Part of the last suture-line, natural size.



A. Gawan del et lith

PLATE LXV.

Concavum-zone.

Figs. 1, 2.—Sonninia marginata, *S. Buckman.*

Fig. 1.—Side view of an immature example to compare with immature *acanthodes* and *crassispinata*. Bradford Abbas. My Collection. (Page 321.)

Fig. 2.—Front view of the same fossil.

Figs. 3—5.—Sonninia crassispinata, *S. Buckman.*

Fig. 3.—Side view of the fossil, showing the irregularly-spined period followed by regular spines on rather more than the last half-whorl. (A copy of a photograph one-half the size of the original fossil.) Bradford Abbas. My Collection. (Page 317.)

Fig. 4.—A section of the whorl in outline, taken from just after the commencement of the regular-spined period.

Fig. 5.—A section of the whorl of the specimen figured in Pl. LVII. Taken at the same diameter, showing the quadrate shape and broad abdomen.

Figs. 6, 7.—Dumortieria grammoceroides, *Haug.*

Fig. 6.—Side view to replace fig. 3 of Pl. XLVII, of which the mouth became falsely represented in the printing. (Page 264.)

Fig. 7.—A portion of the other side, showing the mouth and the test above the furrow—to supplement fig. 6.

Fig 4

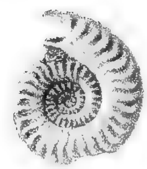
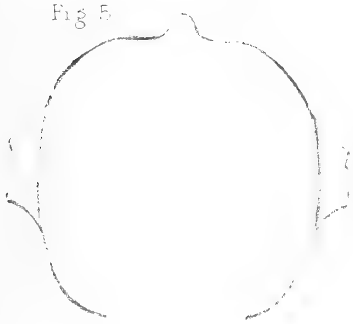
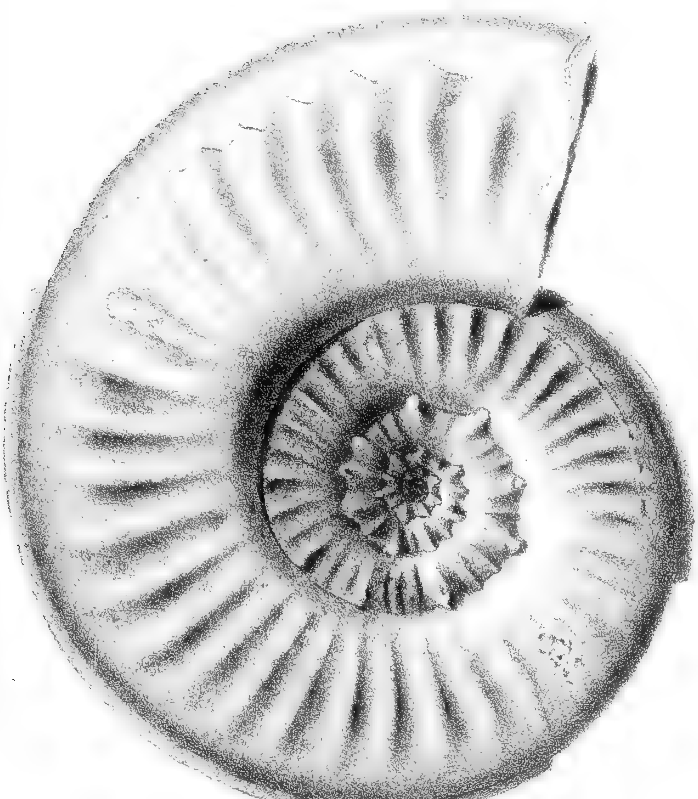


Fig 5





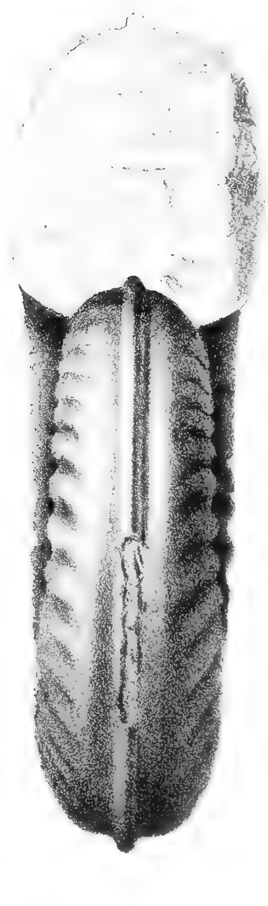


PLATE LXVI.

Concavum-zone.

Figs. 1, 2.—Sonninia dominans, *S. Buckman.*

Fig. 1.—Side view of a grand adult specimen to compare with adult *marginata* (Pl. LXIV). It will be seen that the spines are confined to the infantile whorls. Bradford Abbas, Dorset. My Collection. (This view is a copy of a photograph about two-thirds natural size, namely, 193 mm. [$7\frac{5}{8}$ inches] against 302 mm. [$11\frac{7}{8}$ inches], the diameter of the fossil.[1]) (Page 322.)

Fig. 2.—Outline of the front view, two-thirds natural size.

[1] In both measurements allowance is made for the broken piece opposite the × which marks the last suture-line.

PLATE LXVII.

Concavum-zone.

Figs. 1, 2.—Sonninia dominans, *S. Buckman.*

Fig. 1.—Side view of an immature example to compare with *marginata* (Pl. LXV). Natural size. Bradford Abbas. My Collection. (The ribs, especially those of the first three-quarters of the last whorl, are hardly sufficiently conspicuous.) (Page 322.)

Fig. 2.—Front view of the same shell.

Figs. 3, 5.—Sonninia, intermediate form.

Fig. 3.—Side view of a ribbed form which is, practically speaking, intermediate between *marginata* and *dominans*. Natural size. Bradford Abbas. My Collection. The last three ribs are incorrectly drawn.) (Page 322.)

Fig. 4.—Front view of the same shell.

Fig. 5.—Parts of two suture-lines, showing the slightly unsymmetrical trifurcate superior lateral lobe.

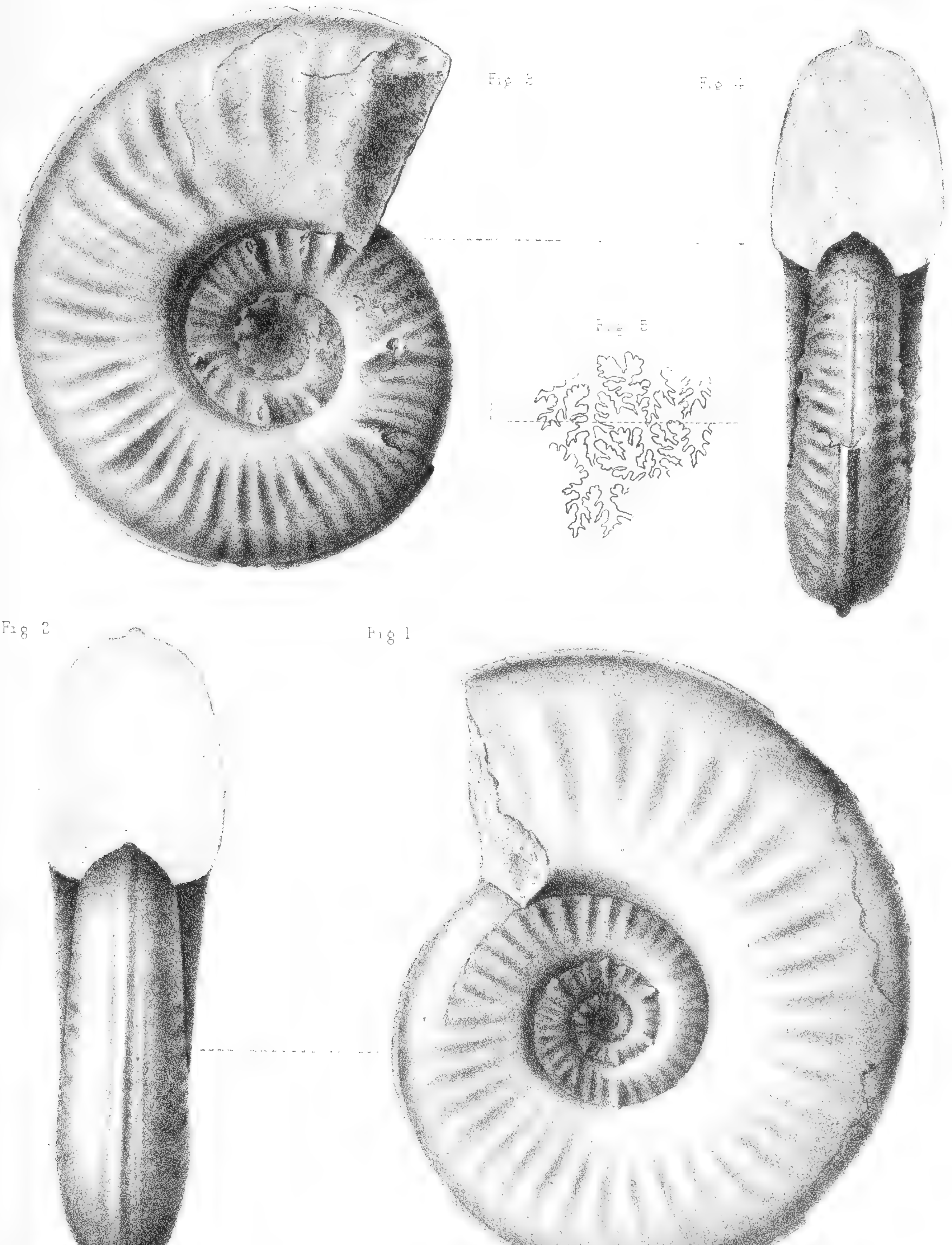


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PLATE LXVIII.

Concavum-zone.

Figs. 1, 2.—Sonninia modesta, *S. Buckman.*

Fig. 1.—Side view of an example in which the last quarter-whorl is abnormally costate, presumably the result of injury. Without these costæ[1] the shell exactly represents the ordinary form of the species. Bradford Abbas, Dorset. My Collection. (Owing to breakage neither side of the specimen affords complete details, and therefore it has been necessary to combine the features of both sides of the fossil in order to show its characters properly.) (Page 325.)

Fig. 2.—Outline to show the shape of the whorls in front view, taken from the place marked ○.

[1] The arcuate shape of these costæ is incorrect; they should be nearly upright. The last rib is too conspicuous; it should be somewhat tuberculate at its middle. The penultimate rib should have been rather less conspicuous than the last; the antepenultimate and its predecessor are much too conspicuous; the forerunner of these is hardly conspicuous enough.

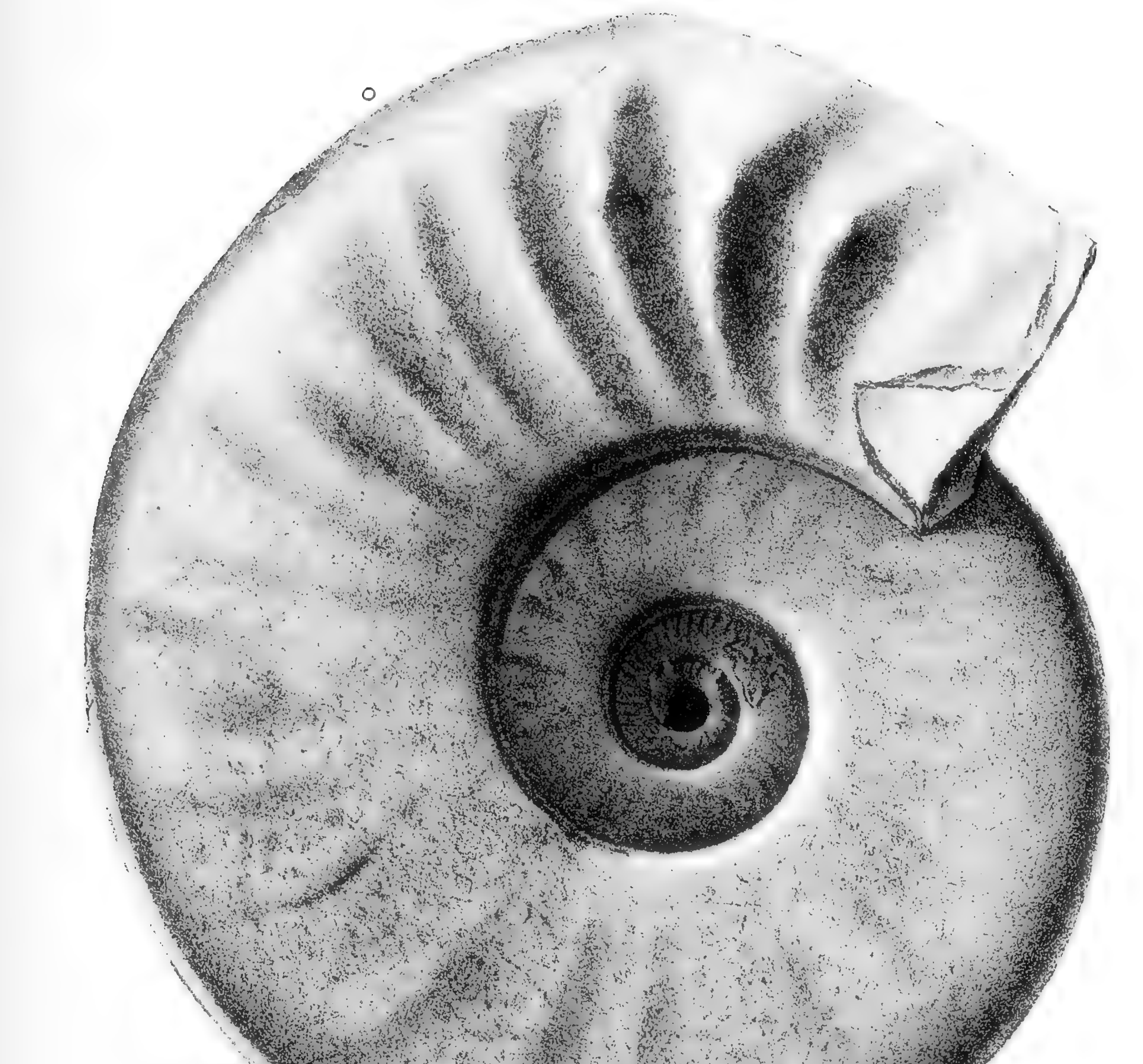

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PLATE LXIX.

Concavum-zone.

Figs. 1—3.—Sonninia dominans, *S. Buckman.*

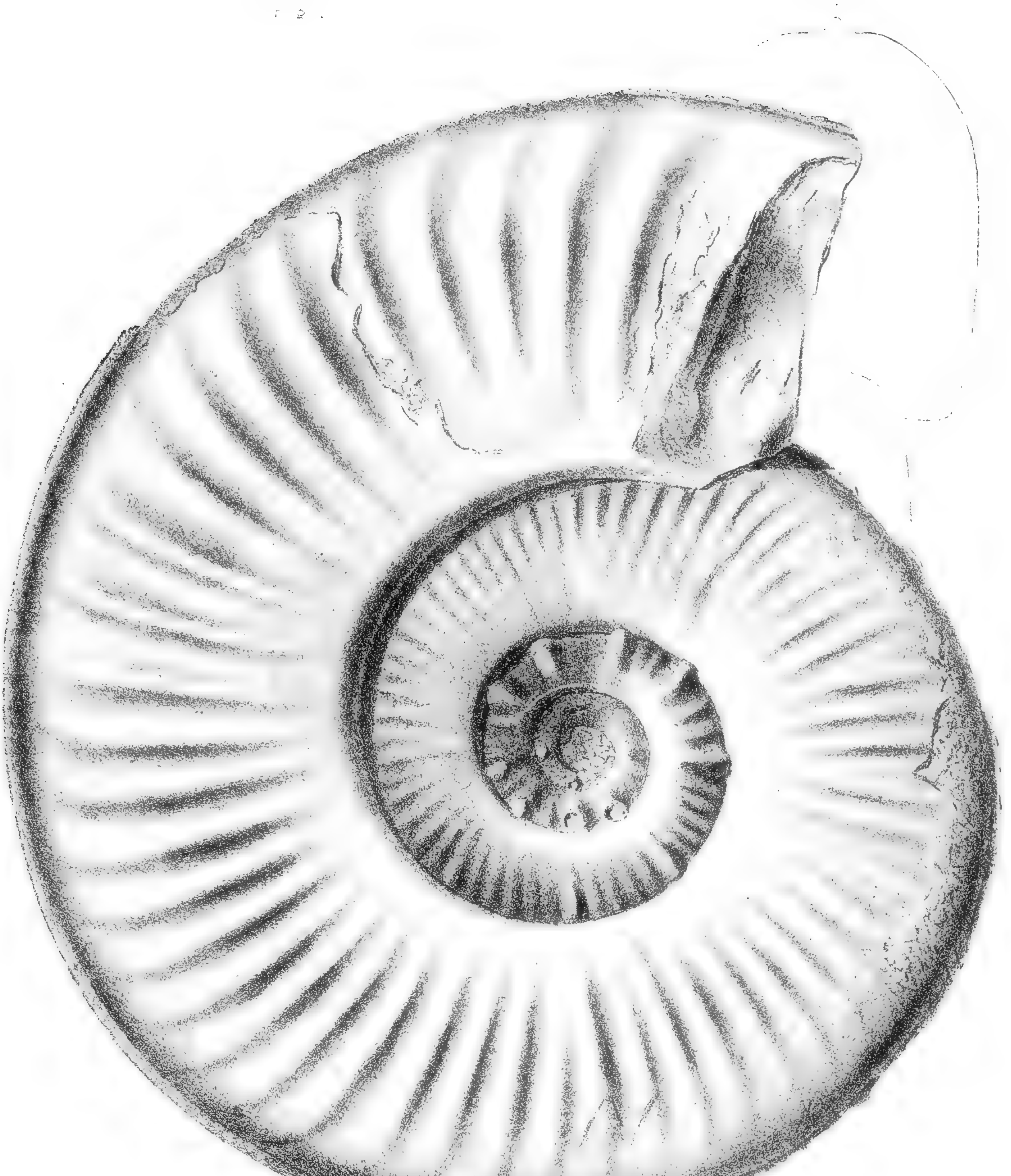
Fig. 1.—Side view of a form with rather small, regular, closely-set ribs. In many respects this form is intermediate between *marginata* (Pl. LXII) and *dominans* (Pl. LXVI), and shows the development. Natural size. Bradford Abbas, Dorset. My Collection. (Page 322.)

Fig. 2.—Section of the whorl in outline.[1]

Fig. 3.—A part of the suture-line.

[1] The included whorl and the inner part of embracing whorl both rather too thin.

F 2.



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A. Gawan del. et lith.

Mintern Bros

PLATE LXX.

Concavum-zone.

Fig. 1.—SONNINIA REVIRESCENS, *S. Buckman.*

Fig. 1.—Side view of a portion of a specimen showing the coarse distant ribs of the last half-whorl, the preceding half-whorl being very obscurely ribbed. (The outer whorl is without test.) Bradford Abbas, Dorset. My Collection. (Page 324.)

(This drawing is a copy of a photograph about one-half the natural size. The fossil measures 238 mm. [$9\frac{3}{8}$ inches] in diameter.)

Figs. 2—4.—SONNINIA SIMPLEX, *S. Buckman.*

Fig. 2.—Side view of example with test, showing the excentric umbilicus. Bradford Abbas, Dorset. From my father's Collection. (Page 326.)

Fig. 3.—Section of the whorl in outline, showing rounded ventral area of last whorl and subcarinate area of preceding whorl.

Fig. 4.—Suture-line from another specimen. Natural size.

Fig. 5.—SONNINIA MODESTA, *S. Buckman.*

Fig. 5.—Suture-line of a typical specimen. (Page 325.)

(This drawing is a copy of a photograph, and is within a fraction of natural size. For side and front views of another specimen see Pl. LXVIII.)

Figs. 6, 7.—SONNINIA SUBSTRIATA, *S. Buckman.*

Fig. 6.—Side view of a young specimen with test; the inner whorls show no spines.[1] Bradford Abbas. My Collection. (For adult see Pl. LXXI.) (Page 330.)

Fig. 7.—Front view of the same fossil. (The aperture too narrow ventrally.)

[1] The ribs are too conspicuous, too irregular, and, towards the end, too much reclined. The umbilicus is too large, the curve of the last quarter-turn of the inner margin being incorrect.

Fig 1.

PLATE

Fig 5

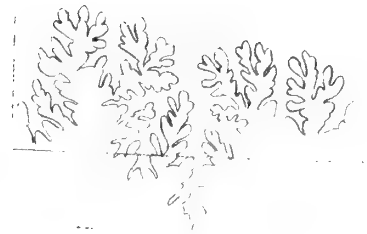

Fig 4.

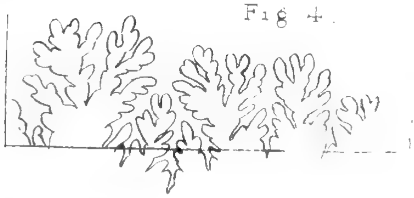

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Fig 6

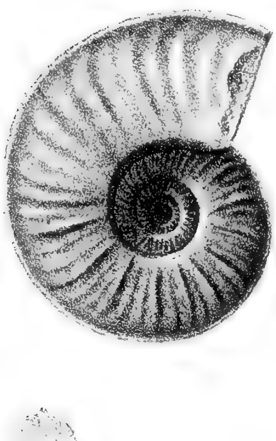
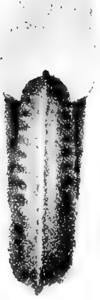


Fig 7



Gawan del et lith

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PLATE LXXI.

Concavum-zone.

Figs. 1—3.—Sonninia submarginata, *S. Buckman.*

Fig. 1.—Side view of a portion of a specimen with complete test, showing short spinous stage[1] followed by finely ribbed costate stage. Bradford Abbas. My Collection. Natural size. (Page 329.)

Fig. 2.—Section of the whorl in outline, with test.

Fig. 3.—Suture-line of the same fossil. (It has not been possible to follow the minor denticulations of the suture, as some of the test had to be removed by acid.)

Figs. 4, 5.—Sonninia subcostata, *S. Buckman.*

Fig. 4.—Side view. Test present. Natural size. Bradford Abbas. My Collection. (Page 330.) (Central spines damaged in cleaning.)

Fig. 5.—Section of the whorl in outline, with test.

Figs. 6—8.—Sonninia substriata, *S. Buckman.*

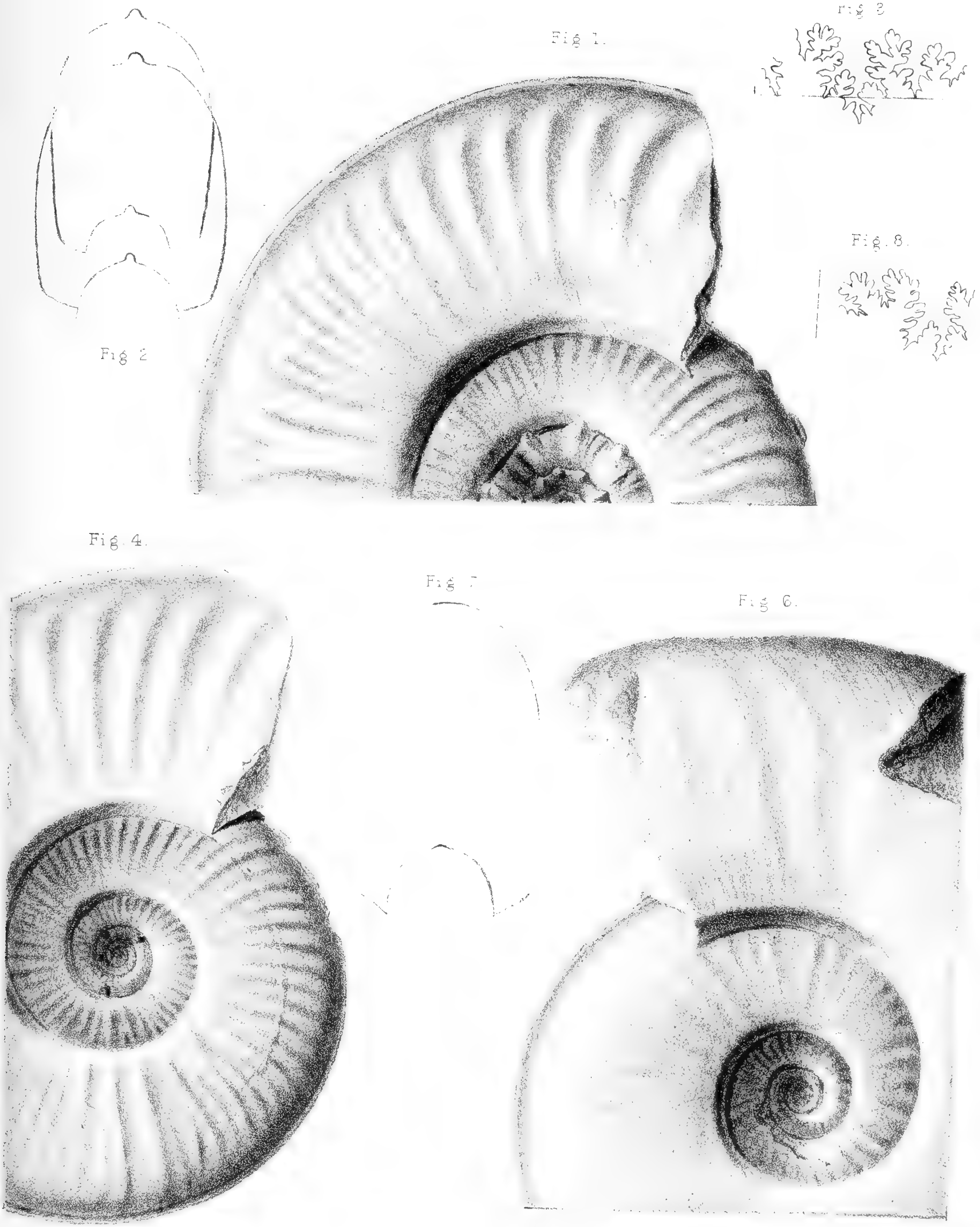
Fig. 6.—Portion of side view. Test present. Natural size. Bradford Abbas. From my father's Collection (see Pl. LXX, figs. 5, 6). (Page 330.)

Fig. 7.—Section of the whorl in outline, showing rounded ventral area of last whorl and subcarinate area of preceding whorl. Test present.

Fig. 8.—A part of the suture-line of another specimen. (A copy of a photograph nearly natural size.)

[1] The last spine is seen to the right.

PLATE LXXI.



A. Gawan del et lith

Mintern Bros. imp.

PLATE LXXII.

Concavum-zone.

Figs. 1, 2.—SONNINIA, intermediate form.

Fig. 1.—Side view of a young specimen intermediate between *subcostata* and *substriata*. It has some rudimentary spines in the inner whorls, but they have escaped the artist's notice. Test present. Natural size. Bradford Abbas, Dorset. (Page 330.)

Fig. 2.—Section of the whorl in outline, with test.

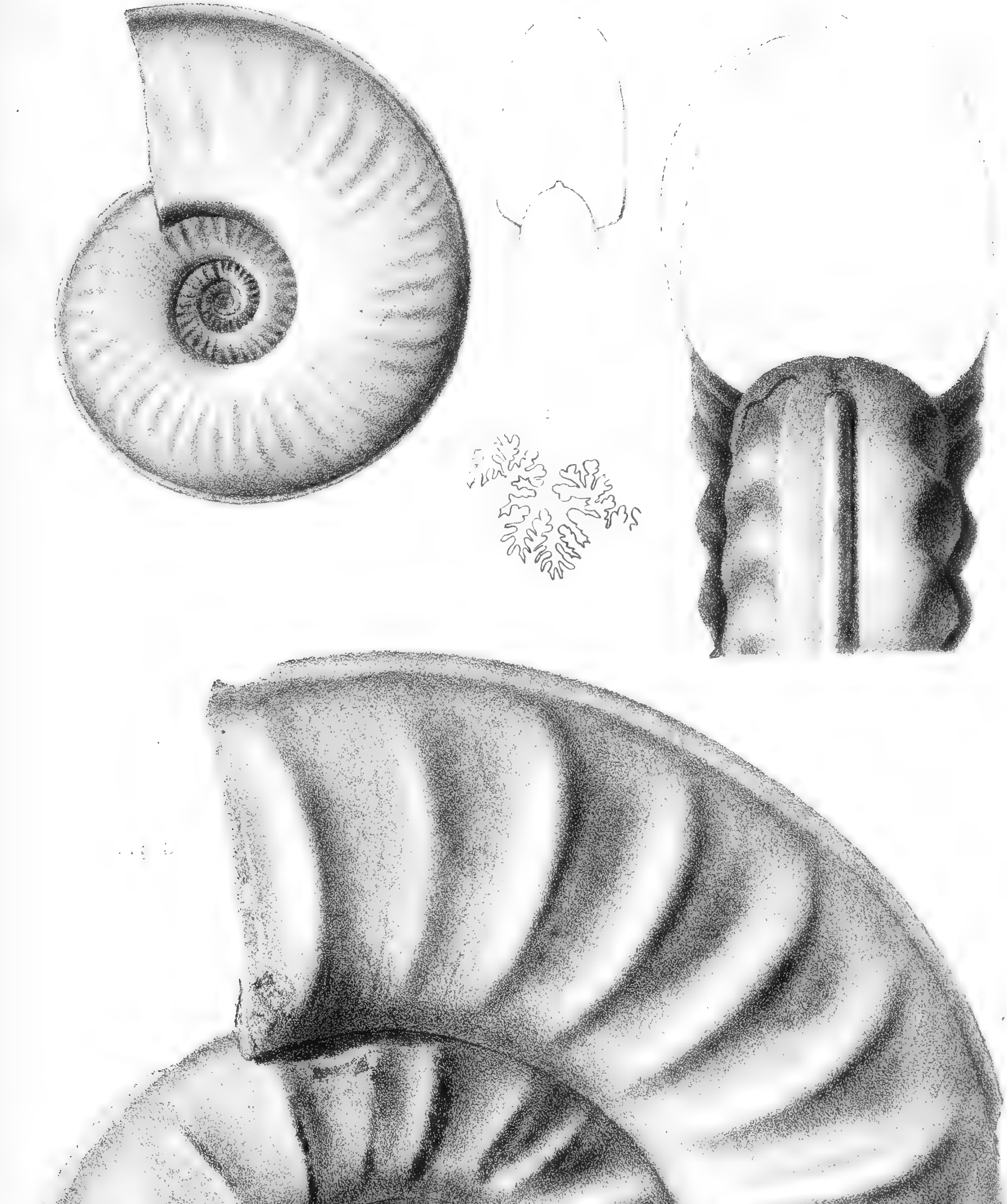
Figs. 3—5.—SONNINIA OBTUSIFORMIS, *S. Buckman.*

Fig. 3.—Side view (upper portion) of a grand specimen with test preserved, showing the large reclining ribs. Natural size. Bradford Abbas, Dorset. From my father's Collection. (Page 333.)

Fig. 4.—Part of the front view, showing the inflated whorls, the large ribs, and the sulcate-carinate ventral area.[1]

Fig. 5.—Part of the suture-line, showing the superior lateral lobe.

[1] The artist has scarcely succeeded in showing the sulcation.



A Gawan del et lith.

PLATE LXXIII.

Fig. 1.—SONNINIA PTYCTA, *S. Buckman.*

Fig. 1.—Side view of an adult specimen with complete body-chamber. (The drawing is a copy of a photograph reduced to about one-quarter the size of the fossil, which is about 250 mm. in diameter.) Bradford Abbas, Dorset. My Collection. (Page 332.)

Figs. 2, 3. SONNINIA CYMATERA, *S. Buckman.*

Fig. 2.—Side view of a young specimen, showing small spines and reclining ribs. Natural size. Bradford Abbas. Collected by Mr. Darell Stephens, F.G.S., &c. Now in my cabinet. (Page 332.)

Fig. 3.—Section of the whorl in outline, with test. (Ventral area not broad and flat enough; included whorl not broad enough.)

Figs. 4—6.—SONNINIA SPINICOSTATA, *S. Buckman.*

Fig. 4.—Side view of specimen with complete body-chamber. The body-chamber is without test, but apparently its ribs would have been spinous if the test had been present.[1] Bradford Abbas. From my father's Collection. (The drawing is reduced to two-thirds the size of the fossil.) (Page 337.)

Fig. 5.—Section of the whorl in outline, without test; reduced two-thirds of natural size.

Fig. 6.—Suture-line of the same specimen of natural size. (Compare Pl. LVII, fig. 2.)

[1] The left side of this fossil should have been depicted, but, through some misunderstanding, the artist has drawn the outer whorls of this specimen from the right side, while filling in the umbilicus from the left. The umbilicus is correct, though reversed. The outer whorl, being without test, does not show the persistence of the knobs up to the × as on the other side; and the artist has failed to indicate sufficient elevation (indications of knobs) for the middles of the ribs on the core of the last half-whorl.

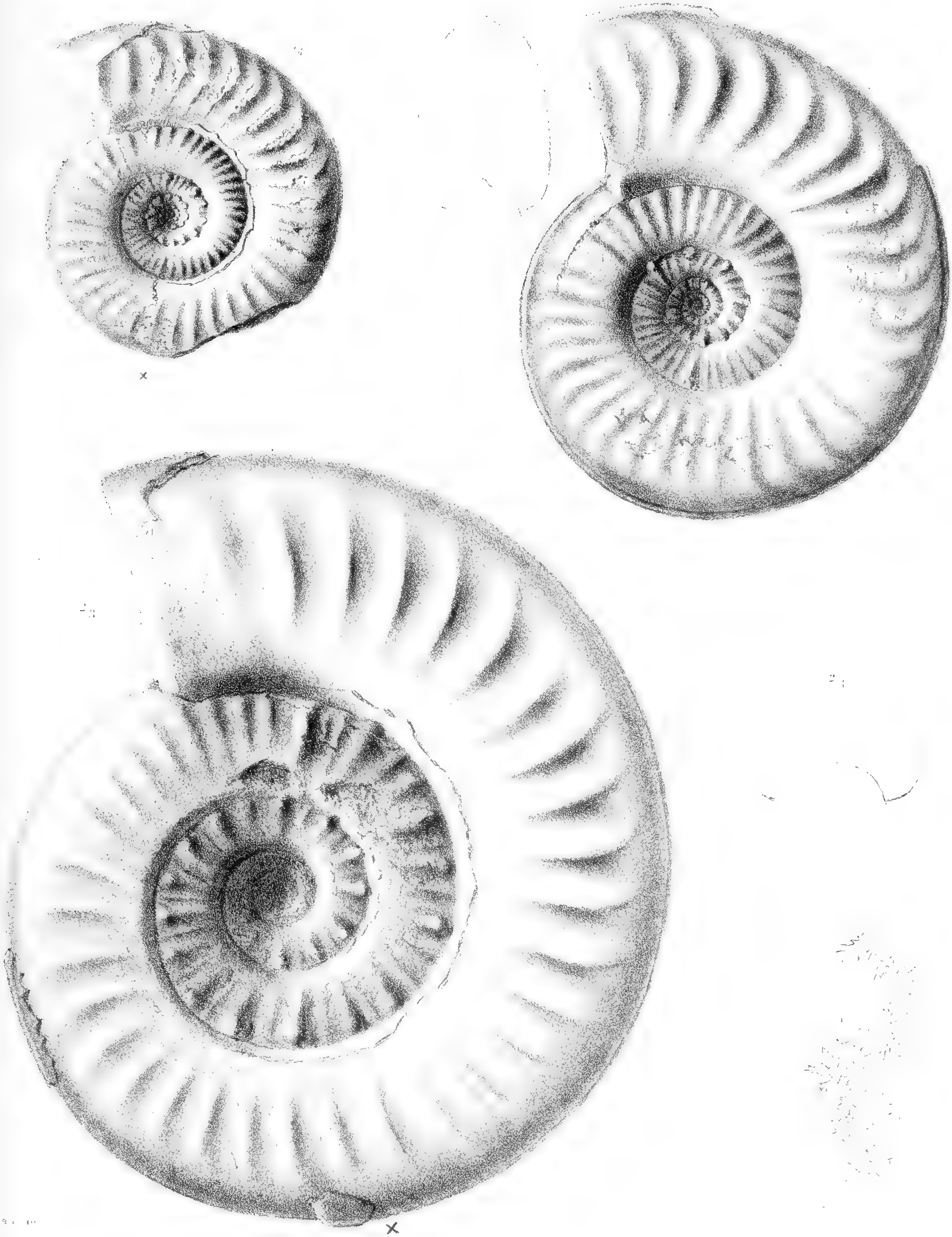


PLATE LXXIV.

Concavum-zone.

Fig. 1.—Sonninia costata, *S. Buckman.*

Fig. 1.—Side view of a well-ribbed form with test.[1] Bradford Abbas, Dorset. My Collection. Two-thirds natural size. (Page 338.)

Figs. 2, 3.—Sonninia parvicostata, *S. Buckman.*

Fig. 2.—Side view of a young example with well-preserved test. Bradford Abbas. My Collection. (Page 339.)

Fig. 3.—Front view of the same shell.

Figs. 4—6.—Sonninia spinigera, *S. Buckman.*

Fig. 4.—Side view of a presumably adult example, showing reclining ribs practically obsolete on the outer third of the whorl. Bradford Abbas. My Collection. Natural size. (Page 335.)

Fig. 5.—Front view of the same shell.

Fig. 6.—Part of the suture-line, showing unsymmetrical superior lateral lobe.

[1] The reclining ribs of the penultimate whorl are somewhat incorrectly placed, are too pronounced, and too sloped. They are due to an injury.

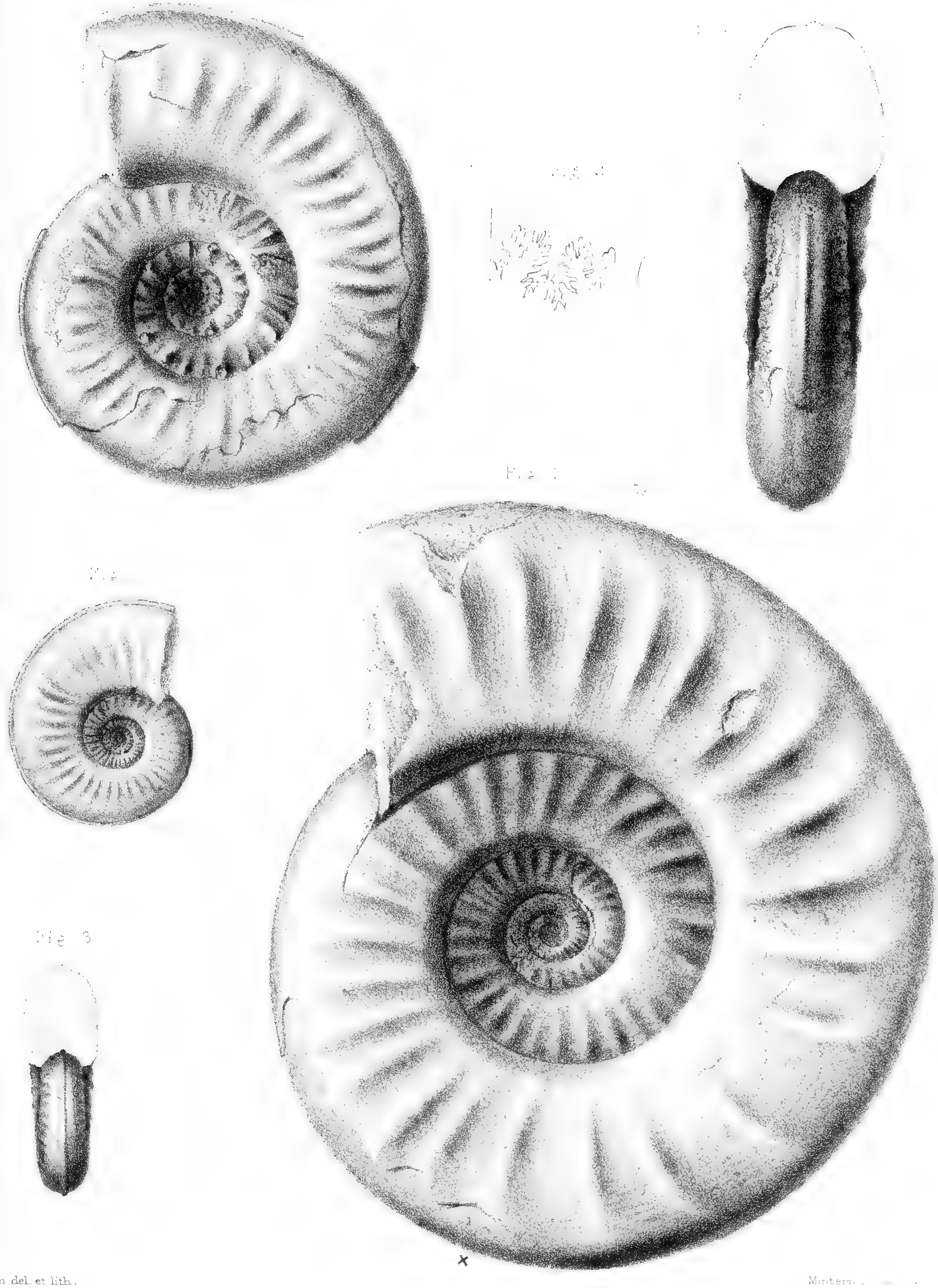


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PLATE LXXV.

Concavum-zone.

Figs. 1, 2.—Sonninia costata, *S. Buckman.*

Fig. 1.—Outline of the front view of the specimen depicted in Pl. LXXIV, fig. 1. (Page 338.)

Fig. 2.—Suture-line of the same specimen, showing broad-stemmed superior lateral lobe.

Figs. 3—5.—Sonninia parvicostata, *S. Buckman.*

Fig. 3.—Part of the side view of a typical adult.[1] Bradford Abbas. My Collection. Natural size. (Page 339.)

Fig. 4.—Outline of the front view of the same shell.[2]

Fig. 5.—Suture-line from another specimen.

Figs. 6—8.—Sonninia brevispinata, *S. Buckman.*

Fig. 6.—Side view of a presumably adult example, showing twisted umbilicus due to reclining ribs.[3] Bradford Abbas. My Collection. Natural size. (Page 343.)

Fig. 7.—Front view, showing compressed whorls.[4]

Fig. 8.—Part of the suture-line of the same shell, showing superior lateral lobe.[5]

[1] The ribs of the inner whorls not clear enough; last inch of outside of outer whorl too incurved.

[2] Aperture too compressed ventrally. The slope of an inner margin often varies with age, so that there may be discrepancy between drawing (of aperture) and general description—a fact to be noted in this and other cases.

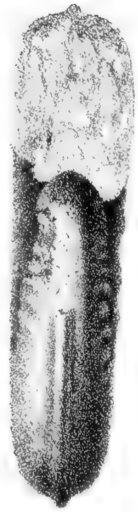
[3] Too little inclusion. Ribs of last part of whorl incorrect. No rounded bulges on inner margin.

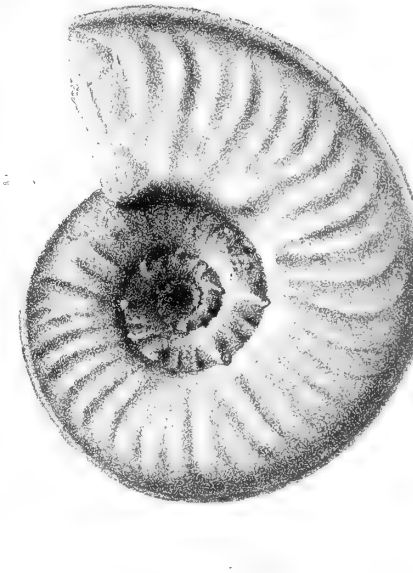
[4] Ventral area between carina and aperture fictitious.

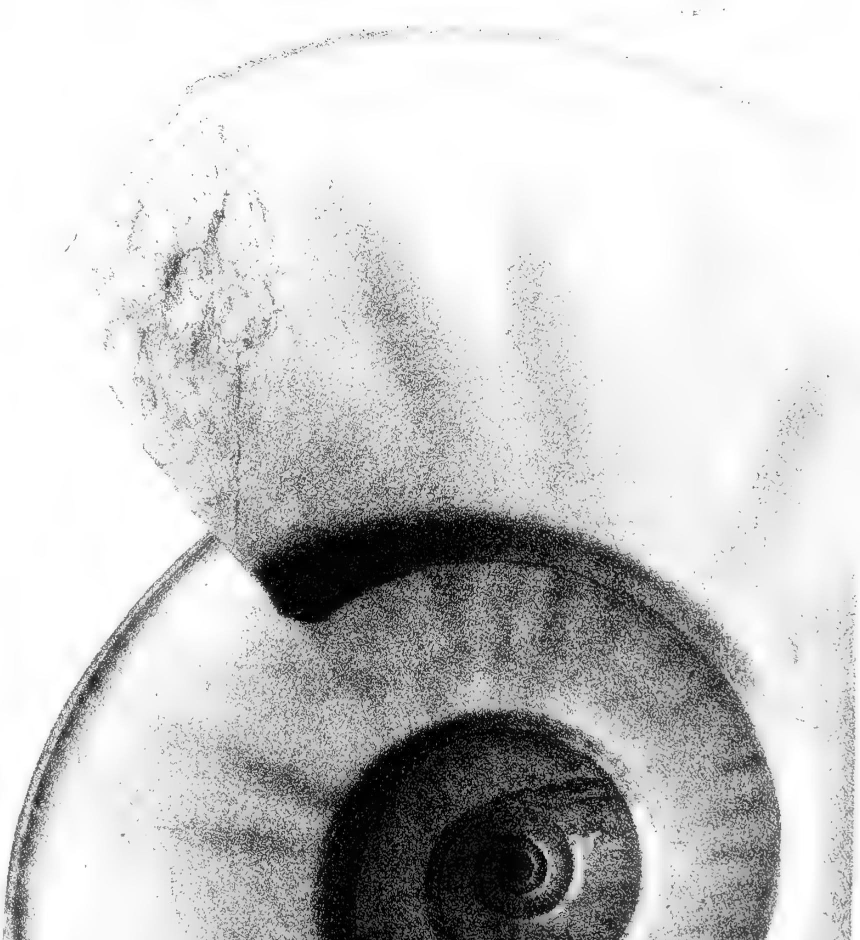
[5] Should have been drawn upright.

Fig 1

Fig 2







A. Gawan del et lith

PLATE LXXVI.

Concavum-zone.

Figs. 1—6.—SONNINIA MAGNISPINATA, *S. Buckman.*

Fig. 1.—Side view of the typical form, showing the large regular spines followed by spines and ribs. Bradford Abbas, Dorset. My Collection. (Page 341.)

Fig. 2.—Front view of the same shell, showing the size of the spines.

Fig. 3.—Back view of the same specimen, to illustrate the carina and ventral area.

Fig. 4.—Side view of an older example, to show the costate stage. Bradford Abbas. From my father's Collection.

Fig. 5.—Section of the aperture, in outline; embraced whorl with test, outer whorl without.

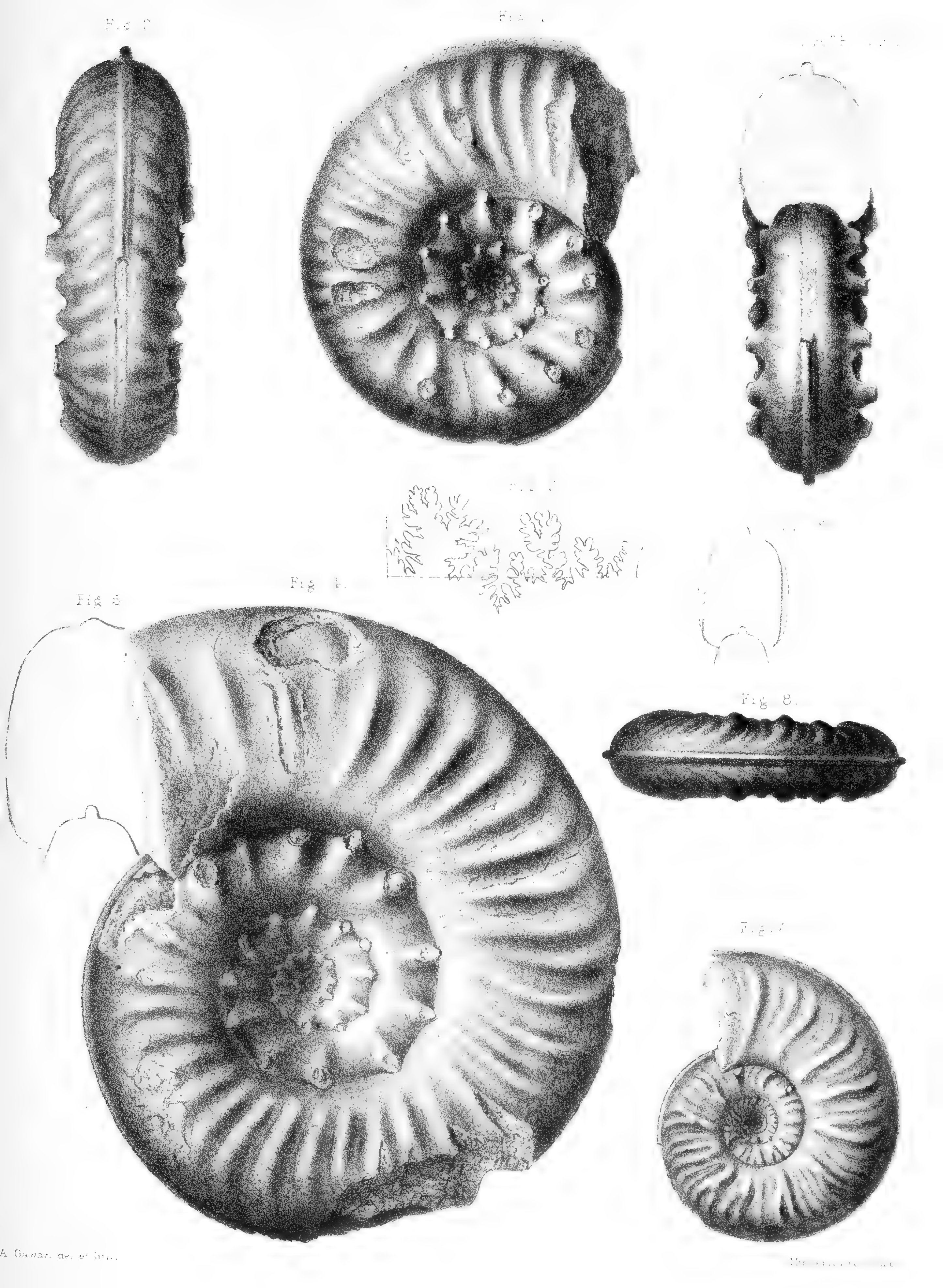
Fig. 6.—The suture-line of the same specimen, showing a rather broad-stemmed, tripartite superior lateral lobe.

Figs. 7—9.—SONNINIA ALTERNATA, *S. Buckman.*

Fig. 7.—Side view of a young specimen with well-preserved test, showing the peculiarities of the ribbing. (This is the form described as β, page 345.) Bradford Abbas. From my father's Collection. (Page 346.)

Fig. 8.—Back view, showing the ventrally-projected striæ.

Fig. 9.—Section of the whorl in outline, test present.



A Gawan del. et lith.

THE

PALÆONTOGRAPHICAL SOCIETY.

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LONDON:

MDCCCXCII.

A MONOGRAPH

OF THE

DEVONIAN FAUNA

OF THE

SOUTH OF ENGLAND.

BY

G. F. WHIDBORNE, M.A., F.G.S.

VOL. II.—PART II.

THE FAUNA OF THE LIMESTONES

OF

LUMMATON, WOLBOROUGH, CHIRCOMBE BRIDGE, AND CHUDLEIGH

(*continued*).

PAGES 57—88; PLATES VI—X.

LONDON:

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1892.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE

Isocardia vetusta, Goldfuss,[1] differs from the widest variety of our shell by having a blunter umbo, a staighter hinge-line, and more definite wings.

Inoceramus inversus, Goldfuss,[2] which is *Posidonomya inversa*, Geinitz,[3] has a more terminal umbo, no anterior ear, and indistinct posterior radiations.

Rutotia obtusa, de Koninck,[4] is much higher than long, and has more equal and angular wings and a blunter umbo.

R. obesa, de Koninck,[5] is transversely striated, and has a more obtuse umbo and a more defined and higher hind wing.

R. ornithocephala, de Koninck,[6] has a more prominent, twisted, and sharper beak, and is more oblique and not quite smooth.

R. amygdalina, de Koninck,[7] very nearly agrees in shape with our younger forms, but is striated, and has a smaller, blunter umbo and less unequal wings.

3. *Genus*.—Pterinea, *Goldfuss*, 1826.

This genus seems distinguished from *Avicula* and *Actinopteria* by its large prominent central and lateral teeth, by its strong horizontal ligamental furrows, and by the great inequality of its valves. The shell seems generally to be thick and the hinge-area broad and flat. The anterior muscle-scar is moderately developed and deep.

Frech has placed it with *Actinoderma*, Sandberger, in a separate sub-family, which he calls *Pterinæinæ*, while Hall ranks it with *Actinopteria* under a distinct family, *Pterinidæ*.

It finds its chief development in the Devonian period, but it is also quoted from the Silurian and the Carboniferous.

1. Pterinea bellula, *Whidborne*. Pl. IV, fig. 11.

1889. Pterinea bellula, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 79.

Description.—Left valve large, slightly oblique, apparently much broader than long, moderately convex. Umbo small, anterior, proximate, incurved, and

1 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 284, fig. 160, fig. 14.

2 Ibid., vol. ii, p. 108, pl. cix, figs. 6 *a*, *b*.

3 1853, Geinitz, 'Verst. Grauw. Sachsen,' pt. 2, p. 53, pl. xii, fig. 25; and pl. xiii, figs. 1, 2.

4 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. ix, pt. v, p. 199, pl. xxii, figs. 6, 17.

5 Ibid., p. 199, pl. vii, figs. 3, 4.

6 Ibid., p. 200, pl. vii, figs. 29, 30; and pl. xxii, figs. 25, 29.

7 Ibid., p. 200, pl. xiii, figs. 24, 25, 44, 45.

turned forward. Front wing defined. Anterior margin (omitting the front wing, which is broken away) concave above, convex below. Inferior margin apparently short and very convex. Contour of surface steeply convex in front and sloping out flatly below and behind. Posterior wing apparently not defined. Surface bearing about twelve large, narrow, elevated, triangular, distant ribs, extending from the umbo, between which, at least on the posterior side, is a secondary series of smaller and shorter ribs, and again between these a third series of still smaller riblets, the whole being crossed by a few ridges of growth and possibly with a finer lineation.

Size.—About 40 mm. broad, 48 mm. deep.

Locality.—A single defective specimen from Wolborough is in the Museum of Practical Geology.

Remarks.—This evidently is a distinct and fine species belonging to the true *Pterineæ* of the group of *Pt. costata*, Goldfuss,[1] as defined by Frech.[2] Our solitary example is unfortunately too defective to permit a full description. Its anterior wing is gone, the margins can only be approximately traced, and the surface has lost its finer ornamentation. The posterior portion is obscured by matrix, but it appears to have been considerably produced, so as to form a large undefined hind wing with few and coarse ribs.

Affinities.—It so closely resembles *Pt. dichotoma,* Krantz,[3] as in the defective state of our specimen to admit the question of its identity. It appears, however, to have fewer and more definitely alternating ribs, and a much less defined hind wing, which, as far as seen, shows no signs of fine radiations. Frech's[4] version of that shell approaches it more nearly in shape, but still differs in the same particulars.

Pt. fasciculata, Goldfuss,[5] differs in its greater obliquity, its more evenly rounded back, its flat defined hind wing, its numerous equal minor striæ between the major ribs, and its smooth cast. Frech,[6] however, disagrees with Goldfuss in describing its major ribs as alternating.

Pt. costulata, F. A. Römer,[7] is distinguished by having its ribs nodulous.

[1] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 137, pl. cxx, fig. 4.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band 9, pt. 3, p. 81.

[3] 1857, Krantz, 'Verhand. n. Vereins preuss. Rheinl.,' vol. xiv, p. 157, pl. xi, fig. 5.

[4] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band 9, pt. 3, p. 88, pl. ix, fig. 16.

[5] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 137, pl. cxx, fig. 5; and 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 293, pl. xxx, fig. 7.

[6] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band 9, pt. 3, p. 84, pl. viii, figs. 1, 1 *a;* and pl. ix, figs. 1—3.

[7] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 3, pl. i, fig. 3.

Avicula Ibergensis, F. A. Römer,[1] and *Pt. flabella*, Conrad,[2] differ from it in most of the same particulars as does *Pt. fasciculata*, Goldfuss.

Pt. Sechendorfii, F. A. Römer,[3] appears to have fewer costæ, a blunter umbo, and a straighter anterior side.

Avicula lævicostata, Follmann,[4] seems to be a decidedly more transverse shell, with a larger and more prominent umbo, blunter ridges, and no minor ribs.

Pt. Paillettei, de Verneuil,[5] is distinguished by its greater obliquity and its large and smooth hind wing.

Pt. subfasciculata, de Verneuil[6] (which is separated from *Pt. fasciculata*, Goldfuss, by its smaller size, smaller posterior ear, and the absence of minor ribs), seems to differ from the present shell in having flat interspaces and no alternations in the ribs.

4. *Genus.*—Actinopteria, Hall, 1883.

Hall describes this genus or sub-genus as " characterised from *Pterinea* in the absence of a broad striated ligamental area, and strong cardinal and lateral teeth. Right valve sub-convex. Surface with fine rays." Frech, on the other hand, regards it as merely a group in the genus *Avicula*, and intimates that living forms which are classed with *Avicula* fall within its limits. To this latter genus it is certainly more closely allied than to *Pterinea*, but it appears to be very different in general aspect from its typical forms, and I should be inclined to regard Barrois as right in accepting it as a genus or sub-genus. It is characteristic of Devonian Beds, and many forms occur in Europe and America. It is especially well represented in the localities now under review.

1 1855, F. A. Römer, 'Beitr.,' pt. 3, p. 35, pl. vii, fig. 3.

2 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 93, pl. xiv, figs. 1—21; pl. xv, figs. 8—10; and pl. lxxxiii, figs. 11, 12.

3 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 23, pl. xii, fig. 28.

4 1885, Follmann, 'Verh. Nat. Hist. Vereins Preuss. Rheinl.,' vol. xlii, p. 195, pl. v, figs. 4, 4 *a*.

5 1855, de Verneuil, 'Bull. Soc. Géol. Fr.,' ser. 2, vol. xii *b*, p. 1003, pl. xxix, fig. 3; and 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 83, pl. 9, fig. 3.

6 1869, de Verneuil, 'Faun. Devon. Bosphore,' p. 32, pl. xx, fig. 6.

1. Actinopteria ? Robertsii, n. sp. Pl. VI, figs. 2—4.

Description.—Left valve small, oblique, convex, transverse. Umbo small, anterior, proximate. Anterior wing small, obtuse, convex, divided from the back by a sharp concave depression. Posterior wing small, triangular, flat, sharply defined. Hinge-line rather short, being less than half the length of the shell. Anterior margin convex above, straight and oblique below. Inferior margin oblique and gently convex. Postero-inferior corner much produced and very convex. Posterior margin oblique and straight below, becoming broadly concave above, where it bounds the wing. Contour of surface convex, the highest line running down from the umbo to the postero-inferior corner, and the surface sloping from it more steeply on the posterior than the anterior side. Surface of wings almost smooth, or marked by sharp, distant growth-ridges. Surface of back bearing between twenty-five and thirty very distant, small, sharp rays, divided by broad and slightly concave interspaces, and crossed by sharp, distant, irregular, and indistinct threads or growth-lines.

Size.—Length 20 mm., breadth 16 mm., depth of left valve 4 mm.

Locality.—Lummaton. There are seven specimens in my Collection, and two in the Woodwardian Museum.

Remarks.—This species is distinguished by the shape of its wings; the front wing being short, swollen, and rounded, and the hind wing being very small, flat, triangular, well-defined, and with a concave posterior margin. Its ornament is also characteristic, the ribs being few in number, narrow and sharp, and much more prominent than the distant, transverse striæ or threads on the body of the shell, while on the wings the latter become stronger, and the former almost entirely disappear. It would seem, however, that on the hind wing at least six or seven rays were normally present, but these are generally obliterated either during life or fossilization.

Affinities.—I have met with few foreign species that approach it closely except *Avicula immunis*, Barrande.

Beushausen's[1] figure of *A. Jugleri*, F. A. Römer,[2] agrees in the shape of its hind wing, but its anterior side is different, and its ribs are stronger and closer. As given by F. A. Römer and Frech[3] this species is widely distinct.

Avicula mucro, Barrande,[4] has a much smaller front wing, and differs in the

[1] 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 1, p. 55, pl. ii, fig. 9.

[2] 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 21, pl. vi, fig. 4.

[3] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 18, pl. xvii, fig. 2.

[4] 1881, Barrande, 'Syst. Sil. Bohêm.,' vol. vi, pl. ccxviii, figs. 7—10, Ét. E.

contour of its margins, and in the closeness of its transverse ornament, but presents some general approximation.

Aviculopecten dupliciradiatus, de Koninck,[1] seems distinguished by its closer transverse marks, its double ribs, and its more triangular front wing.

Avicula immunis, Barrande,[2] has a smaller front wing, and a larger hind wing. Its front wing seems sharper, and the rays on the hind wing are coarser than the transverse striæ. The ornament, though much the same in character, seems decidedly finer. It is very nearly allied, but not I think identical.

Actinopteria eta, Hall,[3] has a larger, sharper, and more closely striated hind wing and coarser ornament.

Pterinea oblonga, Trenkner,[4] seems hardly identifiable from its figure and description. In some respects it is not unlike the present shell, but its rays seem coarser. Its wings do not seem to be shown.

Note.—In naming this species after the late Mr. Tom Roberts, F.G.S., the writer cannot forbear expressing his sense of the great loss which British palæontology has sustained by his death. He combined with a keen eye and a clear judgment a fund of quiet perseverance and an extensive knowledge both of the literature and the stone records of his favourite science. Had he lived he would doubtless soon have occupied a place as a palæontologist rivalled by few. That he had not already done this was due to the simple fact of his generosity. He spent his time in helping others, and so he could do little to make the results of his own researches known. The present writer has been under the deepest obligation to him for constant help, guidance, and correction in the course of this work.

2. Actinopteria hirundella, *Whidborne*, sp. Pl. VI, figs. 5, 5 *a*, 6, 6 *a*, and Pl. VII, figs. 4, 4 *a*, 4 *b*.

1889. Pterinea hirundella, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 79.

?? 1889. Actinopteria manca, *Barrois* (not *Barrande*). Faun. Calc. d'Erbray, p. 175, pl. xii, figs. 1, 1 *b*.

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[1] 1885, De Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. xi, pt. 5, p. 239, t. 34, figs. 1—3.

[2] 1881, Barrande, 'Syst. Sil. Bohêm.,' vol. vi, pl. ccxxiv, figs. 3, $^{1-13}$, Ét. E.

[3] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 124, pl. lxxxiv, figs. 8—11.

[4] 1867, Trenkner, 'Paläont. Novit.,' pt. 1, p. 24, pl. iii, fig. 52.

Description.—Left valve large, transverse, very oblique, convex. Umbo very anterior. Front wing unseen. Anterior margin rather narrow, receding. Inferior margin very long, oblique, and slightly convex. Postero-inferior corner very much produced, very convex. Posterior margin oblique and nearly straight, becoming erect and concave in the upper part which bounds the hind wing. Hind wing rather small, triangular, flattish, rather clearly defined, and bearing coarser rays. Contour of surface nearly straight along the line from the deepest point near the umbo to the postero-inferior corner, and nearly evenly convex in the direction perpendicular to this line. Surface covered with multitudinous, minute, distant, elevated, slightly alternating rays, crossed and cancellated by fine, regular, elevated threads, rather more distant than the rays, and by a few coarse bulges or striæ of growth. Hinge-line apparently about two thirds the length of the shell.

Right valve very similar in shape and convexity to the left, but with its umbo rather less anterior, with a produced front wing, and with a rather broader anterior margin. Hind wing large, undefined. Surface covered by delicate, regular, distant, transverse threads, which are crossed on the postero-superior part, or hind wing, by some rather closer and more rounded, small, irregularly alternating rays. Shell-structure very thin.

Size.—Length 48 mm., breadth 35 mm., depth of left valve 8 mm.

Localities.—From Wolborough there is a left valve in the Museum of Practical Geology. From Lummaton there is a left valve in Mr. Lee's Collection in the British Museum, and a right valve and a small and doubtful left valve in my Collection.

Remarks.—Although many of the most important parts of the shell are very imperfectly indicated by the specimens here described, enough remains to show that they belong to a species distinct from the others which accompany it, though bearing a strong resemblance to some of them.

The left valve seems distinguished by its short hinge-line, its small hind wing, its fine and numerous ribs, its great length and obliquity, and the delicate regular and distant threads which traverse both the ribs and the furrows. The ribs on the hind wing seem decidedly coarser and larger than those upon other parts of the shell.

It approaches *Avicula* (*Pterinea ?*) *ala*, Barrande,[1] very closely, but differs by its much greater length and obliquity, and by its ornament being finer, its postero-inferior corner more produced, and its hind wing apparently smaller and more definite.

In that Bohemian shell the two valves are very dissimilar from each other in

[1] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccv, fig. 3, 1–7; pl. ccxvii, fig. 5, 1–3; pl. ccxviii, figs. 21—23; and pl. cclxxxi, figs. 1—6, Ét. F.

ornament and other points, and its right valve bears much the same relationship to the right valve here described from Lummaton, that the respective left valves do. We are therefore led to the belief that the English right and left valves belong to one species; and this belief is confirmed by comparing them together. The ornament of the right valve appears to agree with that of the left in essence though not in development, while it does not seem to me to do so with the left valves of any of the accompanying species.

The specimen from Lummaton is interesting from showing a curious mending of an injury to the shell during life.

Under the name *Actinoptera manca*, Barrois[1] describes a very kindred species, which seems chiefly to differ in being rayed only over the central part of the surface, and in having more lamellar transverse markings; the latter point, however, may perhaps be an accidental effect of age or sediment. Possibly it may prove identical. Barrande's[2] original *Avicula* or *Myalina manca* seems to differ in shape and in the coarseness of its ornament.

Affinities.—*Pterinea perdita*, Barrande,[3] resembles the right valve in ornament, but is a very much shorter shell, and has the transverse striæ much less curved.

Pterinea (*Actinoptera*) *Trigeri*, Œhlert,[4] seems distinguished by having no rays whatever on the right valve, and no regular fine striæ on the left valve. Its anterior wing cannot of course be compared with that of our shells. It evidently is so closely allied as to be on the verge of identity.

3. Actinopteria musicata, n. sp. Pl. VI, figs. 7, 7*a*, 7*b*.

Description.—Left valve large, flattish, transverse, sub-quadrate, oblique. Umbo rather small, situated at the anterior end of the hinge-line (excluding the anterior wing, which is unknown), oblique, flattened, proximate. Hinge-line long, straight, nearly equal to the greatest extension of the shell behind. Anterior margin probably narrow and oblique. Inferior margin wide, moderately convex. Posterior margin slightly oblique, sigmoid. Posterior wing large, sloping, undefined. Contour of surface slightly convex, steeper in front, slightly concave behind the post-umbonal line. Surface ornamented by a major series of thirty or forty fine, low, narrow, rounded, and very distant rays, between each of which are

[1] 1889, Barrois, 'Faun. Calc. d'Erbray,' p. 175, pl. xii, figs. 1, 1 *a*, 1 *b*.

[2] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxxii, figs. 8, 9, Ét. F.

[3] 1881, ibid., vol. vi, pl. cxxv, figs. 1—3, Ét. F.

[4] 1888, Œhlert, 'Bull. Soc. Géol. Fr.,' ser. 3, vol. xvi, p. 646, pl. xiv, figs. 4, 4 *a*.

a varying number of still finer sub-equal radiations, the whole crossed by numerous, transverse undulations, and by sharp, close growth-striæ, which occasionally break the continuity of the ribs. Shell-structure very thin.

Size of left valve.—About 45 mm. long, 35 mm. broad, and 7 mm. deep.

Locality.—Wolborough. There is a specimen in Mr. Vicary's Collection.

Remarks.—This species appears to be well characterised by its ornamentation. The major rays are very small and distant. The number of the minor rays in each interspace varies, there often being four or five in the central parts, and frequently none in the front parts or on the hind wing, while sometimes the central line is larger than the rest. The transverse striæ and undulations together result in a rather irregular ornament. The shell is also distinguished from most of the accompanying species, except *A. placida,* by its greater flatness. I am aware of few, if any, other species which are similarly marked.

Affinities.—Some specimens of *Actinopteria subdecussata*, Hall,[1] very nearly approach this shell, but the rays of that species seem to alternate more regularly, and the cross lines to be less crowded.

4. Actinopteria dilatata, *Whidborne*, sp. Pl. VI, figs. 8—10; Pl. VII, figs. 1—3; and Pl. VIII, figs. 8, 8 *a*.

? 1842. Avicula clathrata, *Sandberger*. Neues Jahrb. f. M., p. 397.
? 1848. — — *Bronn* (pars). Handbuch, pt. 3, p. 1052.
? 1853. — — *Sandberger*. Verst. Rhein. Nassau, p. 286, pl. xxix, figs. 18—18 *d*.
1889. Pterinea dilatata, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 79.
? 1891. Avicula clathrata, *Frech*. Abhandl. Geol. Specialk. Preuss., Band 9, pt. 3, p. 41, pl. iii, figs. 10, 10 *a*.

Description.—Left valve large, convex, sub-quadrate, transverse. Umbo prominent, wide, rounded, oblique, situated at the anterior end of the hinge-line (excluding the front wing). Hinge-line long, straight, extending almost the extreme length of the shell behind. Front wing apparently small, rounded, convex, and rather undefined. Anterior margin rather narrow, convex, and oblique. Inferior margin very long, slightly oblique, and gently convex. Posterior margin nearly erect and sigmoid. Hind wing long, narrow, sloping, and undefined. Contour of surface convex in the centre, very steep in front, and slightly concave behind the umbo. Surface ornamented with about sixty or

[1] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 110, pl. xvii, figs. 23, 24—27, 29—31.

seventy distant, elevated, rounded, and usually alternating rays, which are separated by flat interspaces, generally wider than the rays; the whole crossed by occasional indistinct bulges, by minute, close, regular, rounded, transverse striæ, and in some well-preserved specimens by rather regular, distant, fine, foliaceous threads. Shell-structure thin.

Right valve large, flattish, oblique, slightly transverse. Umbo apparently prominent, oblique, anterior. Anterior margin receding. Inferior margin obliquely convex. Infero-posterior corner broadly convex. Posterior margin straight, erect. Posterior wing large, broad, triangular, undefined, extending the whole length of the shell. Contour of surface convex near the umbo, flattened towards the margins. Surface with about twelve low, rounded, small, distant rays on the posterior wing, and about ten, which are still less distinct, on the adjacent parts of the median region; elsewhere without rays; the whole shell being covered by fifty or sixty sharp, minute, and very distant, transverse ridges, the steep sides of which face the umbo.

Size.—A left valve measures about 45 mm. long, 36 mm. broad, and 12 mm. deep. A right valve apparently measures about 60 mm. long, 47 mm. broad, and 10 mm. deep.

Localities.—There are fifteen examples of the left valve in my Collection from Lummaton, and four of the left valve and one of the right valve in Mr. Vicary's Collection from Wolborough.

Remarks.—The left valve of this species seems characterised by its convexity, its transverse sub-quadrate shape, its low, rounded, distant ribs, and its small, regular, close striæ.

It seems to vary considerably both in length and in shape, as well as in the number of ribs, the latter quality being apparently due to the smaller of the alternating ribs being in some cases obsolete. Some of the extreme forms, perhaps, may ultimately prove to be distinct; but, as it does not seem possible to draw any definite line between them, I have thought it best to leave them together. Thus several specimens show a narrower and more oblique anterior side, and in these the distant transverse threadings are more clearly seen. Hence they approach *A. intermedia*, Œhlert,[1] though still being much less triangular in shape than that species. But to prove that these small differences are more than accidental would require a much more perfect series of specimens than are at present at command.

The largest specimen from Wolborough (Pl. VI, fig. 8) seems to be much flatter than the other shells, and its rays are more numerous and less prominent. I am inclined to think that these characters are to be accounted for by the fact that it

[1] 1881, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 21, t. 3, figs. 1—1*c*.

is an aged shell. As the specimen is very imperfect it may appear less convex than it really is.

Another large specimen in Mr. Vicary's Collection (Pl. VII, fig. 2) is interesting from having been broken during life, and mended by a convex patch of shell in which the ribs run obliquely.

It appears difficult from the state of our material to decide whether *A. clathrata*, Sandberger, is identical. Its resemblance in shape and in the arrangement of the ribs and striæ is close, but its ornament seems rather coarser, its shape less convex, its anterior side less steep, and its front wing larger and flatter and less defined. The front wing is, however, very imperfectly seen in all the English specimens.

I have regarded as belonging to this species a very large and imperfect right valve (Pl. VIII, fig. 8) in Mr. Vicary's Collection. As it is not in contact with a left valve, and as its ornamentation is very different from that of the other specimens, this identification can only be regarded as tentative. But, on the other hand, the close similarity between the mutually corresponding valves of *Actinopteria theta*, Hall, and *A. ala*, Barrande, are strong arguments in its favour, and Mr. Vicary's specimen of the right valve appears to agree more nearly in size and character with the left valves of the present species than with those of any of the adjoining forms.

Affinities.—Actinopteria theta, Hall,[1] *Avicula normata*,[2] Barrande, and *Avicula* (*Actinopteria*) *æmiliana*, Frech,[3] are very closely allied species, but all differ in being decidedly broader shells. The transverse ornament on the left valve of *A. æmiliana* is more regular and distant, and the right valve of *A. theta* has fewer rays.

Avicula (*Pterinea*) *perdita*, Barrande,[4] has every appearance of being simply the right valve of his *A. normata*, and it is moreover rather broader and smoother than the present fossil.

Avicula ala,[5] Barrande, also seems a broader and more quadrate shell. The transverse ridges of its left valve appear to be stronger and more regular, and the hind wing seems shorter. The smoothness of its right valve varies greatly; the rays on it being sometimes numerous, and sometimes entirely absent except on the wing.

[1] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 125, pl. lxxxiv, figs. 18, 19.

[2] 1881, Barrande, 'Syst. Sil. Bohêm.,' vol. vi, pl. cxxv, figs. 4—9; and pl. ccxxii, figs. 17—20, Ét. F.

[3] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 43, pl. iii, figs. 1—1 *b*.

[4] 1881, Barrande, 'Syst. Sil. Bohêm.,' vol. vi, pl. cxxv, figs. 1—3, Ét. F.

[5] Ibid., pl. ccv, fig. 3, 1–7; pl. ccxvii, fig. 5, 1–3; pl. ccxviii, figs. 21—23; and pl. cclxxxi, figs. 1—6, Ét. F.

Pterinea lineata, Goldfuss[1] (which includes *Pt. plana*, Goldfuss,[2] and *Pt. elongata*, Goldfuss,[3] according to Frech[4]), appears distinguished by a much more defined and usually much longer hind wing, and by finer radiations.

Avicula intermedia, Œhlert,[5] seems more triangular in shape, being much more truncated in the antero-inferior region.

Avicula cancellata, Phillips,[6] from North Devon, might, as figured by him, perhaps be supposed to be identical. Specimens, however, in Mr. Hall's collection and in the Museum of Practical Geology, which evidently belong to that species, show that it is a shell of a different type. Its general contour is different and its ribs are finer and not alternating. It belongs, with its cogener *Avicula Damnoniensis*, Sowerby,[7] to the group of shells which Hall has separated under the generic name of *Ptychopteria*.[8]

5. Actinopteria placida, *Whidborne*, sp. Pl. VII, figs. 5—11; and Pl. VIII, figs. 7, 7 *a*.

1887. Actinopteria Boydi, *Tschernyschew* (not *Conrad*). Mém. Com. Géol. Russ., vol. iii, pt. 3, p. 44, pl. vi, figs. 18—20.
1889. Pterinea placida, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 79.
1889. — obovata, *Whidborne*. Ibid., dec. 3, vol. vi, p. 79.

Description.—Left valve small, sub-quadrate, oblique, rather transverse, moderately convex. Umbo prominent, oblique, incurved, proximate, extending slightly above the hinge-line, and situated at the anterior quarter of its length (including the anterior wing). Anterior wing very large, broad, convex, trapezoidal, defined by a shallow concavity from the umbo, and ornamented by about ten coarse, close rays. Posterior wing large, flattish, triangular, slightly defined, and bearing about twelve coarse, rounded, and rather close rays. Anterior margin oblique, slightly notched under the wing, and convex below it. Inferior margin wide, slightly oblique, and convex. Postero-inferior corner broadly rounded. Posterior margin nearly erect and slightly concave. Hinge-line straight and equal to the greatest length of the shell. Contour of surface gently convex, sinking suddenly to the anterior wing and rather more gradually

1 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 135, pl. cxix, figs. 6 *a*—*c*.
2 Ibid., p. 135, pl. cxix, figs. 4 *a*—*f*.
3 Ibid., p. 135, pl. cxix, figs. 5 *a*—*c*.
4 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 89, pl. ix, figs. 17—19.
5 1881, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 21, pl. iii, figs. 1—1 *c*.
6 1841, Phillips, 'Pal. Foss.,' p. 49, pl. xxii, fig. 84.
7 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liii, fig. 22.
8 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. xii.

to the posterior wing, and sloping out flatly to the lower margins. Surface covered with about sixty rather close, alternating, elevated, rounded rays, separated by narrow furrows; the whole crossed by occasional indistinct growth-bulges and (in well-preserved specimens) by very minute and distant, regular, elevated threads, and apparently by close, intermediate striæ.

Right valve transverse, convex, oblique. Umbo slightly more central and less prominent than the umbo of the other valve. Front wing long, square, deeply-notched below; in contour, convex, and separated from the umbo by a deep concavity. Hind wing flattish, well-defined. Contour of surface slightly convex in the centre, very steep in front and behind, and spreading out flatly to the lower margins. Surface bearing six or seven sharp, coarse, distant rays upon the hind wing only, the rest of the surface having no rays; but the whole being covered by minute, distant, sharp, very regular, elevated threads, which become closer on the front wing, and follow the curves of the margins.

Size.—Left valve: Length, 23 mm.; breadth, 18 mm.; depth, 4 mm. A small specimen of the closed valves measures 15 mm. long, 11 mm. broad, and 6 mm. deep.

Localities.—Of the left valve there are seventeen specimens in my Collection and four in the Woodwardian Museum from Lummaton, two probably from the same locality in the Torquay Museum, and one from Barton in Mr. Lee's Collection. Of the right valve there are three specimens from Lummaton in my Collection. There is a specimen of the closed valves from Lummaton in the Torquay Museum.

Remarks.—This species seems to be well-defined and clearly distinguishable from the accompanying forms. It is characterized by its small size, its large front wing, its close-set, rounded ribs, and its very distant, minute, and regular transverse threads. The ribs seem coarser on the wings than on the central parts of the shell, and the furrows increase in width as they approach the margins.

This shell presents some amount of variation both in shape, convexity, and ornament. I formerly thought that several of the specimens (*e. g.* Pl. VII, figs. 10 and 11) could be specifically separated, owing to their larger front wing, their greater convexity, their more defined hind wing, and their closer and fewer ribs. Further examination, however, makes me believe that these appearances are in great part due to these specimens, though apparently well-preserved, really wanting their marginal parts, and therefore that they can at most only be regarded as varieties of the present form.

The evidence that the right valves belong to the same species is only presumptive. My three examples of them are all so defective that their true shape cannot be defined, but their ornament is just what might be expected in comparison with that of the left valves. The only specimen with the two valves in contact is in the Torquay Museum, and, while the surface of its right valve is in a fair state of preservation, that of its left valve is almost entirely destroyed, so that all that can be asserted is that it agrees with the other specimens of the left valve in general shape. It shows that the right valve is slightly flatter than the left, and that its umbo is a little more central.

The specimen shown at Pl. VIII, fig. 7, has caused me some perplexity. I believe, however, that it is a specimen of the present shell, obliquely set in the matrix, and with the finer ornamentation of its surface weathered away.

Affinities.—Both valves of this shell bear great likeness to the two valves of *Avicula troglodytes*, Goldfuss MS.,[1] thus supporting the presumption of their own identity; the likeness even extends to the existence of the minute threads, and to the nearly equal depth of the two valves, so that the German species is evidently a very near relation. It seems, however, to be specifically distinguished by its shape, being a much less oblique shell, and having longer and more defined wings and more arching margins. Frech[2] refers Follmann's species to his group of *Avicula Wurmii*.

Pterinea lineata, Goldfuss,[3] with which Frech[4] unites *Pt. elongata*, Goldfuss,[5] and *Pt. plana*, Goldfuss (pars), is also very similar in ornament, but has a very much smaller anterior wing, a more defined and generally much longer posterior wing, and a more sigmoid posterior margin.

Avicula expulsa, Barrande,[6] approaches our shells in shape, but its ribs are finer and not alternating, its transverse markings are much fewer and coarser, and its front ear is more truncated.

A. urbana, Barrande,[7] is much too fragmentary for identification. Its ribs do not alternate, and show no transverse markings, and its shape seems broader.

The right valve of *Avicula tumida*, F. A. Römer,[8] seems to be much more produced in front, and to have a much smaller wing.

[1] 1885, Follmann, 'Verh. Nat. Hist. Vereins preuss. Rheinl.,' vol. xlii, p. 202, pl. iii, figs. 6, 6 *a*, 6 *b*.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 40, pl. iii, fig. 5.

[3] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 135, pl. cxix, figs. 6 *a*—*c*.

[4] Ibid., p. 135, pl. cxix, figs. 5 *a*—*c*.

[5] Ibid., p. 135, pl. cxix, figs. 4 *a*—*f*.

[6] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxviii, figs. 13, 14.

[7] Ibid., pl. ccxix, fig. 6, 1, 2.

[8] 1860, F. A. Römer, 'Beitr.,' pt. 4, p. 161, pl. xxv, fig. 7.

6. Actinopteria Justi, *Frech*, sp. Pl. VII, figs. 12, 12 *a*; and Pl. VIII, fig. 1.

1891. Avicula Justi, *Frech.* Abhandl. Geol. Specialk. Preuss., Band ix, pt. 3, p. 36, pl. iii, fig. 11; and pl. xiv, fig. 7.

Description.—Left valve of moderate size, quadrate, nearly as broad as long. Umbo prominent, slightly oblique, incurved, slightly elevated above the hinge-line, and situated nearly at its anterior end. Hinge-line straight and equal to the length of the shell. Anterior wing small, convex, defined, and bearing three or four ribs. Anterior margin broad, nearly erect. Inferior margin moderately convex, hardly oblique. Infero-posterior corner broadly rounded. Posterior margin erect and nearly straight. External contour evenly convex in the centre, almost perpendicular in front, and sloping gently to the other margins. Hind wing large, sloping, and undefined. Surface bearing about thirty large, rounded, distant ribs, of which about ten are on the hind wing; the whole being crossed by coarse striæ and by a few indistinct undulations. Shell-structure thin.

Size of left valve.—Length 30 mm., breadth 26 mm., depth 9 mm.

Locality.—A single specimen from Wolborough is in Mr. Vicary's Collection, and two smaller examples from Lummaton are in my Collection.

Remarks.—Mr. Vicary's specimen is almost perfect in shape, but, if not actually a cast, it is certainly without the outer layer of shell, and hence its ornament is lower and more confluent than would otherwise be the case.

The species is distinguished from those that accompany it by its quadrate shape, its broad and erect anterior side, and the fewness and coarseness of its ribs. It appears to agree accurately with the German fossil to which Frech has given the name *Avicula Justi.*

The anterior wing in Mr. Vicary's specimen is very obscure, but I think the figure at Pl. VIII, fig. 1, would have more accurately represented it if a minute triangular slip had been removed from its upper part.

Affinities.—*A. placida* differs in the much greater size of its front wing, and the fineness and closeness of its markings.

A. dilatata is much more transverse and has finer and more numerous ribs.

Whether *A. Justi* is more than a variety of *A. Wurmii* may perhaps be questioned. Our English material would be hardly sufficient by itself to decide the point. But a comparison of our specimens of the two forms with Frech's description of them confirms the view that they are distinct species. Not only are the ribs much fewer and coarser in *A. Justi*, but the anterior side is broader and less truncated, so that the shell is squarer in shape.

7. Actinopteria Wurmii, *F. A. Römer*, sp. Pl. VIII, figs. 2, 3, and 5.

1843. Avicula Wurmii, *F. A. Römer.* Verst. Harzgeb., p. 21, pl. vi, fig. 7.
1848. — clathrata, *Bronn.* Handbuch, pt. 3, p. 1052.
1849. — Wurmii, *d'Orbigny.* Prodrome, vol. i, p. 85.
? 1860. — trapeziformis, *F. A. Römer.* Beitr., pt. 4, p. 161, pl. xxv, fig. 6.
1881. — (Pterinea ?) normata, *Barrande.* Syst. Sil. Bohêm., vol. vi, pl. cxxv, figs. 4—9; and pl. cxxii, figs. 17—20, Ét. F.
1881. — — perdita, *Barrande.* Ibid., vol. vi, pl. cxxv, figs. 1—3, Ét. F.
1884. Pterinea Wurmii, *Clarke.* Neues Jahrb. f. Min., Beil.-Band iii, p. 369.
1884. Avicula Wurmii, *Tschernyschew.* Mém. Com. Géol. Russ., vol. i, p. 3, pl. i, fig. 11.
? 1885. — — *Maurer.* Abhandl. Grossh. Hessich. Geol. Lands., Band i, pt. 2, p. 224, pl. ix, fig. 17.
1887. Actinopteria Wurmii, *Tschernyschew.* Mém. Com. Géol. Russ., vol. iii, pt. 3, p. 43, pl. vii, figs. 15 *a—c.*
1889. Pterinea Wurmii, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 78.
1891. Avicula Wurmii, *Frech.* Abhandl. Geol. Specialk. Preuss., Band ix, pt. 3, p. 42, pl. iii, figs. 4—4 *d.*

Description.—Left valve rather large and convex, oblique, very broad. Umbo rather oblique and recurved, prominent, apparently extending slightly above the hinge-line, and situated at its anterior end (excluding a small front wing). Hinge-line straight, nearly the same length as the shell. Posterior wing large, broad, undefined, triangular, slightly concave. Anterior margin long, oblique. Inferior margin gently convex. Postero-inferior corner broadly rounded. Posterior margin nearly perpendicular. External contour gently rounded, steeper in front. Surface bearing rather numerous and very distant, low, rounded, alternating rays crossed by occasional minute threads and by microscopic transverse markings. Shell-structure very thin.

Size of left valve.—About 25 mm. long, about 25 mm. broad, and about 7 mm. deep.

Localities.—From Lummaton there are five specimens in my Collection; and from Wolborough a worn and doubtful example is in the Museum of Practical Geology. A fragmentary specimen is in the Bristol Museum.

Remarks.—As usual among these fossils the state of preservation of the specimens renders their specific determination perplexing. They seem, however, in their general shape and ornament to be distinguishable from the adjoining shells, though until better specimens come to hand some doubt must remain both as to their specific value and their relationship to foreign forms.

In none of our specimens is the front wing clearly seen; but in other respects they agree accurately with *Avicula Wurmii*, F. A. Römer, both as originally described, and as given by Frech. The same shell has been described from Russia by Tschernyschew.

Frech considers the shell referred to Römer's species by Maurer as doubtful, and it certainly has decidedly fewer ribs than are seen in our English specimens.

Avicula trapeziformis, F. A. Römer, is a very imperfectly described shell. It seems to me that it may possibly be identical with the present species.

Pterinea normata, Barrande, also appears to be identical, although in some of Barrande's figures the ribs appear to be more distant and to alternate more rarely; and in others to be closer and finer.

Pt. perdita, Barrande, has every appearance of being the opposite valve of *Pt. normata*. Barrande mentions that his specimen is lost, which may be the reason he has not united them.

Affinities.—*Avicula intermedia*, Œhlert,[1] is very similar, and Frech seems half inclined to regard it as identical. It chiefly differs from the German species (including our specimens) by its much greater length and much more triangular shape.

A. Trigeri, Œhlert,[2] is more transverse and more finely ribbed.

Pterinea Morleti, Œhlert and Davoust,[3] is broader, less oblique, and more finely and evenly ribbed.

Avicula pectinoides, Sowerby,[4] while presenting in his fragmentary type a somewhat similar appearance, is easily distinguished by its large anterior wing and much more central umbo.

Sandberger[5] describes a shell under the name of *Pterinea clathrata*, with which he identifies both *A. Wurmii*, F. A. Römer, and *A. texturata*, but which is certainly distinct from the former, and most probably from the latter. From *A. Wurmii* it is at once to be distinguished by its transverseness and its very large anterior wing, as well as by its prominent transverse striæ.

Frech seems to doubt whether *Actinopteria subdecussata*, Hall,[6] is not identical. While it certainly is extremely similar, it seems to me that its ornamentation is

[1] 1881, Œhlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 21, pl. iii, figs. 1—1 *c*.

[2] 1888, ibid., ser. 3, vol. xvi, p. 647, pl. xiv, fig. 4.

[3] 1880, Œhlert and Davoust, ibid., ser. 3, vol. vii, p. 715, pl. xv, fig. 9.

[4] 1840, Sowerby, 'Trans. Geol. Soc.,' ser. 2, vol. vi, pt. 3, pl. liv, fig. 2.

[5] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 286, pl. xxix, fig. 18.

[6] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 110, pl. xvii, figs. 23, 25—27, 29—31; and pl. xix, fig. 25.

decidedly finer, and that its shape is generally more transverse. I therefore have followed him in not uniting it at present.

Actinopteria Boydii, Conrad, sp.,[1] has more or less foliaceous transverse striæ, and its front wing is rather larger.

Under the name *Avicula æmiliana*, Frech[2] separates from *A. Wurmii* a shell which he chiefly distinguishes by its rather finer striæ and its rather larger front ear. Thus it tends in the direction of *A. dilatata*, but its distinctions from *A. Wurmii* are so slight as to be in my view scarcely specific; especially when the variability of these shells is taken into account. As the anterior wings of our specimens are unknown, no comparison can be made in that direction; their ribbing seems to agree rather better with that of Römer's shell.

Limoptera Bohemica, Barrois,[3] which is *Avicula Bohemica*, Barrande,[4] has much more definite threads which reticulate the rays.

Actinopteria theta, Hall,[5] which is regarded as a synonym of the present species by Tschernyschew, is much more finely ribbed.

8. Actinopteria rudis, *Phillips*, sp.? Pl. VIII, figs. 4 and 6, 6 *a*.

1841.	Avicula rudis, *Phillips*.	Pal. Foss., p. 50, pl. xxii, figs. 85 *a*, *b*.
1848.	— — *Bronn*.	Handbuch, pt. 3, p. 141.
1849.	— — *d'Orbigny*.	Prodrome, vol. i, p. 84.
1854.	— — *Morris*.	Catal. Brit. Foss., p. 162.
? 1860.	— semiglobosa, *F. A. Römer*.	Beitr., pt. 4, p. 161, pl. xxv, fig. 8.
1880.	Pterinea Morleti, *Œhlert and Davoust*.	Bull. Soc. Géol. Fr., ser. 3 vol. vii, p. 715, pl. xv, fig. 9.
1888.	— rudis, *Etheridge*.	Foss. Brit., vol. i, Pal., p. 159.
1889.	— — *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 78.

Description.—Left valve rather small, convex, broader than long, slightly oblique. Umbo large, prominent, rounded, proximate, apparently extending slightly above the hinge-line, and situated at about the anterior third of its length (including the anterior wing). Anterior wing rather large, long, trapezoidal, perpendicularly convex, and defined. Posterior wing large, very broad, flattish, and defined. Hinge-line straight, nearly as long as the shell. Anterior margin

[1] 1842, Conrad, 'Journ. Acad. Nat. Sci. Philad.,' vol. viii, p. 237, pl. xii, fig. 4; and 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 113, pl. xix, figs. 2—24, 26—30; and pl. lxxxiv, figs. 16, 17.

[2] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band xi, pt. 3, pl. iii, figs. 1—1 *b*.

[3] 1889, Barrois, 'Faun. Calc. d'Erbray,' p. 173, pl. x, figs. 9—9 *b*.

[4] 1881, Barrande, 'Syst. Sil. Bohêm.,' vol. vi, pl. ccxix, fig. 7, 1—3; and pl. ccxxii, fig. 1, 14—16, Ét. F.

[5] 1884, Hall. 'Pal. N. Y.,' vol. v, pt. 1, p. 125, pl. lxxxiv, figs. 18, 19.

very long, nearly horizontal under the wing, and then obliquely convex. Inferior margin rather narrow, roundly convex. Posterior margin nearly erect, sigmoid. Contour of surface flatly convex in the centre, sinking steeply to the wings, and sloping out to the lower margins. Surface covered by about eighty very fine, narrow, distant, sharpish, rather irregularly alternating ribs, which are rather coarser on the hind wing, and very indistinct on the front wing, but with hardly any transverse markings except on the front wing, which bears about seven rounded, parallel, regular undulations. Shell-structure thin.

Size of left valve.—Length about 22 mm., breadth 18 mm., depth 5 mm.

Locality.—Lummaton. There are three specimens in my Collection.

Remarks.—Of these specimens the largest is the best, but does not show the front wing; the smallest is slightly narrower, and shows the front wing well; the third is a hardly recognisable fragment.

It is not certain whether they may be identified with *Avicula rudis*, Phillips, from Barnstaple, as his figure is extremely imperfect and his description vague. As far as can be seen, the chief difference is that its transverse bulges are very much more clearly visible, but this may be due to its being a crushed or older shell. There does not seem, therefore, any reason for separating it.

Pterinea Morleti, Œhlert and Davoust, also appears to belong to the same species, the figure of the French shell being exactly similar to my largest specimen; but some doubt must remain for the present, as neither of the two shows the front wing.

The species is characterised by its great breadth, slight obliquity, and fine sharp ornament. The hinge-line meets the posterior margin at a sharp angle, and the posterior wing is very broad.

I have been unable to meet with Phillips's type, but there are two very doubtful specimens in Mr. Townsend Hall's Collection from Sloly, which may possibly belong to the same species.

A. semiglobosa, F. A. Römer, may possibly be identical. Its figure, however, seems to differ in having a smaller wing and a fuller anterior side.

Affinities.—*A. placida* is longer and more oblique, and has coarser and closer ribs and a larger wing.

9. Actinopteria texturata, *Phillips*, sp. Plate IX, figs. 2, 2 *a*, 3, 3 *a*, 5—7.

1841. Avicula texturata, *Phillips.* Pal. Foss., p. 51, pl. xxiii, figs. 87 *a*, *b*.
1848. — — *Bronn.* Handbuch, pt. 3, p. 143.
1849. — — *d'Orbigny.* Prodrome, vol. i, p. 84.
1854. — — *Morris.* Catal. Brit. Foss., p. 163.

? 1881. Avicula (Pterinea ?) migrans, *Barrande.* Syst. Sil. Bohême, vol. vi, pl. ccxxix, fig. 12, 1–12 a, Ét. F.
1888. Pterinea texturata, *Etheridge.* Foss. Brit., vol. i, Pal., p. 159.

Description.—Left valve large, sub-quadrate, moderately transverse, convex. Umbo prominent, rounded, proximate, arching obliquely forward, extending slightly above the hinge-line, and situated at the anterior point of the shell, excluding the anterior wing. Hinge-line straight, equal to the extreme length of the shell, apparently rather oblique in front of the umbo, and bearing a slight linear ligamental (?) groove from the umbo to the hind margin. Anterior wing large, obtusely triangular, convex, separated by a broad concavity from the body of the shell. Anterior margin oblique, concave in the centre, convex above and below. Inferior margin wide, slightly oblique and convex. Postero-inferior corner rather produced and roundly convex. Posterior side oblique. Surface covered with numerous, coarse, distant, elevated ribs, tesselated by coarse, distant, regular, elevated threads or laminæ.

Size of left valve.—Length 25 mm., breadth 20 mm., depth 5 mm. Another specimen is 37 mm. in breadth and 14 mm. in depth.

Localities.—From Wolborough there are two specimens of the left valve in Mr. Vicary's Collection, two in the Museum of Practical Geology, and two, perhaps from the same locality, in the Torquay Museum. From Lummaton there is one specimen in Mr. Lee's Collection, one in the Woodwardian Museum, two doubtful specimens in my Collection, and five, probably from the same locality, in the Torquay Museum. A right valve from Lummaton in my Collection perhaps belongs to this species.

Remarks.—From the fragmentary condition of our specimens and the amount of variation displayed in them it is not very easy to be sure of their specific limits, nor is it absolutely certain that they are really more than the coarser variety of one of the adjoining forms. On the other hand, it seems to me that the presumption is that they will ultimately be found to constitute one well-defined species, and that there is no doubt that they belong to the form to which Phillips has given the name *Avicula texturata.*

This form seems characterised by its large, convex, confluent front wing, its coarse ribs barred with strong sharp concentric striæ, and its oblique and rather short anterior side.

There are several Bohemian shells which present considerable resemblance to it. Of these *Avicula migrans*, Barrande, is probably identical, as it only differs in some slight particulars, *e.g.* in having the anterior side rather narrower, and the posterior margin rather more concave.

I am doubtful whether the right valve in my Collection should be referred to this species or to *A. dilatata.* It has about thirty strong, sharp, distant threads, and the greater portion of its surface is covered with very indistinct rounded rays. It perhaps corresponds best with the left valves of the present form.

Affinities.—The figures of *Avicula Bohemica*, Barrande,[1] are too defective for complete determination. Its sculpture appears similar, but its shape is decidedly broader.

Avicula pupa, Barrande,[2] and *A. sericaria*, Barrande,[3] are distinguished by having smaller front and hind wings.

Avicula fenestrata, Follmann,[4] as given by Frech,[5] is similar in ornament but quite different in shape, being more circular and having a less anterior umbo.

Pterinea reticulata, Goldfuss,[6] seems to be a broader shell, with a more indented posterior side and a smaller front ear.

10. ACTINOPTERIA TEXTURATA, *Phillips*, var. SUBFENESTRATA, nov. Plate IX, fig. 4.

Remarks.—A specimen in the Torquay Museum, which apparently came from Barton or Lummaton, differs from the foregoing species in several particulars. Its ornamentation is much coarser and more foliaceous, its shape much broader, and its anterior side considerably longer. The margins are, however, so covered by the matrix that its exact form cannot be determined with certainty. It seems possible that it may be only a coarse variety of *A. texturata*, as its general contour seems to correspond; and I have thought it safer to regard it as such for the present. At the same time the parts of it that are visible agree with *Avicula fenestrata*, Follman,[7] except that the anterior side has the appearance of being steeper and more oblique, and it is very possible that it may prove to belong to that species instead of to the one to which it is at present annexed.

Affinities.—*Pterinopecten Dauniensis*, Frech,[8] has still coarser and more distant ribs, and a much more central umbo.

1 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxix, fig. 7, 1—5; and pl. ccxxii, figs. 14—16, Ét. F.

2 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxix, fig. 1, 1—3, Ét. F.

3 Ibid., pl. ccxix, fig. 2, 1—3, Ét. F.

4 1885, Follmann, "Ueber Dev. Aviculaceen," 'Verh. Nat. Hist. Vereins preuss. Rheinl.,' vol. xlii, p. 201, pl. ii, figs. 4 *a*, *b*.

5 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 35, pl. xiv, figs. 11—11 *d*.

6 1834-40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 136, pl. cxx, fig. 2; and 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band 9, pt. 3, p. 34, pl. iii, fig. 7; and pl. xiv, figs. 4—4 *b*.

7 1885, Follmann, 'Verh. Nat. Hist. Vereins p. Rheinl.,' vol. xlii, p. 201, pl. iv, figs. 4—4 *b*; and 1891, Frech, 'Abhandl. Geol. Specialk. Preuss,' Band ix, pt. 3, p. 35, pl. xiv, figs. 11—11 *d*.

8 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 15, pl. i, figs. 8—8 B.

11. Actinopteria crenatissima, *Whidborne*, sp. Pl. IX, figs. 8, 8 *a*, 9, 9 *a*.

1889. Pterinea crenatissima, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 79.

Description.—Left valve rather large, more or less convex, trapezoidal, not transverse. Umbo large, prominent, incurved, arching forward, and situate at the anterior extremity of the shell. Hinge-margin straight, almost the full length of the shell. Anterior wing unseen, but apparently very small and short. Posterior wing large, undefined, oblique, and triangular. Anterior margin broad, slightly convex and receding. Inferior margin oblique and slightly convex. Postero-inferior corner slightly produced and rounded. Posterior margin slightly oblique and concave. Contour of surface steep in front, sloping more gradually towards the inferior and infero-posterior margins, and slightly concave on the hind wing. Surface covered with nine or ten low, irregular growth-swellings, and with multitudinous, microscopic, close, rounded rays, crossed by still more numerous, crenulated, concentric threads.

Size of left valve.—Length 41 mm., width 38 mm., depth 9 mm.

Localities.—There are four specimens in my Collection from Lummaton and one in Mr. Vicary's Collection from Wolborough.

Remarks.—These shells are distinguished by their broad sub-quadrate shape, and by their exceedingly minute and numerous radiations, which are hardly visible to the naked eye. These rays are slightly undulating, and are crenulated by crowded elevated threads of unequal strength, which are almost foliaceous. There seems to be a considerable amount of variation in the convexity of the specimens. My best shell is decidedly flatter than the rest and has slightly coarser markings, but I do not think that there is any reason to separate it, even as a variety.

Affinities.—*Avicula Daleidensis*, Steininger,[1] appears to be rather similar in shape, but to have decidedly coarser markings. Steininger describes it as flat. His figure is hardly sufficiently definite for identification.

Pterinea striatocostata, Giebel, as given by Barrois,[2] is a nearly allied form, and I at one time thought it might be identical. It seems, however, to differ by being a more convex shell, and by having a much broader anterior side, as well as coarser and less granulated ribs. Barrois identifies this shell with *Pterinea ?* sp., Kayser,[3] which comes even closer to ours, though still differing from it in much the same particulars. Kayser in turn appears to unite his species with

1 1853, Steininger, 'Geogn. Beschr. Eifel,' p. 56, pl. iv, fig. 7.

2 1889, Barrois, 'Faun. Calc. d'Erbray,' p. 171, pl. x, figs. 8 *a*—*d*.

3 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 135, pl. xix, fig. 4.

Giebel's, though without adopting his name. Giebel's original figure[1] is that of a mere fragment, insufficient for unassisted identification; but it distinctly differs from our fossils, both in the size and the simple character of its ribs, and evidently, if accurate, does not belong to the same species.

Pterinea expulsa, Barrande,[2] seems a decidedly longer shell with simpler ribs.

The original figure of *Pterinea truncata*, F. Römer,[3] bears some slight resemblance to our fossils; but, under the name of *Gosseletia truncata*, it is shown by Frech[4] to be entirely unlike them.

Pterinea crinita, F. A. Römer, is a much more circular and convex shell, with a broader and less oblique anterior margin. It is placed by Frech,[5] together with *Pt. striatocostata*, under a new genus *Myalinoptera* among the *Myalininæ*.

In *Avicula hians*, Waldsmidt,[6] the umbo is much more central and the shape more circular.

5. *Genus.*—Leiopteria, *Hall*, 1883.

This genus or sub-genus is, in contour, median between *Avicula* and *Gervillia*, and is distinguished from *Actinopteria* by its general shape, its sharp posterior wing, and the absence of rays on both valves. It is covered by more or less regular transverse folds or growth-lines; and is quoted from the Devonian and Carboniferous beds of Europe and America.

It is very closely allied to Hall's other genus *Leptodesma*, which he distinguished simply because its "anterior end is always nasute and acute instead of auriculate and rounded." Frech merges both of Hall's genera as "groups" or subdivisions of the genus *Avicula*.

De Koninck gives some forms of *Streblopteria*, M'Coy, which so nearly approach the shell described below as to suggest generic identity.

1. Leiopteria lingulata, n. sp. Pl. X, fig. 1.

? 1882. Pterinea, n. sp., *Holzapfel*. Palæontographica, vol. xxviii, p. 258, pl. xlix, fig. 12.

Description.—Left valve gently convex, transversely oval, slightly oblique, with definite wings. Umbo minute, proximate, anterior, direct, acute, just

[1] 1858, Giebel, 'Silur. Faun. Unterharz,' p. 27, pl. v, figs. 15, 18.

[2] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxviii, figs. 13, 14, Ét. F.

[3] 1844, F. Römer, 'Rhein. Uebergangsgeb.,' p. 78, pl. ii, figs. 1 *a*, *b*.

[4] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band 9, pt. 3, p. 119, pl. xii, figs. 2—4.

[5] Ibid., p. 137, pl. xi, figs. 1—7.

[6] 1885, Waldsmidt, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xxxvii, p. 924, pl. xl, figs. 4, 4 *a*.

projecting above the hinge-line, and situated probably at about its anterior third. Hinge-line straight, thickened, more than half the total length of the shell. Wings small, narrow, seemingly concave. Posterior wing apparently about twice the size of the front wing. Anterior margin, below the wing, narrow and very convex. Inferior margin oblique and slightly convex. Infero-posterior margin very broad and regularly convex. Supero-posterior margin straight and very oblique, till it becomes sharply concave on the wing. Contour of surface gently rounded on the back, sinking steeply to the front, and sloping out more flatly to the rear. Surface bearing several irregularly arranged and slightly foliaceous growth-lines so as to present a tendency to alternating sharpish ridges and depressions. Shell-structure papyraceous.

Size.—Length 20 mm., width 16 mm., depth 4 mm.

Locality.—There is a single specimen from Newton (Wolborough ?) in the Lee Collection in the British Museum.

Remarks.—This is a peculiarly neat and graceful shell, and is very different from any of the accompanying species. It is distinguished by its obliquely ovoid form, by the absence of radiating striæ, and by its concentric markings, which are more in the nature of changes of surface level than of defined ornament. Both wings are defective in the specimen, the hinge-line being injured at both extremities, and the front wing obscured by matrix. Their general form can, however, be pretty clearly traced. There are a few indistinct, radiating markings on the back, which may, perhaps, be the remains of colour-lines, as they do not seem to affect the level of the surface.

Affinities.—It seems to be somewhat similar to a fossil described by Holzapfel as *Pterinea*, n. sp.,[1] which differs in being much smaller, longer, and more coarsely ornamented, and in not showing any defined wings. As, however, Holzapfel's figure is very small, it is possible that these differences may be accidents of the drawing, but, if they are correct, his shell ought, I think, rather to be referred to the genus *Posidonomya*.

Avicula incisa, Barrande,[2] differs in having a longer hinge-line, a more curved inferior margin, and a shorter anterior side.

Clinopistha lata, de Koninck,[3] is at first sight strikingly like, but a closer comparison at once shows that this likeness is purely superficial, and that its generic characteristics are totally different.

The various species of *Leiopteria*, Hall, described by himself and de Koninck,[4] all differ in having the anterior side much narrower and more oblique, but in other

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[2] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pt. 1, pl. cxx, figs. 1—3, Ét. D.

[3] 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. ix, pt. 5, p. 124, pl. xii, figs. 5, 6.

[4] Ibid., p. 187, pl. xxx.

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Description.—Left valve gently convex, transversely oval, slightly oblique, with definite wings. Umbo minute, proximate, anterior, direct, acute, just

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[3] 1844, F. Römer, 'Rhein. Uebergangsgeb.,' p. 78, pl. ii, figs. 1 *a*, *b*.

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[5] Ibid., p. 137, pl. xi, figs. 1—7.

[6] 1885, Waldsmidt, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xxxvii, p. 924, pl. xl, figs. 4, 4 *a*.

projecting above the hinge-line, and situated probably at about its anterior third. Hinge-line straight, thickened, more than half the total length of the shell. Wings small, narrow, seemingly concave. Posterior wing apparently about twice the size of the front wing. Anterior margin, below the wing, narrow and very convex. Inferior margin oblique and slightly convex. Infero-posterior margin very broad and regularly convex. Supero-posterior margin straight and very oblique, till it becomes sharply concave on the wing. Contour of surface gently rounded on the back, sinking steeply to the front, and sloping out more flatly to the rear. Surface bearing several irregularly arranged and slightly foliaceous growth-lines so as to present a tendency to alternating sharpish ridges and depressions. Shell-structure papyraceous.

Size.—Length 20 mm., width 16 mm., depth 4 mm.

Locality.—There is a single specimen from Newton (Wolborough ?) in the Lee Collection in the British Museum.

Remarks.—This is a peculiarly neat and graceful shell, and is very different from any of the accompanying species. It is distinguished by its obliquely ovoid form, by the absence of radiating striæ, and by its concentric markings, which are more in the nature of changes of surface level than of defined ornament. Both wings are defective in the specimen, the hinge-line being injured at both extremities, and the front wing obscured by matrix. Their general form can, however, be pretty clearly traced. There are a few indistinct, radiating markings on the back, which may, perhaps, be the remains of colour-lines, as they do not seem to affect the level of the surface.

Affinities.—It seems to be somewhat similar to a fossil described by Holzapfel as *Pterinea*, n. sp.,[1] which differs in being much smaller, longer, and more coarsely ornamented, and in not showing any defined wings. As, however, Holzapfel's figure is very small, it is possible that these differences may be accidents of the drawing, but, if they are correct, his shell ought, I think, rather to be referred to the genus *Posidonomya*.

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[3] 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. ix, pt. 5, p. 124, pl. xii, figs. 5, 6.

[4] Ibid., p. 187, pl. xxx.

respects their resemblance is so close that I think it may be safely referred to that genus.

III. Sub-order.—MONOMYARIA, *Lamarck*, 1809.

I. *Family.*—Pectinidæ, *Fleming*, 1828.

1. *Genus* or *Sub-genus.*—Pterinopecten, *Hall*, 1883.

This is a section of the Aviculopectens, with a long hinge-line and large undefined and subequal wings. I have retained the name as marking a prevalent group, for which it is a good designation. As pointed out below, however, it would have been better (if it were not for the confusion it would cause) to have limited the name *Aviculopecten* to the present group, and to have found a new designation for the shells to which Hall has restricted that name.

These shells occur in the Devonian and Carboniferous Rocks.

1. Pterinopecten gracilinus, *Whidborne*, sp. Pl. IX, fig. 10; and Pl. X, figs. 2, 2 *a*, 3, 3 *a*.

1889. Aviculopecten gracilinus, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 79.

Description.—Left valve of moderate size, flat, sub-circular, slightly inequilateral. Umbo minute, low, proximate, not elevated above the hinge-line, slightly anterior, undefined. Hinge-line almost or quite as long as the shell, straight. Anterior wing small, flat, narrow, acutely triangular, with a sigmoid anterior margin; and defined by a concave line running from the front of the umbo. Hind wing confluent with the rest of the shell. Anterior margin very broad, with a small deep notch at the base of the wing, and then obliquely convex, forming a continuous curve with the inferior and posterior margins, till, in the upper part, the posterior margin becomes slightly concave. Contour of surface slightly convex in the central part, and sloping flatly to the margins on every side, except the supero-anterior, where a sudden depression divides it from the wing. Surface covered by about sixty prominent, rounded, radiating ribs, only about fifteen of which are seen on the umbo itself, and the others start at different points, sometimes near the umbo, and sometimes only close to the margin; the whole crossed by much more numerous, very fine, flat, close, microscopic threads, and occasional low irregularities or bulges. Front wing with only one or two indistinct ribs. Shell-structure papyraceous. Right valve unknown.

Size.—Length 30 mm., breadth 27 mm., depth of one valve 4 mm.

Localities.—From Wolborough there is a single fine specimen in Mr. Lee's Collection, another in Mr. Vicary's Collection, and two more in my Collection. From Lummaton there is a specimen in my Collection.

Remarks.—This is a peculiarly beautiful shell. It is distinguished by its flatness, by its well-defined narrow and almost smooth front ear, by its close rounded ribs, which arise in all parts of the shell, often very near the margins, and by its very regular and close transverse threads or beading.

Affinities.—*Pecten papyraceus*, Sowerby,[1] is evidently a proximate form. It is, however, distinguished by its much broader and more convex front wing, by its ornamentation, especially on the wing, and apparently by its greater convexity when it retains its natural shape.

According to the original figure, *Pecten granosus*, Sowerby,[2] from the Black Limestone of Queen's County, seems to come still closer, and the anterior ear seems similar in shape and in ornament. It is described as "having about thirty granulated very regular rays, and as many nearly smooth ones alternating between them." From this figure and description it might, perhaps, be supposed to be identical, but Irish specimens in the Museum of Practical Geology at once prove it to be quite distinct. Its rays are fewer and coarser, and the cross-striæ are very distant and coarsely granulate the ribs. Their front ears also seem to be diverse in character.

Avicula Neptuni, Goldfuss,[3] has a much broader and differently ornamented front wing.

Avicula papyracea, Sowerby, sp., as given by Goldfuss,[4] seems chiefly to differ in having the anterior ear shorter, broader, and strongly rayed, and in being more transverse.

I formerly thought that my specimen from Wolborough was distinct from the others, and corresponded with *Aviculopecten consolans*, Barr.[5] Further examination proves this not to be the case. The apparent differences are evidently due to the defectiveness and the crushing of the fossil, while *A. consolans*, though similar to that shell, is easily distinguishable from the other English specimens. It is a much longer form; its front wing differs very much in shape, and bears numerous ribs; its umbo is less central, and its depth is greater.

[1] 1822, Sowerby, 'Min. Conch.,' vol. iv, p. 75, pl. cccliv.

[2] 1827, ibid., vol. vi, p. 144, pl. dlxxiv, fig. 2.

[3] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 125, pl. cxvi, figs. 4 *a*, *b*.

[4] Ibid., p. 126, pl. cxvi, figs. 5 *a*, *b*.

[5] 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. ccxxii, figs. 2, 1–14, Ét. F.

Under the designation *Pterinea*, sp., Kayser[1] figures the hinder part of a right valve of a species which may, perhaps, be kindred to the present, but his figure is insufficient for specific identification. It seems to differ in having much wider interspaces and narrower ribs, and in not having a minor series coming in between the major ribs.

Monotis Hercynica, Beushausen,[2] differs in the shape of its anterior ear, in its ribs being coarser, and its umbo more prominent.

Pterinopecten crenicostatus, Hall,[3] and *Pterinopecten suborbicularis*, Hall,[4] are American forms that come so near as to be local representatives or possibly even local varieties of the present species. The first is distinguished by its fewer, coarser, and more distant ribs, the second by its much less defined anterior ear.

2. Pterinopecten Cybele, *Barrande*, sp. Pl. VIII, fig. 9, 9 *a*, 10, 10 *a*; Pl. IX, fig. 1.

1881. Aviculopecten Cybele, *Barrande.* Syst. Sil. Bohême, vol. vi, pl. ccxxviii, figs. 2, 1–10, Ét. E.
1889. — — *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 78.

Description.—Left valve of moderate size, obliquely ovoid, not transverse; length and breadth nearly equal. Umbo small, low, direct, rather flattened, proximate, extending slightly above the hinge-line, and situated some distance in front of the middle line of the shell. Hinge-line long, straight, equal to the greatest length of the shell. Anterior wing diffuse, broad, rather large; convex above and then concave as it passes insensibly into the median part of the shell. Posterior wing broad, triangular, flat. Anterior margin oblique, being nearly erect and slightly concave below the hinge-line, the margin being then continued in a slightly convex curve over the rest of the anterior and inferior rim until the infero-posterior corner, round which the curvature increases. Posterior margin sigmoid, being slightly convex and oblique below and concave above. Contour of surface gently and evenly convex in the central parts, concave at the junction of the wings. Surface covered with about seventy or eighty smooth, rounded, distant ribs, sometimes alternating and mostly extending nearly to the umbo, separated by flat interspaces wider than the ribs; the whole crossed by minute threads and by ten or twelve well-marked and rather regular concentric undula-

[1] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 133, pl. xix, fig. 1.
[2] 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 2, p. 61, pl. ii, fig. 4.
[3] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 78, pl. viii, figs. 3, 4; and pl. lxxxii, fig. 14.
[4] Ibid., p. 80, pl. viii, figs. 1, 2; pl. xxiv, fig. 10; and pl. lxxxii, fig. 6.

tions, which sometimes break the course of the ribs, or even obliterate them. Shell-structure apparently thin.

Size of left valve.—Length about 38 mm., breadth about 35 mm., depth about 6 mm.

Localities.—There are two specimens from Lummaton in my Collection, and one from Wolborough in Mr. Vicary's Collection.

Remarks.—Our specimens of this shell are defective. The front part only is shown in two and the rear part in the third. Nevertheless, they mutually present so close a resemblance to *Aviculopecten Cybele*, Barrande, that I have little hesitation in identifying them with that species. They are to be distinguished by their squarish shape, their sub-central umbo, their numerous regular, concentric bulges, their numerous smooth rays, of which a few seem slightly larger than the rest, and their diffuse anterior ear. The shape of the latter is especially characteristic; it is only marked by a slight concavity of the margin, and by a gentle convexity of the surface succeeded by a concavity.

In Mr. Vicary's specimen the rays are worn off from most of the concave slopes of the bulges, which thus assume the appearance of smooth transverse bands. The same seems to have occurred in Bohemian specimens.

It is not clear from Barrande's figures whether the rays are close or distant.

The shell seems to have reached a considerably larger size in England than in Bohemia.

Affinities.—*Aviculopecten Jugleri*, F. A. Römer,[1] has very much smaller wings.

Pterinopecten Neptuni, Goldfuss, sp.,[2] is less oblique and has coarser ribs. It seems otherwise very closely related.

3. Pterinopecten consolans, *Barrande*, Pl. IX, fig. 11.

1881. Aviculopecten consolans, *Barrande.* Syst. Sil. Bohêm., vol. vi, pl. ccxxii, figs. 2, 1–14, Ét. F.

? 1884. Pterinopecten Vertumnus, *Hall.* Pal. N. Y., vol. v, pt. 1, p. 71, pl. v, figs. 1—8; and pl. lxxxiii, figs. 2, 3.

1889. Aviculopecten consolans, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 78.

1891. — — *Frech.* Abhandl. Geol. Specialk. Preuss., Band ix, pt. 3, p. 26, pl. ii, fig. 6.

Description.—Left valve of moderate size, convex, transverse, slightly oblique. Umbo small, not prominent, situated at about the anterior third of the length.

[1] 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 21, pl. vi, fig. 4; and 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 18, pl. xvii, fig. 2.

[2] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 125, pl. cxvi, fig. 4; and 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 18, pl. ii, figs. 1, 2.

Hind wing apparently narrow, flat, ill-defined. Lower margin moderately convex. Contour of surface gently convex on back, steeper in front, and concave near the hind wing. Surface ornamented by between forty and fifty bold, rounded, alternating rays, separated by similar furrows; about ten of the major series of rays being much larger than the rest, and the rays upon the hind wing becoming smaller, closer, and more equal; the whole crossed by a series of broad, low, rounded, regular, transverse undulations, in number about twelve.

Size of left valve.—Length about 35 mm., width 25 mm., depth 7 mm.

Locality.—A single specimen from Lummaton is in my Collection.

Remarks.—Unfortunately the hinge-line, wings, and margins of this interesting fossil are so defective and obscured that a complete description is impossible, and an identification difficult. Its shape and ornamentation distinctly separate it from its English comrades.

There seems no reason to doubt that it belongs to the group of shells of which *Aviculopecten consolans*, Barrande, *Pterinopecten Vertumnus*, *lætus*, and *intermedius*, Hall, and *Aviculopecten Wulfi*, Frech, are members. When, however, we proceed to the question of specific identity, the subject becomes more difficult. I am inclined to think after comparing it with the various figures of *A. consolans* given by Barrande that it falls within the limits of that species. On the other hand, it corresponds minutely in all the points which it actually shows with one of Hall's figures of *P. Vertumnus*. This American species chiefly differs from the Bohemian shell by having a rather smaller hind wing and more oblique anterior and posterior margins, and in these points the indications in our fossil rather point to the latter, though the small equal ribs of its hind wing agree better with the former. The solution may be that the two foreign shells are really local varieties of the one species, and that the English fossil is a link between them.

Affinities.—*Pterinopecten lætus*, Hall,[1] has finer and more equal ribs.

In *P. intermedius*, Hall,[2] the ribs are much smaller and more distant.

In *A. multiplicans*, Barrande,[3] the ribs form complex groups.

In *A. Wulfi*, Frech,[4] the umbo is more central, the shape broader, and the ribs rounder, closer, and more even.

Pterinopecten gracilinus has finer ribs and is flatter and less transverse in shape than the present specimen. It differs widely from *Pt. consolans* in other particulars.

[1] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 63, pl. i, fig. 13.

[2] Ibid., p. 68, pl. xvii, fig. 19; and pl. lxxxiii, figs. 4, 5.

[3] 1881, Barrande, 'Syst. Sil. Bohêm.,' vol. vi, pl. ccxxi, figs. 3, $_{1-6}$, Ét. F.

[4] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 26, fig. 1; and pl. ii, fig. 7.

2. *Genus.*—Aviculopecten, *M'Coy.*

This genus is thus defined by Woodward :—" Shell inequivalve, sub-orbicular, eared; hinge-areas flat, with several long cartilage-furrows, slightly oblique on each side of the umbones; right valve with a deep and narrow byssal sinus beneath the anterior ear; adductor-impression large, simple, sub-central; pedal scar small and deep, beneath the umbo." There appears some difference of opinion whether it should be classed with the *Pectinidæ* or the *Aviculidæ;* for instance, Hall, Zittel, Fischer place it with the former; S. P. Woodward and Frech with the latter. Tate, in his Appendix to Woodward's 'Manual of the Mollusca,' transposes it from the latter to the former family, remarking that it "does not possess the prismatic of the *Aviculidæ*, but the peculiar corrugated tubular structure of the *Pectinidæ* (Meek). It bears the same relations to existing Pectens as *Pterinea* does to existing Aviculas."

Hall restricts the genus "to those forms which have the hinge-line usually shorter than the transverse diameter, and both ears well-defined. Test ornamented with rays." This division seems unfortunate, as it excludes the type species of the genus, *Pecten granosus*, Sowerby, which comes closer to Hall's new genus *Pterinopecten*. As, however, the latter is probably, as pointed out by Frech, only to be regarded as a section or sub-genus of *Aviculopecten*, useful for the convenient grouping of kindred shapes, rather than for marking any decided physiological differences, it may cause less confusion simply to point out the accident.

Aviculopecten occurs from the Lower Silurian to the Permian.

1. Aviculopecten aviformis, *Whidborne.* Pl. X, figs. 7—11.

1889. Aviculopecten aviformis, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 79.

Description.—Right valve of moderate size, very flat, more or less transverse, oblique, inequilateral. Umbo minute, low, sharp, proximate, not elevated above the hinge-margins, situated rather in front of the centre of the hinge-line, or about one-third from the anterior extremity of the shell, and bounded on each side by sharp concavities, which define the wings. Anterior wing very small, acutely triangular, with sigmoid margin, flat, and well-defined. Posterior wing slightly larger, acutely triangular, with concave margin, flat, and well defined. Anterior margin rather broad, deeply convex. Inferior margin oblique, long, moderately convex. Posterior margin straight and very oblique in the part immediately below the wing, and much produced and rapidly convex in the lower part. Contour of surface slightly convex in the central region, and flattening out to the margin. Surface marked by about sixty low, fine, very distant, sharpish, alternating ribs, separated by broad, flat interspaces, of which a few are generally visible on the umbo, but most start at different points lower down on the back of the shell; the whole crossed by occasional, low, concentric bulges or inequalities, and by very indistinct, close, fine, concentric striæ. Wings similarly, but more finely, marked. Shell-structure papyraceous. Left valve unknown.

Size.—Length 26 mm., breadth 23 mm., depth of left valve about 3 mm.

Localities.—From Wolborough there are three specimens in Mr. Vicary's Collection, and three in the Museum of Practical Geology. From Lummaton there are two specimens in my Collection; three specimens in the Torquay Museum probably came from the same locality or from Barton.

Remarks.—While presenting the same general characters, the specimens above enumerated show considerable variation in detail, and, unfortunately, they are not sufficiently perfect to be easily compared. Thus they seem to vary considerably in length and obliquity, in the smoothness of the shell about the umbo, and in the distinctness of the transverse striæ. I have, however, been unable to find anything like specific differences in them, and in this view I had the support of my friend the late Mr. Tom Roberts when we examined them together. The species must therefore be regarded as somewhat variable.

Affinities.—I have met with no described shell hitherto with which they could be classed.

3. *Genus.*—Lyriopecten, *Hall*, 1883.

This genus or sub-genus contains Aviculopectens, which have short hinge-lines and small ears, and which are sub-circular in shape.

Frech has substituted the name *Orbipecten* because Hall had originally used for them the name *Lyropecten*, which had been preoccupied by Conrad for a different genus of more recent shells. As, however, Hall has himself changed his name to *Lyriopecten* there seems no logical reason for any further alteration.

The group or genus appears to have been confined to the Devonian period.

1. Lyriopecten fibratus, n. sp. Pl. VI, figs. 1, 1 *a*, 1 *b*.

Description.—Left valve large, flat, wider than long, equilateral, sub-circular. Umbo minute, direct, sharp, low, proximate, not elevated above the hinge-line, and situated slightly in front of its central point. Hinge-line straight, long, probably about two-thirds the length of the shell. Front wing rather large, triangular, flat, well defined. Posterior wing large, undefined. Anterior margin very broad, sigmoid, being concave on the wing and then advancing and becoming regularly convex over its greatest portion. Inferior margin apparently moderately convex. Posterior margin apparently moderately convex below, and becoming slightly concave near the hinge-margin. Contour of surface slightly convex in the central parts, divided from the front wing by a straight, perpendicular declivity from the umbo, and becoming slightly concave longitudinally in the postero-superior margin, so as to form the hind wing. Surface marked by multitudinous, fine, alternating and rather irregularly placed, narrow, elevated rays, divided by broader concave interspaces, and crossed by equally numerous, very fine, distant threads, so as to divide the surface into hollow tesseræ. Shell-structure papyraceous. Right valve unknown.

Size.—Length 44 mm., width 45 mm., depth of one valve 7 mm.

Locality.—There is a single specimen in Mr. Champernowne's Collection from Lummaton.

Remarks.—This is a very beautiful and distinct species. Mr. Champernowne's fine fossil is unfortunately much injured round the margin, so that the shape can only be made out approximately by tracing the lines of growth; the surface, moreover, is slightly decayed, so that the fine reticulations can only be observed in occasional patches.

The shell is widely distinct from any that accompany it, and may easily be distinguished by its broad wings, by the central position and small obliquity of its umbo, and by the very great fineness of its ornamentation.

Affinities.—Phillips's figure[1] of *Pecten transversus*, Sowerby,[2] presents some similarity. Specimens of that shell, however, in Mr. Townsend Hall's Collection and in the Museum of Practical Geology show that it is very different. For instance, its ornament is coarser, and consists of sharp triangular ridges grouped in sets of three, the central of which is the largest. Sowerby's original description bears out its distinctness; while *Pterinea radiata*, Goldfuss,[3] with which Mr. Phillips identifies the North-Devon shell, is still further removed from ours, having very much fewer and more rounded ribs.

Pecten lineatus, Goldfuss,[4] is more oblique, and has still more numerous and closer ribs. That shell seems very kindred to *P. granulosus*, Phillips.[5]

Orbipecten Follmanni, Frech,[6] approaches it most nearly, but is distinguished by a less defined front wing, and the absence of the prominent transverse threads.

[1] 1841, Phillips, 'Pal. Foss.,' p. 46, pl. xxi, figs. 7, 7 *a*, *b*.

[2] 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liii, fig. 3.

[3] 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 128, pl. cxix, figs. 7 *a*, *b*.

[4] Ibid., p. 78, pl. cxiv, fig. 9.

[5] 1841, Phillips, 'Pal. Foss.,' p. 46, pl. xxi, figs. 75 *a*—*c*.

[6] 1891, Frech, 'Abhandl. Geol. Specialk. Preuss.,' Band ix, pt. 3, p. 29, pl. ii, figs. 8—9 *a*.

Pterinea, sp., Kayser,[1] is more inequilateral and still less transverse.

In *Lyriopecten orbicularis*, Hall,[2] the ribs are coarser, and the front wing is undefined.

Avicula simplicicosta, Trenkner,[3] seems to have a smaller front wing and close rounded rays divided by linear furrows.

Aviculopecten cœlatus, M'Coy,[4] which is a kindred Carboniferous form, is much more coarsely ribbed.

4. *Genus.*—Crenipecten, *Hall*, 1883.

Hall defines this genus as having "the form of *Aviculopecten*, but with a hinge furnished with a series of small cartilage-pits throughout its entire length." This distinctive hinge is not visible in any of our English examples, but they so nearly correspond with the shells placed by Hall in this group that they may presumptively be located within it.

1. Crenipecten ? comma, *Whidborne*, sp. Pl. X, figs. 4, 4 *a*, 5, 5 *a*.

1889. Aviculopecten comma, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 79.

Description.—Left valve small, flattish, triangular, equilateral, oblique. Umbo small, sharp, central, direct, proximate, slightly elevated. Hinge-margin short, straight. Front wing unseen. Hind wing small, short, flat, broad, triangular. Sides of the umbo defined by two nearly straight steep declivities, forming the boundaries of the shell apart from the wings, of which the front is about one-third, and the rear about two-thirds the total breadth of the shell. Front margin rather narrow, slightly concave as far as the end of the declivity, and then becoming convex. Inferior margin obliquely convex. Posterior margin oblique, straight for the greatest part of its width, and then produced and convex in the inferior region. Contour of valve-surface gently convex, almost perpendicular at the sides, and spreading out flatly to the ventral margins. Surface covered with about thirty low, rounded, alternating ribs, separated by much wider, flat interspaces; some of the ribs reaching almost to the umbo, but others being much smaller and starting much lower down; the whole crossed by numerous, very fine, linear, distant threads, which thus reticulate the surface.

Size.—Length 9 mm., width 9 mm., depth of one valve 1 mm.

[1] 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 135, pl. xix, fig. 5.

[2] 1884, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 42, pl. iv, figs. 3—8; and pl. lxxxii, fig. 3.

[3] 1868, Trenkner, 'Paläont. Novitat.,' pt. 2, p. 23, pl. vii, fig. 4.

[4] 1855, M'Coy, 'Brit. Pal. Foss.,' p. 483, pl. iii, figs. 5, 5 *a*.

PLATE VI.

Lyriopecten fibratus, n. sp. (Page 86.)

Fig.

1. Left valve of a large specimen, defective round the edges; 1 *a*, superior view; 1 *b*, portion of surface enlarged. Lummaton. Champernowne Collection.

Actinopteria ? Robertsii, n. sp. (Page 60.)

2. Left valve, defective in front; 2 *a*, portion of surface enlarged. Lummaton. My Collection.
3. Another specimen showing the anterior wing; 3 *a*, front view. Lummaton. My Collection.
4. Another specimen showing the anterior wing, defective behind. Lummaton. Woodwardian Museum.

Actinopteria hirundella, *Whidborne*, sp. (Page 61.)

5. Left valve, defective above and in front (the hinge-margin being destroyed the amount of obliquity cannot be ascertained, but it is probably greater than appears from the figure); 5 *a*, portion of surface enlarged. Wolborough. Museum of Practical Geology.
6. Another specimen; 6 *a*, portion of surface enlarged. Lummaton. Lee Collection, British Museum.

Actinopteria musicata, n. sp. (Page 63.)

7. Portion of a left valve; 7 *a*, 7 *b*, portions of surface enlarged. Wolborough. Vicary Collection.

Actinopteria dilatata, *Whidborne*, sp. (Page 64.)

8. Portion of a very large shell; 8 *c*, portion of surface enlarged. Wolborough. Vicary Collection.

9, 10. Two worn specimens from one slab; 9 *a*, portion of surface enlarged. Lummaton. My Collection.

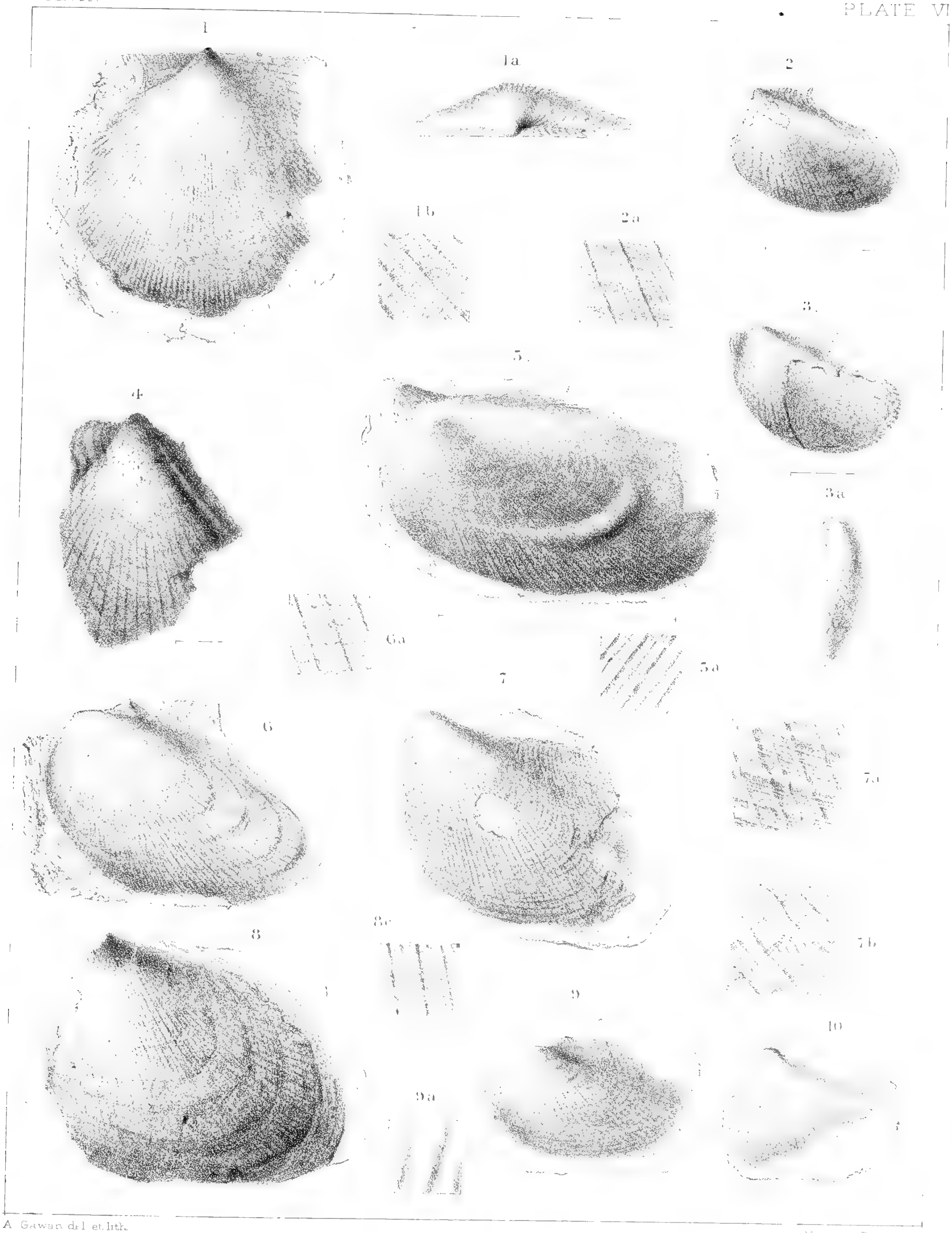

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PLATE VII.

ACTINOPTERIA DILATATA, *Whidborne*, sp. (Page 64.)

FIG.

1. Left valve of a very transverse specimen, imperfectly showing the front wing; 1 *a*, portion of surface enlarged. Lummaton. My Collection.
2. Left valve of a large specimen; 2 *a*, portion of surface enlarged. Wolborough. Vicary Collection.
3. Left valve of another specimen. Lummaton. My Collection.

ACTINOPTERIA HIRUNDELLA, *Whidborne*, sp. (Page 61.)

4. Right valve of a large specimen wanting the greatest part of the wings; 4 *a*, portion of the posterior wing enlarged; 4 *b*, portion of the central part of the surface enlarged. Lummaton. My Collection.

ACTINOPTERIA PLACIDA, *Whidborne*, sp. (Page 67.)

5. Right valve, showing the front wing and the coarse ribs on the hind wing; 5 *a*, portion of the surface enlarged. Lummaton. My Collection.
6. Worn specimen of the closed valves; 6 *a*, superior view. Lummaton (?). Torquay Museum.
7. Left valve of a flat specimen. 7 *a*, portion of surface enlarged. Lummaton (?). Torquay Museum.
8. Left valve of a more oblique specimen. Lummaton (?). Torquay Museum.
9. Left valve of another flattish specimen. Lummaton. My Collection.
10. Left valve of a very well preserved specimen with coarse ribs; 10 *a*, portion of surface enlarged. Lummaton. My Collection.
11. Left valve of a coarsely-ribbed specimen, probably wanting the lower and posterior margins; 11 *a*, portion of surface enlarged. Lummaton. My Collection.

ACTINOPTERIA JUSTI, *Frech*, sp. (Page 70.)

12. Left valve of a rather oblique specimen; 12 *a*, portion of surface enlarged. Lummaton. My Collection.

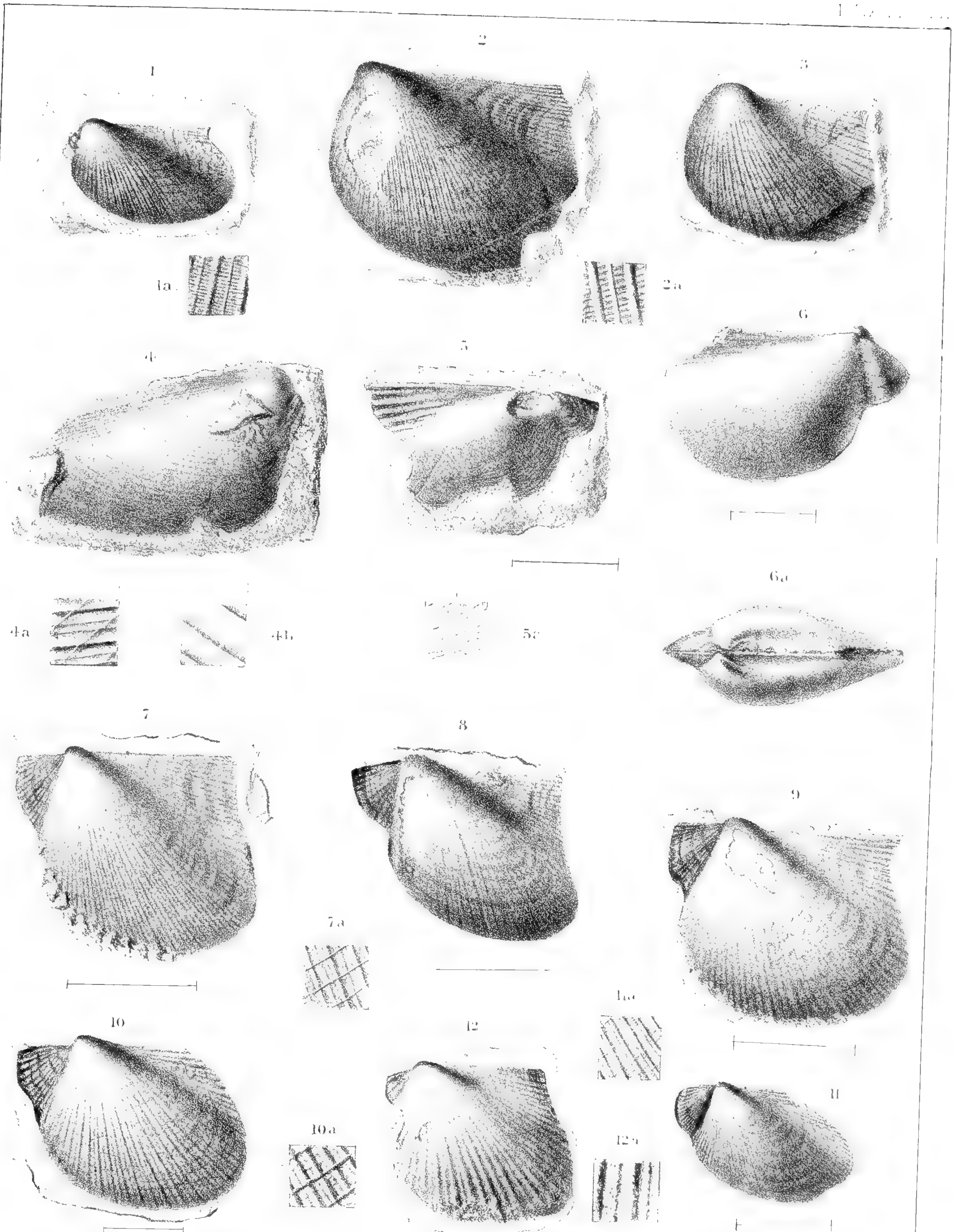

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PLATE VIII.

ACTINOPTERIA JUSTI, *Frech*, sp. (Page 70.)

FIG.

1. Left valve wanting the external shell. Wolborough. Vicary Collection.

ACTINOPTERIA WURMII, *F. A. Römer*, sp. (Page 71.)

2. Left valve of a coarse-ribbed specimen. Lummaton. My Collection.
3. Left valve of a fine-ribbed and well-preserved, but very defective specimen. Lummaton. My Collection.
5. Left valve of a specimen partly hidden by the matrix. Lummaton. My Collection.

ACTINOPTERIA RUDIS, *Phillips*, sp. (Page 73.)

4. Left valve of a small specimen, showing the long anterior wing. Lummaton. My Collection.
6. Left valve of a larger specimen, defective in front; 6 *a*, portion of surface enlarged. Lummaton. My Collection.

ACTINOPTERIA PLACIDA, *Whidborne*, sp. (Page 67.)

7. Left valve of a specimen set obliquely in the matrix and injured behind; 7 *a*, portion of the worn surface enlarged. Lummaton. My Collection.

ACTINOPTERIA DILATATA, *Whidborne*, sp. (Page 64.)

8. Right valve of a very large, but much injured, specimen; 8 *a*, portion of posterior wing enlarged. Wolborough. Vicary Collection.

PTERINOPECTEN CYBELE, *Barrande*, sp. (Page 82.)

9. Left valve of a well-preserved specimen, wanting the umbo; 9 *a*, portion of surface enlarged. Lummaton. My Collection.
10. Left valve of a smaller specimen showing the front wing; 10 *a*, portion of surface enlarged. Lummaton. My Collection.

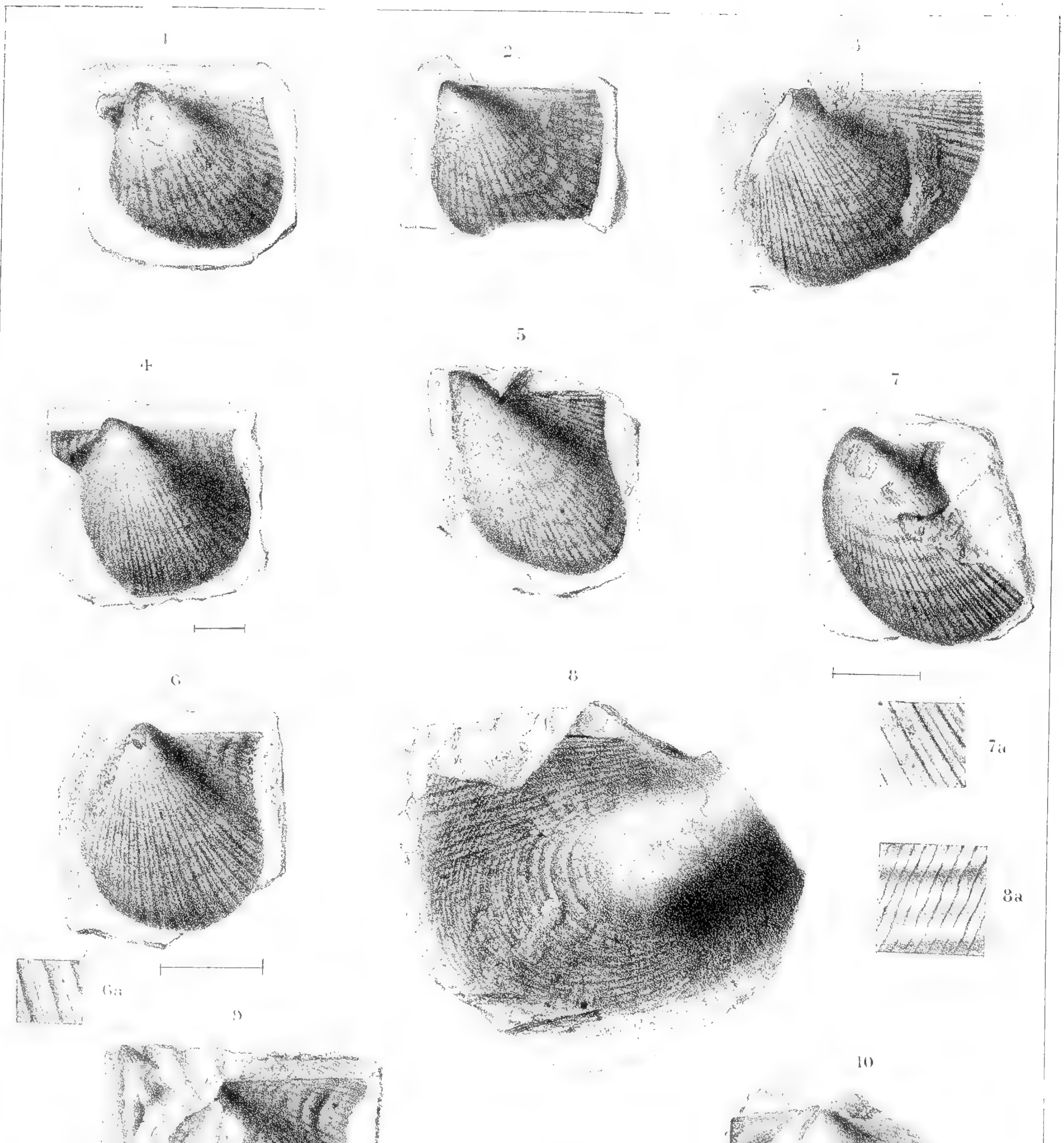
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PLATE IX.

Pterinopecten Cybele, *Barrande*, sp. (Page 82.)

Fig.

1. Left valve, defective behind, showing the discontinuous character of the ribs. Wolborough. Vicary Collection.

Actinoperia texturata, *Phillips*, sp. (Page 74.)

2. Left valve, somewhat worn on the back. 2 *a*, portion of surface enlarged. Lummaton. Torquay Museum.
3. Left valve of a well-preserved and perfect specimen. 3 *a*. Portion of surface enlarged. Barton. Torquay Museum.
5. Left valve with well-preserved surface, but much hidden by matrix. Wolborough (?). Torquay Museum.
6. Left valve of a large specimen, defective behind. Wolborough. Museum of Practical Geology.
7. Left valve of another large specimen; 7 *a*, portion of surface enlarged Wolborough. Vicary Collection.

Actinopteria texturata, *Phillips*, var. subfenestrata, nov. (Page 76.)

4. Left valve showing the very coarse ornamentation. (A fragment of a Brachiopod is on the same slab.) Lummaton (?). Torquay Museum.

Actinopteria crenatissima, *Whidborne*, sp. (Page 77.)

8. Left valve of a very convex specimen; 8 *a*, portion of surface enlarged showing the very minute ribs. Wolborough. Vicary Collection.
9. Left valve of a very large and flattish specimen; 9 *a*, portion of surface enlarged. Lummaton. My Collection.

Pterinopecten gracilinus, *Whidborne*, sp. (Page 80.)

10. Left valve, defective on the front wing and margins. Wolborough. My Collection.

Pterinopecten consolans, *Barrande, sp*. (Page 83.)

11. Left valve, much injured, but showing the coarse rounded ribs. Lummaton. My Collection.

Conocardium Marsi, *Œhlert* (?). (Page 23.)

12. Small specimen partially embedded in matrix; 12 *a*, anterior view; 12 *b*, portion of surface enlarged. Lummaton (?). Torquay Museum.

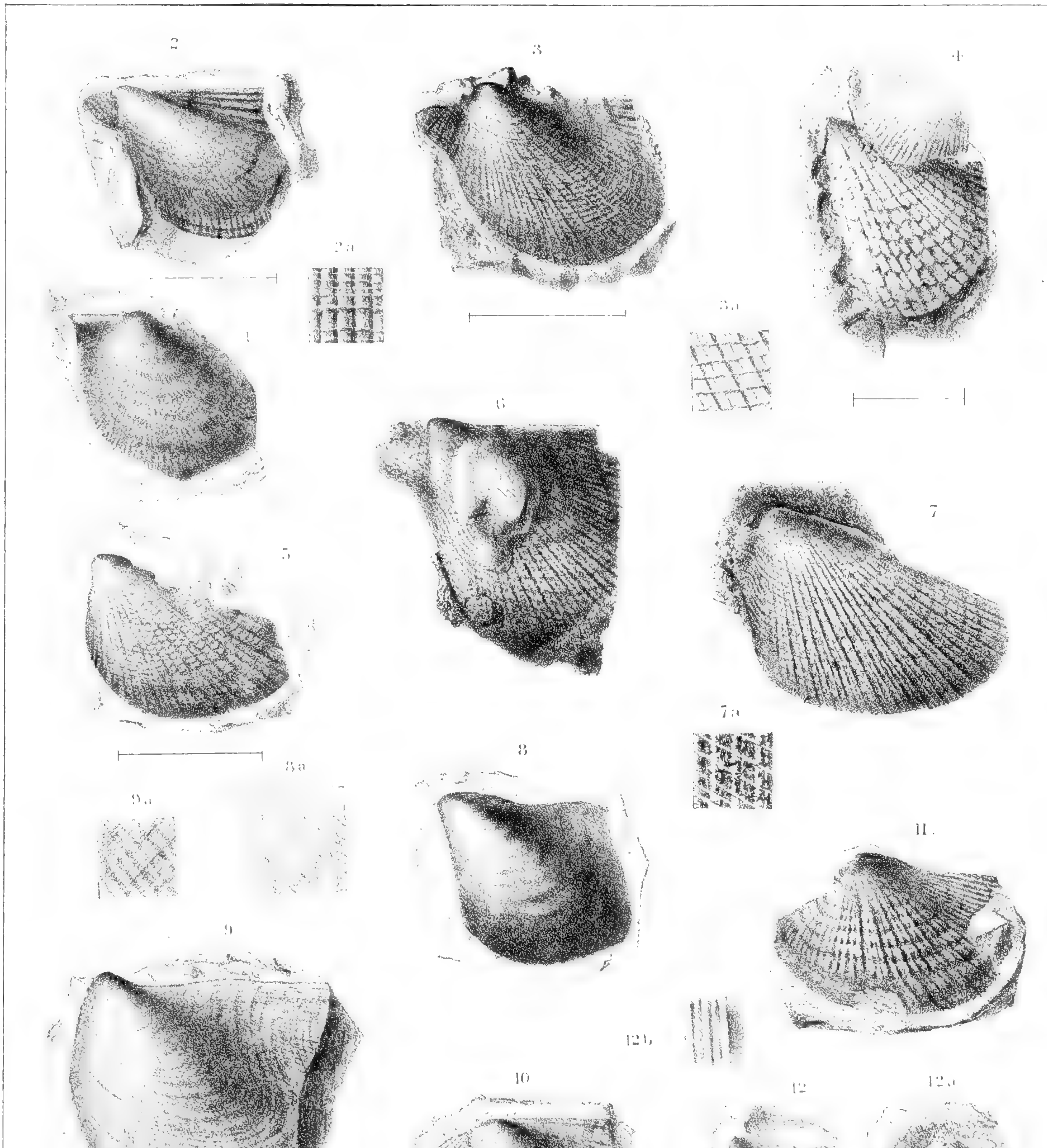
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PLATE X.

LEIOPTERIA LINGULATA, n. sp. (Page 78.)

FIG.

1. Left valve, somewhat defective about the wings. Wolborough. British Museum.

PTERINOPECTEN GRACILINUS, *Whidborne*, sp. (Page 80.)

2. Large and nearly perfect specimen of the left valve showing the alternating ribs; 2 *a*, portion of surface enlarged. Wolborough. Lee Collection.
3. Still larger left valve, somewhat obscure round the margins; 3 *a*, portion of surface enlarged. Wolborough. Vicary Collection.

CRENIPECTEN ? COMMA, *Whidborne*, sp. (Page 88.)

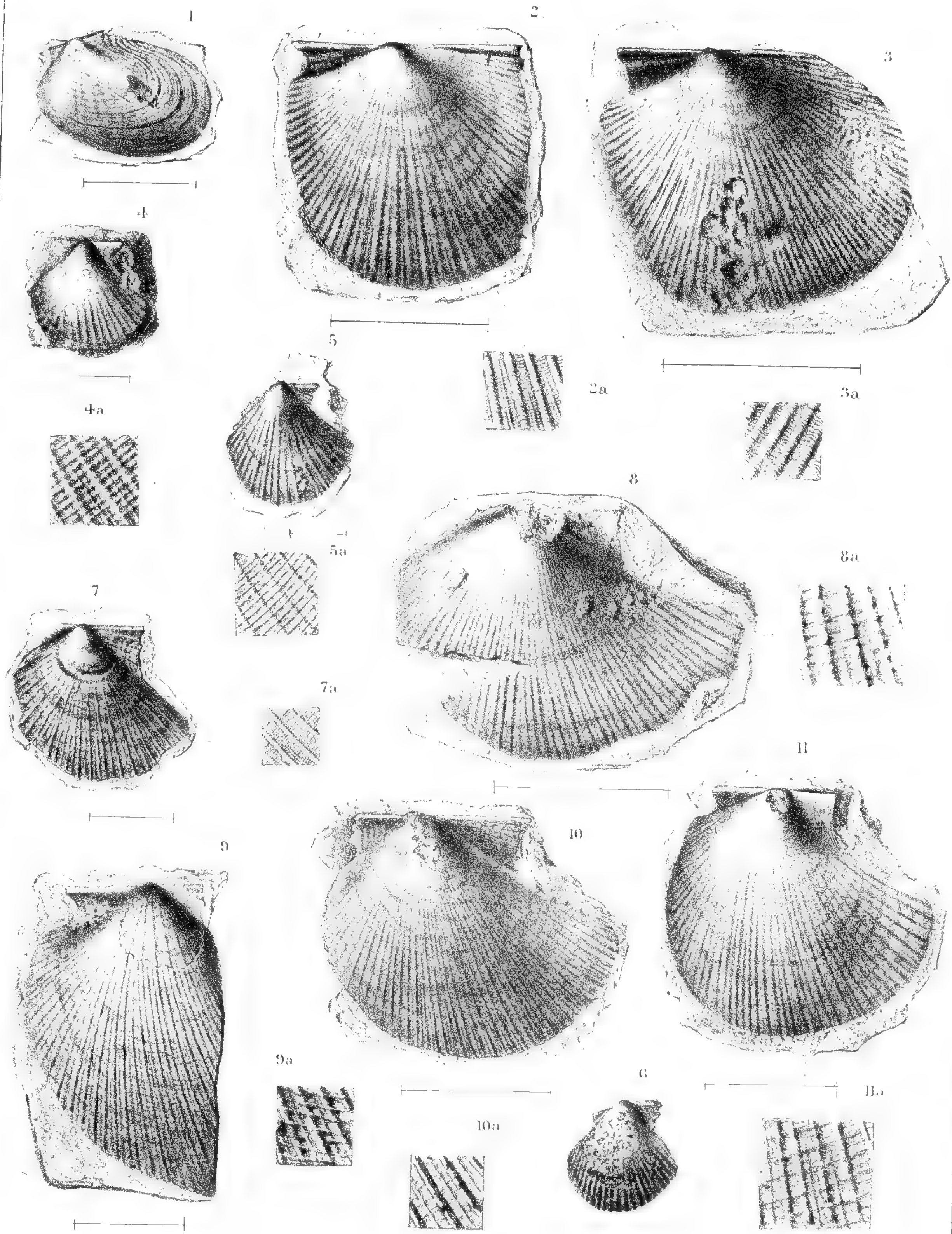
4. Left valve, showing hind wing; 4 *a*, portion of surface enlarged. Lummaton. My Collection.
5. Another specimen, defective in front, but apparently rather more produced in the antero-superior part; 5 *a*, portion of surface enlarged. Lummaton. My Collection.

CRENIPECTEN ? OCEANI, *Goldfuss*, sp. (Page 89.)

6. Specimen figured by Phillips as *Pecten plicatus*, Sowerby. Wolborough. Museum of Practical Geology.

AVICULOPECTEN AVIFORMIS, *Whidborne.* (Page 85.)

7. Specimen of the umbonal half of a left valve showing the character of the radiations; 7 *a*, portion of surface enlarged. Lummaton. My Collection.
8. A large and very transverse specimen; 8 *a*, portion of surface enlarged. Lummaton. My Collection.
9. Another specimen defective behind; 9 *a*, portion of surface enlarged. Wolborough. Vicary Collection.
10. Another transverse specimen; 10 *a*, portion of surface enlarged. Lummaton (?). Torquay Museum.
11. A much less transverse specimen; 11 *a*, portion of surface enlarged. Wolborough. Vicary Collection.



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