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ISSUED FOR 1888.

MARCH, 1889.

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AND

I. A CATALOGUE OF THE WORKS ALREADY PUBLISHED;

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

III. THE DATES OF ISSUE OF THE ANNUAL VOLUMES;

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

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

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§ I. CATALOGUE OF WORKS

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

* 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.

CATALOGUE OF WORKS—Continued.

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

* This Vol. is marked on the outside 1856.

CATALOGUE OF WORKS—Continued.

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

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope. The previous Volumes are not in separate parts.

CATALOGUE OF WORKS—Continued.

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

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

CATALOGUE OF WORKS—Continued.

Vol. XXXV*	Issued for the Year 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, Cretaceous, Vol. I, Part X (*Conclusion*), by Dr. Wright, 5 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part V (*Conclusion*), by Dr. Davidson. Supplement to the Fossil Brachiopoda, Vol. V, Part I (Devonian and Silurian), by Dr. Davidson, 7 plates. The Lias Ammonites, Part V, by Dr. Wright, 22 plates.
„ XXXVII*	„ 1883	The Eocene Flora, Vol. II, Part I, by Mr. J. S. Gardner, 9 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part V (*Conclusion*), by the late Mr. J. W. Salter. The Carboniferous Trilobites, Part I, by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part II (Silurian), by Dr. Davidson, 10 plates. The Fossil Trigoniæ (Supplement No. 2), by the late Dr. Lycett, 4 plates. The Lias Ammonites, Part VI, by Dr. Wright, 8 plates.
„ XXXVIII*	„ 1884	The Eocene Flora, Vol. II, Part II, by Mr. J. S. Gardner, 11 plates. The Carboniferous Entomostraca, Part I, No. 2 (*Conclusion*), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady, 2 plates. The Carboniferous Trilobites, Part II, by Dr. H. Woodward, 4 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part III (*Conclusion*), by Dr. Davidson, 4 plates. The Lias Ammonites, Part VII, by Dr. Wright, 10 plates.
„ XXXIX*	„ 1885	The Eocene Flora, Vol. II, Part III (*Conclusion*), by Mr. J. S. Gardner, 7 plates. The Stromatoporoids, Part I, by Prof. Alleyne Nicholson, 11 plates. The Fossil Brachiopoda (Bibliography), Vol. VI (*Conclusion*), by the late Dr. Davidson and Mr. W. H. Dalton. The Lias Ammonites, Part VIII (*Conclusion*), by the late Dr. Wright, 1 plate.
„ XL*	„ 1886	The Morphology and Histology of Stigmaria Ficoides, by Prof. W. C. Williamson, 15 plates. The Fossil Sponges, Part I, by Dr. G. J. Hinde, 8 plates. The Jurassic Gasteropoda, Part I, No. 1, by Mr. W. H. Hudleston. The Inferior Oolite Ammonites, Part I, by Mr. S. S. Buckman, 6 plates. The Pleistocene Mammalia, Part VI, by Prof. Boyd Dawkins, 7 plates.
„ XLI*	„ 1887	The Fossil Sponges, Part II, by Dr. G. J. Hinde, 1 plate. The Palæozoic Phyllopoda, Part I, by Prof. T. R. Jones and Dr. Woodward, 12 plates. The Jurassic Gasteropoda, Part I, No. 2, by Mr. W. H. Hudleston, 6 plates. The Inferior Oolite Ammonites, Part II, by Mr. S. S. Buckman, 8 plates.
„ 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.

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

§ II. LIST OF MONOGRAPHS

Completed, in course of Publication, and in Preparation.

8. 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* 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* 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 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.)

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.)

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* 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 Stromatoporoids, by Prof. H. Alleyne Nicholson.
Supplement to the Fossil Corals, by Dr. Duncan.
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.

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3. MONOGRAPHS which are in course of PREPARATION :—†

The Fossil Cycadeæ, by Mr. W. Carruthers.
The Rhizopoda of the Chalk, Chalk Marl, Gault, and Upper Greensand, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady.
The Foraminifera of the Lias, by Mr. H. B. Brady.
The Carboniferous Entomostraca, Part II (Leperditiadæ), by Messrs. T. Rupert Jones, J. W. Kirkby, and G. S. Brady.
Supplement to the Cretaceous Entomostraca, by Prof. T. Rupert Jones.
The Wealden, Purbeck, and Jurassic Entomostraca, by Messrs. T. R. Jones and G. S. Brady.
The Cretaceous Mollusca (exclusive of the Brachiopoda), by the Rev. Prof. T. Wiltshire.
The Purbeck Mollusca, by Mr. R. Etheridge.
The Rhætic Mollusca, by Mr. R. Etheridge.
The Silurian Fish Bed, by Dr. Harley.

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* Unfinished through the death of the Author, but will be continued by Mr. R. Etheridge.

† 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.

§ 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.

§ IV. Summary of the Monographs issued to the Members (*up to* MARCH, 1889): *showing in the* first *column whether each Monograph hitherto published be* complete, *or in the* course of completion; *in the* second *column, the yearly volumes which contain each particular Monograph (as a guide to binding the same); and in the* fourth *and following columns, the number of pages, plates, figures, and species described in the different Monographs.*

I. Subject of Monograph.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
The Morphology and Histology of Stigmaria ficoides, by Prof. W. C. Williamson, COMPLETE	1886	1887	66	15	91	1
The Eocene Flora, by Mr. J. S. Gardner and Baron Ettingshausen. Vol. I, COMPLETE	1879, 1880, 1882	1879, 1880, 1882	87	13	151	23
,, ,, by Mr. J. S. Gardner. Vol. II, COMPLETE	1883, 1884, 1885	1883, 1884, 1886	159	27	400	31
The Flora of the Carboniferous Strata, by Mr. E. W. Binney, *in course of completion*	1867, 1870, 1871, 1875	1868, 1871, 1872, 1875	147	24	141	16
The Fossil Sponges, by Dr. G. J. Hinde, *in course of completion*	1886, 1887	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, *in course of completion*	1885, 1888	1886, 1889	161	19	269	16
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 Fossil Corals, by Prof. Duncan, *in course of completion*	1865, 1866, 1867, 1868, 1869, 1872	1866, 1867, 1868, 1869, 1870, 1872	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
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
,, ,, ,, (Supplement), COMPLETE	1888	1889	55	3	134	48
The Cretaceous Entomostraca, by Prof. Rupert Jones, COMPLETE	1849	1850	41	7	176	27
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*
The Palæozoic Phyllopoda, by Prof. Rupert Jones and Dr. H. Woodward, *in course of completion*	1887	1888	72	12	121	39
		Carried forward...	4077	521	8719	1653

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* MARCH, 1889)—*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...	4077	521	8719	1653
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	1850, 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	1887, 1888, 1889	192	11	377	109
The Inferior Oolite Ammonites, by Mr. S. S. Buckman, *in course of completion*	1886, 1887, 1888	1887, 1888, 1889	144	24	281	31
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
The Belemnites, by Prof. Phillips, *in course of completion*	1863, 1864, 1866, 1868, 1869	1865, 1866, 1867, 1869, 1870	128	36	622	69
		CARRIED FORWARD...	9881	1202	25,842	5111

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* MARCH, 1889)—*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...	9881	1202	25,842	5111
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 of the South of England, by the Rev. G. F. Whidborne, *in course of completion*	1888	1889	48	4	153	22
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	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	12,061	1647	29,702	5575

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—1888) *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	1851, 1854	1849	...	......	......	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	......	......	1888	1860	1865, 1868, 1872, 1878	1862, 1888	
Silurian............	...	1886, 1887	...	1854, 1885	......	......	...	1887	1868, 1871, 1872, 1878	1862, 1863, 1864, 1866	
Cambrian	...	1886, 1887	...	...	......	......	...	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—1888) *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	1850, 1861, 1868, 1869, 1886, 1887, 1888	...	(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	......	......	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.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1888.

LONDON:

MDCCCLXXXIX.

A MONOGRAPH

OF THE

BRITISH STROMATOPOROIDS.

BY

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REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF ABERDEEN.

PART II.—DESCRIPTION OF SPECIES.

Pages 131—158. Plates XII—XIX.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1889.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

Family—ACTINOSTROMIDÆ.

Genus 1.—Actinostroma, *Nicholson*, 1886.

(Introduction, p. 75.)

1. Actinostroma clathratum, *Nich.* Pl. I, figs. 8—13, and Pl. XII, figs. 1—5.

Stromatopora concentrica, *M'Coy* (?). Brit. Pal. Foss., p. 65, 1851.
— — *Bargatzky.* Die Stromatoporen des rheinischen Devons, p. 54, 1881.
— — *Frech.* Zeitschr. der deutsch. geol. Gesell., Jahrg. 1885, p. 116.
Actinostroma clathratum, *Nich.* Monogr. Brit. Strom., General Introduction, p. 76, pl. 1, figs. 8—13, 1886.
— — *Nich.* Ann. Nat. Hist., ser. 5, vol. xvii, p. 226, pl. vi, figs. 1—3, 1886.

Cœnosteum massive, usually spheroidal or globular, but very irregular in form, and sometimes attaining a large size (Plate XII, fig. 1). The base of attachment is small and the under surface is not epithecate, as a general rule. In many cases the process of growth was intermittent, and the skeleton thus comes to consist of more or less conspicuous concentric strata or "latilaminæ." The concentric laminæ are simply curved or are but slightly undulated, and the surface is, therefore, smooth and free from pointed eminences or "mamelons." In well-preserved examples the surface exhibits numerous rounded tubercles—the upper ends of the radial pillars—connected by radiating "arms," which enclose angular or rounded meshes—the apertures of the zoöidal pores. Less well-preserved specimens (Plate II, fig. 11) show simply the rounded tubercles.

Astrorhizæ may be present, in which case they are mostly quite inconspicuous, and are hardly recognisable except in thin tangential sections. In one variety astrorhizæ are comparatively numerous, and in some cases they appear to be wholly wanting.

As regards internal structure the radial pillars are "continuous," each pillar passing without interruption through several successive laminæ (Plate XII, figs. 3 and 4). On an average there are from three to four radial pillars, and the same number of interlaminar spaces in the space of 1 mm. The pillars and concentric laminæ are thus about $\frac{1}{6}$ mm. more or less apart. The radial pillars are connected by horizontal processes or "arms," which are given off with great regularity in radiating whorls, the result being the formation of an angular meshwork, which in tangential sections (Plate XII, fig. 2, and Plate XIII, fig. 1) has a close resemblance to the structure of a hexactinellid sponge. The angular pores formed in this way served for the emission of the zoöids, and definite tabulate zoöidal tubes are not present.

Obs.—Actinostroma clathratum, Nich., is of very variable outward form, and has also a wide range as regards size. Small specimens are usually globular, subglobular, or pyriform; large examples are mostly hemispherical or irregular in shape. The under surface is generally, if not always, non-epithecate, and the upper surface is destitute of "mamelons." Very generally the cœnosteum is composed of successive thick, concentric strata ("latilaminæ"); but in some instances this structure is not observable. In the former case the radial pillars are continuous from the bottom to the top of each latilamina at least. In the latter case the pillars run continuously for apparently indefinite distances.

In some specimens "astrorhizæ" cannot be detected at all, but they are by no means universally wanting in this species, as stated by Bargatzky. I have now found them to exist in many of the German specimens, and they seem to be always, or almost always, present in British specimens. In the Dartington specimens they are even numerous. Their individual development is, however, an imperfect and irregular one, and they do not appear to be usually superposed in vertical series in successive interlaminar spaces. Hence the cœnosteum is not traversed by conspicuous vertical astrorhizal canals, and, for the same reason, the surface is free from "mamelons."

The surface, in well-preserved examples, is studded with minute rounded tubercles, representing the free ends of the radial pillars (Plate II, fig. 11), and sometimes exhibits also the radiating connecting-processes between them and the intervening zoöidal pores. In some dolomitised specimens the skeletal network becomes dissolved out of the matrix towards the surface of the mass, leaving stellate or rounded pores which represent the pillars and their radiating "arms" (Plate I, fig. 5).

In spite of the great variability in external form, the *general type* of internal structure is in this species very constant. The radial pillars are stout, usually rounded, but in some forms subangular. Cross sections of the pillars usually show a minute axial canal (Plate I, figs. 10 and 13), but this cannot always be made out. The horizontal "arms" are very regularly produced, and give rise by their union to a regular "hexactinellid" network, the zoöidal pores being more or less angular in form (Plate XII, fig. 2).

On an average there are generally about three radial pillars and as many concentric laminæ in the space of a millimètre. It must be borne in mind, however, that precise measurements of this kind possess but a limited and general value, even individual specimens commonly showing more or less variability as regards the closeness of the pillars and laminæ. Moreover, specimens collected from distant localities very generally show slight but apparently constant differences in this respect.

A. clathratum is liable to considerable variation, and among the forms which I am disposed to include under this title are three recognisable types, two of which are so far distinct from one another that some palæontologists would probably consider them to be separate species.

In the first of these varietal forms—which I regard as the type of the species—the radial pillars are very regularly developed, the distances between them being approximately uniform in a given specimen (generally about $\frac{1}{5}$ or $\frac{1}{6}$ mm.). The pillars are, further, remarkably parallel to one another, making due allowance for the intercalation of new ones as the surface is approached, and in cross-sections they usually have a well-marked round shape (Plate I, figs. 11—13). Astrorhizæ may be wholly wanting, but there are usually small astrorhizæ to be detected in tangential sections, though the development of these is always feeble. This form of *A. clathratum* is the one which occurs commonly in the Middle Devonian of Germany (Gerolstein, Hebborn, &c.), and it likewise occurs in Devonshire, though it is not the most abundant form in the latter region.

In the second of the varietal forms in question, the radial pillars are comparatively irregular in their development, and vary considerably, even in the same specimen, as regards their distances apart, while they are often variously bent or sloped; and they show a want of general parallelism to each other (Plate XII, fig. 3). In transverse sections (Plate XII, fig. 2), the pillars are often more or less angular, rather than strictly round. Upon the whole, also, the pillars are mostly farther apart than in the preceding variety, being usually separated by interspaces of about $\frac{1}{3}$ or $\frac{1}{4}$ mm. Lastly, astrorhizæ are comparatively well developed, and are not only numerous but comparatively large. This form occurs commonly in the Devonian Rocks of Devonshire, being particularly abundant at Dartington. If it should be thought necessary to distinguish this variety by a special name, I should propose to call it *A. irregulare*.

Finally, there exists a third varietal form which is intermediate in its characters between the two previously described. The form in question agrees with the normal form of the species in having stout round pillars (Plate XIII, fig. 1), but it resembles the last-named variety in having the pillars irregularly developed, and incompletely parallel (Plate XIII, fig. 2). This variety occurs comparatively rarely in the Devonian Limestones of Devonshire.

As compared with the other species of the genus, *Actinostroma clathratum*, Nich., is most nearly related to *A. verrucosum*, Goldf., with which it closely agrees as regards minute structure. It is, however, readily separated by the fact that the laminæ are not flexuous, and that it is devoid of the astrorhizal cylinders and corresponding conical "mamelons," which are so characteristic of the latter species. From its next nearest ally, viz. *A. hebbornense*, Nich. (*Stromatopora astroites*, Barg.), the present species is distinguished by its much stouter pillars and generally coarser structure, and also by the fact that the latter possesses very well-developed astrorhizæ arranged in vertical groups. From *A. bifarium*, Nich., again, it is separated by the fact that the pillars are approximately uniform in size, and are not divisible into two distinct sets, as they are in the latter. None of the other species of *Actinostroma* are sufficiently near to *A. clathratum* in structure to require special mention in this connection.

It is probable that this abundant species has been often described, as *Stromatopora concentrica*, or under some other title, by previous observers. In this case, however, as in the case of many other species, it is difficult to give an extensive synonymy, as most of the older descriptions and figures of Stromatoporoids are insufficient to allow of confident identification. Even in the case of the *Stromatopora concentrica* of M'Coy, which I have placed, with some doubt, in the list of synonyms of this species, it would not be possible to arrive at complete certainty without an examination of the actual specimens which this observer had before him.

Distribution.—Actinostroma clathratum, so far as known to me, is exclusively confined to the Middle and Upper Devonian Rocks. In Devonshire it occurs abundantly (Dartington, Teignmouth, Plymouth). In the German Devonians it is very abundant in the Eifel (Gerolstein, Sötenich, &c.). It is also very common in the Paffrath district in certain localities (Hebborn), but is rare at others (Büchel). I have not hitherto recognised this species as occurring in the Devonian deposits of North America.

2. Actinostroma verrucosum, *Goldfuss* sp. Pl. XVI, figs, 1—8,

Ceriopora verrucosa, *Goldfuss*. Petref. Germ., p. 33, Taf. x, fig. 6, 1826.

? Alcyonium echinatum, *Steininger*. Mém. de la Soc. Géol. de France, tom. i, pl. xx, fig. 11, 1834

Stromatopora polymorpha, *D'Orbigny* (*pars*). Prodr. de Paléont., tom. i, p. 109, 1850.

— verrucosa, *Quenstedt*. Petrefaktenkunde Deutschlands, Bd. v, p. 560, Taf. cxli, fig. 10, 1878.

— — *Bargatzky*. Die Strom. des. rheinischen Devons, p. 55, 1881.

Actinostroma verrucosum, *Nich*. Ann. Nat. Hist., ser. 5, vol. xvii, p. 228, 1886.

The cœnosteum in this species is massive, spheroidal, or hemispherical, often attaining a considerable size, and having a broad base of attachment, the under surface being seemingly non-epithecate. The cœnosteum is composed of undulated and flexuous concentric laminæ, which are bent round a largely-developed series of "astrorhizal cylinders," and fill up the interspaces between these (Plate XVI, fig. 1). Each astrorhizal system consists of a vertical, wall-less, axial canal, enclosed in a sheath formed by a variable number (three to five or more) of concentrically disposed laminæ, the innermost of these being often loosely reticulate (Plate XVI, fig. 5). To the structure thus formed, the name of "astrorhizal cylinder" may be given. In its course through the cœnosteum, the axial canal of the astrorhizal cylinder gives off irregular and feebly developed radiating canals at different heights, and it ultimately terminates by an aperture on the surface, which is placed at the summit of a prominent conical "mamelon" (Plate XVI, fig. 8).

The astrorhizal cylinders radiate outwards from the base of the cœnosteum, and the surface therefore exhibits a number of pointed conical eminences (Plate XVI, fig. 4), which may be 5 to 10 mm. in width at their base, and are often 4 or 5 mm. in height. Each of these eminences or "mamelons" represents the free upper end of an astrorhizal cylinder. Tangential sections of the cœnosteum (Plate XVI, fig. 1) exhibit the transversely divided cylinders, and the flexuous concentric laminæ of the general skeleton filling up the interspaces between these. The cylinders are generally from 5 to 10 mm. in diameter, and are mostly placed about their own width apart. In well-preserved specimens, the whole surface further exhibits numerous minute rounded tubercles (Plate XVI, fig. 8), which represent the upper ends of the radial pillars.

As regards the minute structure of the cœnosteum, this species does not essentially differ from *A. clathratum*, the skeletal tissue consisting of stout radial pillars of the "continuous" type, crossed by strong concentric laminæ (Plate XVI, figs. 3 and 6). As there are no "latilaminæ," the pillars appear to run without a break for indefinite distances. There are usually about four pillars and five concentric laminæ in the space of 1 mm. The pillars are approximately equal in size, and often show a minute axial canal (Plate XVI, fig. 7). As seen in cross-sections the pillars are connected by numerous radiating "arms" (Plate XVI, figs. 2 and 5), which give rise to a hexactinellid network, and enclose angular zoöidal pores.

Obs.—It is unnecessary to enter into any discussion as to the differential characters of *A. verrucosum*, Goldf.; since, so far as I am aware, it is the only species of the genus *Actinostroma* in which the cœnosteum is built up of astrorhizal cylinders filled in by undulated, concentrically laminated tissue. A precisely similar general structure is shown by at least one species of *Clathrodictyon* (viz. *C. retiforme*, Nich. and Mur.), but in this case the skeletal tissue is of a different generic type. *A. verru-*

cosum, as regards its *minute* structure, is not separable from the normal form of *A. clathratum.* Specimens of the former are, however, readily distinguished from those of the latter by the prominent "mamelons" on the surface, while weathered or fractured surfaces at once reveal the presence of astrorhizal cylinders. The general features of *A. verrucosum* are singularly constant; but some specimens have comparatively small "mamelons."

Distribution.—*A. verrucosum* appears to be exclusively confined to the horizon of the Middle Devonian. In the Devonian Limestones of Devonshire it is a decidedly rare species, and I am only acquainted with it as occurring in the pebbles from the Triassic conglomerates of Teignmouth. In the Middle Devonian of Germany the species is comparatively abundant, occurring commonly in the Paffrath area (Büchel, Bosbach, &c.), and being less frequent at Gerolstein and Sötenich.

3. Actinostroma bifarium, *Nich.* Pl. XIII, figs. 3—7.

Actinostroma bifarium, *Nich.* Ann. Nat. Hist., ser. 5, vol. xvi, p. 231, pl. iv, figs. 4 and 5, 1886.

The cœnosteum in this species is massive, spheroidal or hemispherical in shape, and of considerable size. The base has not been observed, and the surface is also unknown. Irregular astrorhizæ are sometimes present, but they are not extensively developed and are sometimes not to be recognised at all.

As regards internal structure the radial pillars are of two sizes, large and small. The large pillars are very stout, and are much fewer in number than the small pillars, their development being irregular, so that they may be from $\frac{1}{2}$ mm. or less to more than 1 mm. apart. The small pillars are very numerous, and are set more closely together, and both sets are connected by numerous radiating "arms" (Plate XIII, fig. 6), which enclose angular zöoidal pores. The concentric laminæ are well developed, and there are from four to six interlaminar spaces in the space of one millimètre.

This well-marked species is distinguished at once from all the other recorded forms of *Actinostroma* by the possession of a series of specially large radial pillars interspersed among the ordinary pillars of the cœnosteum. As growth does not take place by well-marked "latilaminæ," the pillars are apparently continued for indefinite distances, and their development is always more or less irregular. The shape of the zoöidal pores depends upon the state of preservation of the specimen, or is really liable to variation in different individuals. Thus the zoöidal pores are usually distinctly angular, but in some cases the "arms" connecting the pillars appear to be thickened, and the intervening pores then assume a roundish shape. German specimens, so far as I have seen, always have the concentric laminæ placed at a greater distance apart than is the case with English examples (compare figs. 7 and 5 in Plate XIII), but there is no other marked difference to be noted.

Distribution.—*Actinostroma bifarium* is only known as occurring in the Middle Devonian. The species is not rare in the pebbles of Devonian Limestone in the Triassic conglomerates of Devonshire (Teignmouth, &c.). In Germany it has not hitherto been found except in the Paffrath area, occurring not very rarely at Büchel. I have figured the minute structure of the German examples, as all the British specimens which I have examined are more or less extensively affected by crystallisation, and usually somewhat distorted by pressure.

4. Actinostroma hebbornense, *Nich.* Pl. XVI, figs. 9—16.

Stromatopora astroites, *Bargatzky.* Die Stromatoporen des rheinischen Devons, p. 56, 1881. (Non *Stromatopora astroites*, Rosen.)

Actinostroma hebbornense, *Nich.* Ann. Nat. Hist., ser. 5, vol. xvii, p. 228, pl. vii, figs. 7 and 8, 1886.

The cœnosteum in this species is massive, often of large size, and apparently non-epithecate. The skeleton is very regularly laminated, and the surfaces of the laminæ are smooth and devoid of "mamelons." The astrorhizal system is extensively developed, the laminæ showing numerous large branching astrorhizæ (Plate XVI, fig. 9), the centres of which are usually from 6 to 8 mm. apart, and which may or may not be arranged in vertical groups.

As regards the internal structure of the skeleton, the radial pillars are very slender and are straight; and as definite "latilaminæ" are not developed, they run for indefinite distances. Usually about five radial pillars occupy the space of a millimètre, but in some examples they are closer than this. The concentric laminæ are well marked, and there are generally about four (sometimes five) interlaminar spaces in one millimètre. The radial pillars give out radiating "arms" in very regular whorls, each whorl generally consisting of four or five spokes, and the union of these gives rise to a very regular angular meshwork (Plate XVI, figs. 10 and 11).

Obs.—*Actinostroma hebbornense* was identified by Bargatzky with *Actinostroma* (*Stromatopora*) *astroites*, Rosen sp.; but I have examined the original specimens of both species, and find them to be quite distinct. In its general structure *A. hebbornense* is closely related to *A. clathratum*, Nich., with which it agrees in intimate structure and also in its mode of growth. It is, however, clearly distinguished from *A. clathratum* by the much greater delicacy of its general skeletal tissue. The radial pillars are not only straight, and for the most part parallel with one another, but they are very slender. Considerable variations exist, however, in the closeness of the pillars in the specimens which I am disposed to place in this species. The connecting processes or "arms" of the pillars are also exceptionally regular in this species. The specially distinctive feature of *A. hebbornense*, however, is the unusually complete development of the astrorhizæ, as compared with the species of *Actinostroma* in general. In this respect, the species agrees with *A. astroites*, Rosen sp., from which, however, it is at once separated by its much coarser skeletal tissue, as well as by other minor characters. The only other species of *Actinostroma* with which it is necessary to compare the present species is *A. intertextum*, Nich., but the latter is readily separated by the fact that its skeletal tissue is still more delicate than in *A. hebbornense*, while the concentric laminæ are irregular and sub-vesicular, and the astrorhizæ are still more highly developed, and the general form and mode of growth are quite different.

Distribution.—So far as known, *A. hebbornense* is almost exclusively confined to the Middle Devonian, but it seems to be exceedingly local in its distribution. It occurs in great abundance in the Middle Devonian of Hebborn (Bargatzky's original locality), but I have not found it elsewhere in the Paffrath district, and I have also not clearly identified it from the Eifel. In the Middle Devonian of Devonshire it seems to be of rare occurrence, and I am only acquainted with it from the pebbles of the Triassic conglomerates of Teignmouth. The few Devonshire specimens which I have examined are all highly crystallized, and more or less distorted by pressure (Plate XVI, figs. 13—16). I have therefore figured the minute structure of unaltered German examples (Plate XVI, figs. 10—12). By the kindness of Dr. Daniel Œhlert I have been enabled to examine a specimen apparently belonging to this species from the Inferior Devonian of La Baconnière, Mayenne.

5. Actinostroma intertextum, *Nich.* Pl. XIII, figs. 8—11.

Actinostroma intertextum, *Nich.* Monogr. Brit. Stromatoporoids, p. 76, fig. 10, 1886 (figured but not described).
— — *Nich.* Ann. Nat. Hist., ser. 5, vol. xvii, p. 233, pl. vii, figs. 3—6, 1886.

The cœnosteum has the form of a laminar, more or less circular expansion (Pl. XIII, fig. 8), which may reach half a foot or more in diameter, and an inch or more in thickness, and which is covered inferiorly by a concentrically wrinkled basal epitheca. The surface is smooth or gently undulated, without "mamelons," but exhibiting fairly developed astrorhizæ, the centres of which are a centimètre or less apart. The astrorhizæ do not appear to be arranged in vertical groups, and the cœnosteum is, therefore, not traversed by vertical astrorhizal canals. The general surface is covered with exceedingly minute, close-set tubercles, representing the upper ends of the radial pillars.

As regards the internal structure of the cœnosteum, the "continuous" radial pillars are very delicate (Pl. XIII, fig. 11), and, as growth is not effected by means of "latilaminæ," they run apparently indefinite distances. About five pillars occupy the space of 1 mm. The concentric laminæ are placed about as far apart as the pillars, but instead of forming continuous lines, as seen in vertical sections, they are incomplete, and give rise to a species of loose vesicular reticulation, which is highly characteristic of the species. The connecting-processes, or "arms," given out by the pillars, are numerous, slender, and very regularly developed, and they give rise, by their union, to a close "hexactinellid" network, the meshes of which are mostly more or less triangular (Pl. XIII, fig. 10).

Obs.—Actinostroma intertextum, Nich., is distinguished from most of the species of *Actinostroma* by the general characters of its delicate radial pillars, the loosely reticulate structure of the concentric laminæ, and the fact that the cœnosteum has the form of a thin laminar expansion, with a basal epitheca. The species with which it is most nearly related is the *Actinostroma Schmidtii*, Rosen sp., of the Silurian Rocks of Oesel. As I have elsewhere pointed out, however ('Ann. Nat. Hist.,' ser. 5, vol. xvii, p. 233), this latter species is distinguished by the fact that its astrorhizæ are of large size, with wide and very slightly subdivided branches, and are arranged in vertical groups, each group being connected with a wide vertical or axial canal. The network formed by the union of the "arms," as seen in tangential sections, is formed of oblong or irregular, rather than angular meshes; and some of the radial pillars appear to be of decidedly larger size than the others. Lastly, the cœnosteum appears to have been massive, though the mode of growth is not perfectly known.

The ordinary British examples of *A. intertextum*, Nich., show no particular variations from the general type. Examples from the Silurian Rocks of Esthonia have the radial pillars decidedly more closely set, while the concentric laminæ are more completely developed, and are not of such a reticulate or vesicular character. They also do not exhibit the same regular "hexactinellid" network in tangential sections; though this latter feature may be only the result of imperfect preservation. I have therefore proposed (loc. cit. supra, p. 234) to indicate these differences by giving to the Russian examples the special name of *A. intertextum* var. *suevicum*.

In the Silurian and Ordovician Rocks of Britain there occur specimens of what I am inclined to regard as examples of this species in a peculiar state of preservation. The specimens in question are exceedingly ill-preserved, and thin sections have more the aspect of the genus *Clathrodictyon* than of *Actinostroma*. The radial pillars are imperfectly or not at all recognisable in vertical sections, and the hexactinellid network of well-preserved tangential sections is replaced by irregular dark dots, only visible here and there, and partially connected with one another by radiating "arms." My reasons for thinking that these may be only badly preserved examples of the present species are: firstly, that even in well-preserved specimens the radial pillars are not clearly recognisable in vertical sections if these should be at all oblique; and secondly, that unquestionable examples of this species sometimes fail to show the hexactinellid network in tangential sections in any parts of the mass which are imperfectly preserved, but show instead a granular or dotted aspect. The specimens to which I refer must, however, be studied in a more complete series than I possess before it will be possible to assert positively that they are referable to the present species.

Distribution.—All the unquestionable examples of this species which I have seen are from the Wenlock Limestone, occurring not very rarely at Ironbridge, Much Wenlock, and Dudley. The Russian variety is from the Silurian Limestones (zone of *Pentamerus esthonus*) of Kattentack, Esthonia. The doubtful specimens above alluded to occur sometimes in the Wenlock Limestone; but other similar examples have been collected by Mrs. Robert Gray in the Ordovician Rocks ("Balcletchie Conglomerate") of Balcletchie, Girvan.

6. Actinostroma stellulatum, *Nich.* Pl. XIV, figs. 1—8, and Pl. XV.

Stromatopora concentrica, *Maurer*. Die Fauna der Kalke von Waldgirmes bei Giessen, p. 108, pl. ii, figs. 12 and 13. (Non *Stromatopora concentrica*, Goldf.)

Actinostroma stellulatum, *Nich.* Ann. Nat. Hist., ser. 5, vol. xvii, p. 231, pl. vi, figs. 8 and 9.

The cœnosteum in this species is sometimes laminar, with a basal epitheca, sometimes massive. Massive specimens may be more or less spheroidal, and composed simply of concentrically disposed strata; or they may be irregular in form, and may be made up of a series of large-sized cylinders, each of which is composed of concentrically arranged layers. The surfaces of successive strata are sometimes smooth or gently undulated, but are at other times covered with low, rounded, closely-approximated prominences or "mamelons." In well-preserved specimens the free surface of the cœnosteum exhibits the radiating astrorhizal grooves, and the spaces between these are occupied by innumerable minute, rounded, or elongated granules, representing the upper ends of the radial pillars. These granules are either isolated, or may be more or less connected into sinuous groups by means of delicate connecting processes.

Astrorhizæ are invariably present, and are arranged in superposed systems, each system having a common vertical axial canal (Plate XIV, fig. 2), which may or may not open at the surface on a special eminence. In any case, the "mamelons," when present, are comparatively low and flat, and are not prominent and conical (Plate XV). The astrorhizæ are always delicate, with slender, radiating branches, which are sometimes few and comparatively simple, and sometimes numerous and much branched. In the former case the astrorhizæ are small, and their centres are placed at a distance of about 5 or 6 mm. In the latter case, they are comparatively large and their centres are from 6 to 10 mm. apart.

As regards the internal structure of the cœnosteum, the radial pillars are slender, and about six or seven occupy the space of 1 mm. The radial pillars seem to be really continued through an indefinite number of interlaminar spaces. Owing, however, to the fact that no individual pillar lies for more than a short distance in the plane of a vertical section (Plate XIV, figs. 4 and 6), it happens that the pillars only appear to run through a few interlaminar spaces before they seem to terminate. If the plane of the section happens at some point to coincide accurately with the plane of the pillars, then a single pillar may be readily traced through ten or twenty successive interlaminar spaces. If, on the other hand, the section be slightly oblique to the pillars, then these structures may appear to run only through two or three successive interlaminar spaces, or even to be confined to a single space, thus producing a likeness to the genus *Clathrodictyon*.

The concentric laminæ are well marked, about from six to eight occupying the space of 1 mm. Tangential sections (Plate XIV, figs. 3 and 5) show the radiating astrorhizal canals and the cut ends of the radial pillars. In some cases the radial pillars are connected with one another, more or less extensively, by means of numerous delicate and hair-like connecting-processes or "arms" (Plate XIV, fig. 5). In most cases, however, these connecting-processes are not visible at all in tangential sections (Plate XIV, fig. 3), or they can only be very partially detected. Hence such sections do not show the typical "hexactinellid" network characteristic of the genus *Actinostroma*, but usually closely resemble corresponding sections of the genus *Clathrodictyon*.

Obs.—Actinostroma stellulatum, Nich., is a very well-marked and widely distributed species. It is most nearly related to *A. hebbornense*, Nich. (=*Stromatopora astroites*, Barg.). It is, however, distinguished from this, as from all the other species of *Actinostroma*, by the fact that tangential sections do not usually show the characteristic "hexactinellid" meshwork of the genus. On the contrary, such sections resemble corresponding sections of *Clathrodictyon* in showing the detached ends of the transversely divided radial pillars, either quite separate or partially confluent into vermiculate rows. There do, however, occur specimens in which the typical "hexactinellid" structure can be detected, in parts at any rate, in tangential slices. In these cases (Plate XIV, fig. 5) the "arms" given out by the radial pillars are numerous, and almost thread-like or capillary in point of size. The general skeletal framework in the present species is decidedly closer and more dense than in *A. hebbornense* or *A. clathratum*; and a very well-marked and characteristic feature in vertical sections (Plate XIV, figs. 4 and 6) is the presence of large rounded apertures caused by the cutting across of the radiating astrorhizal tubes. These apertures are commonly distributed in irregular vertical lines which correspond with the separate astrorhizal systems. Vertical sections, also, often show the vertical wall-less canals from which spring the astrorhizæ of successive interlaminar spaces and round which the concentric laminæ are usually bent upwards (Plate XIV, fig. 2).

As regards its form and mode of growth *A. stellulatum* is very variable, but its variations may be reduced to the following three chief types:

1. The first type includes forms in which the cœnosteum grows as a larger or smaller laminar expansion of comparatively small thickness, and having a concentrically wrinkled basal epitheca. Growth by "latilaminæ" is not marked, and the surface is destitute of "mamelons." The concentric laminæ are nearly plane or only gently wavy, and are never sharply undulated. Lastly, the astrorhizæ are comparatively large, with numerous long, slender, radiating branches, and have their centres from 6 to 8 mm. or more apart. This laminar variety is common at Gees and at other localities near Gerolstein, but it is of doubtful occurrence in Devonshire.

2. The second type comprises massive forms, often of large size, more or less spheroidal or irregular in shape, and without a basal epitheca. Very commonly the cœnósteum is markedly composed of successive "latilaminæ," and the concentric laminæ are often more or less undulated. The surface is sometimes nearly smooth or gently wavy, but it is very generally covered with low, rounded "mamelons," which average 5—6 mm. apart, and mostly correspond with the axial canals of the astrorhizæ. The astrorhizæ are mostly of small size with few radiating branches, and these comparatively short. The forms of this group are extremely abundant at Gerolstein in the Eifel, and they are not very rare in Devonshire. I have figured (Plate XV) a beautiful pyriform specimen from Devonshire which Mr. Vicary was so kind as to place in my hands for examination.

3. A third well-marked group of forms comprises examples in which the cœnosteum appears in transverse sections (Plate XIV, fig. 1) as if made up of parallel cylinders, the interspaces between which are filled up by undulated laminæ. The cylinders vary from 1—6 cm. in diameter, and longitudinal sections

(Plate XIV, fig. 2) show that they are formed of laminæ which are strongly bent upwards or towards the surface, and which are somewhat wider apart than usual. On the other hand, the intervals between the cylinders are occupied by laminæ, which are sharply bent in the reverse direction, and are closer together than elsewhere. The centres of the cylinders commonly correspond with the axial canals of the astrorhizal systems, and the surface (which I have not seen) would doubtless exhibit prominent "mamelons" corresponding with these. The astrorhizæ are small, with few radiating branches, and have their centres placed 5—6 mm. apart. Intermediate forms between these and the preceding group exist, in which the undulations of the laminæ are sufficiently sharp to produce a system of parallel cylinders, but these are small and close together. The forms of this group are the commonest examples of the species in Devonshire, but I have not yet seen any from the Eifel.

As regards the synonymy of the species I am unable to identify it with certainty with any of the forms described by Bargatzky, or, indeed, with any previously described species except the one which Dr. Maurer (loc. cit. supra) regarded as being *Stromatopora concentrica*, Goldf. Dr. Maurer was good enough to send me a fragment of the type-specimen of this, and from a macroscopic examination of this I came to the conclusion that it was probably referable to *Actinostroma verrucosum*, Goldf. sp. ("Introduction," p. 26). I have, however, prepared thin sections and I now find it to belong really to the present species.

Distribution.—Actinostroma stellulatum appears to be confined to the Devonian formation and is at present only known as occurring in the Middle Devonian. In Devonshire it is by no means a rare species, occurring abundantly at Dartington and Lummaton, and more rarely in the pebbles from the Triassic conglomerates of Teignmouth. In the Eifel it is exceedingly common in the neighbourhood of Gerolstein, and it occurs also at Sötenich, but I have not hitherto recognised it in the Paffrath district.

7. Actinostroma astroites, *Rosen* sp. Pl. XVII, figs. 1—7.

Stromatopora astroites, *Rosen.* Ueber die Natur der Stromatoporen, p. 62, pl. ii, figs. 6 and 7, 1867. (Non *Stromatopora astroites*, Barg.)

Actinostroma ? astroites, *Nich.* Ann. Nat. Hist., ser. 5, vol. xvii, p. 229, pl. vi, figs. 6—7 *a*, 1886.

The cœnosteum in this species is massive, or in the form of a thick laminar expansion, and grows in successive strata, or "latilaminæ," of varying thickness.

Small specimens are often spheroidal or pyriform, and in some cases a wrinkled basal epitheca is recognisable. The concentric laminæ are sometimes nearly horizontal, sometimes simply curved to a greater or less extent, or sometimes gently undulated.

The surfaces of all the strata are covered with well-marked branching astrorhizæ (Plate XVII, fig. 1), the centres of which are placed about 10 or 12 mm. apart. The astrorhizæ do not appear to be arranged in superposed groups or systems, and the cœnosteum is therefore not traversed by wall-less vertical canals corresponding with the axes of such systems. For the same reason, the surface does not exhibit definite "mamelons," though small rounded eminences are sometimes irregularly developed.

As regards internal structure, the cœnosteum is composed of exceedingly delicate and close-set radial pillars, of which from twelve to fifteen may occupy the space of 1 mm. The radial pillars are "continuous," and they are not interrupted in their course by the concentric lines of growth which intersect the skeleton. The radial pillars (Plate XVII, fig. 4) give out exceedingly delicate horizontal connecting processes or "arms," which give rise, as seen in tangential sections (Plate XVII, figs. 2 and 5), to a correspondingly delicate "hexactinellid" structure. About twenty interlaminar spaces occupy the space of 1 mm., but the proper concentric laminæ are irregular and often more or less broken or reticulate (as they are in *A. intertextum*, Nich.).

A constant and exceedingly characteristic feature of vertical sections (Plate XVII, figs. 3, 4, and 7) is that the entire cœnosteum is divided by well-marked and quite definite concentric lines, which have nothing to do with the ordinary concentric laminæ nor with latilaminæ. These concentric "lines of growth," as they may be termed, are placed at distances of from $\frac{1}{10}$th mm. to 1 or 2 mm. apart; and they are usually arranged in groups of close-set lines separated by wider bands in which these lines are few or wanting.

Obs.—When I first fully described this remarkable species ('Ann. Nat. Hist.,' ser. 5, vol. xvii, p. 229, 1886), I was not absolutely clear as to its being truly referable to the genus *Actinostroma*. This uncertainty arose from the fact that von Rosen's original specimens, as also the majority of all specimens hitherto examined, are in such a highly crystalline condition that their minute internal structure is hardly to be deciphered. I have, however, now examined specimens, from the Silurian Rocks of Britain, in which the internal structure is very fairly preserved, and these leave no doubt as to the fact that the species, as I conjectured, is properly referable to the genus *Actinostroma*. The species of this genus, with which *A. astroites* is most nearly related in general structure, is unquestionably *A. intertextum*, Nich. The present species is, however, distinguished from this, as from all the other known forms of *Actinostroma*, by the extraordinary delicacy of its skeletal tissue, the radial pillars and concentric laminæ being so fine, and so close together, as to render their clear recognition with a hand-lens, even in well-preserved specimens, impossible. A still more characteristic feature, which separates the present form from all the other known species of the genus, is the presence of the singular concentric lines of growth above spoken of. These structures can be almost always clearly recognised in fractured surfaces or in thin vertical sections, even in the worst preserved specimens of the species, and they may be taken as diagnostic. The astrorhizæ, though sufficiently well marked on fractured surfaces, can with difficulty be recognised at all in their tangential sections, even where the state of preservation is fairly good.

I have examined a very large number of examples of this species from the Silurian Rocks of Esthonia, Gotland, and Britain, and find the majority of specimens to have undergone a kind of cystalline change, which has more or less extensively obliterated their internal structure. Tangential sections of such examples generally exhibit nothing more than a finely granular aspect, while vertical sections show a finely reticulate structure (Plate XVII, fig. 7). Vertical sections also show the concentric lines of growth, sometimes as dark lines, sometimes as light lines, and the closeness of these differs greatly in different examples. A common phenomenon in this species, though it is one by no means peculiar to it, is that the cœnosteum contains numerous embedded *Spirorbes,* usually arranged in vertical rows (Plate XVII, fig. 7).

In a few specimens the cœnosteum is traversed by minute vertical tubes, which resemble ordinary "Caunopora-tubes" in having definite walls (Plate XVII, figs. 5 and 6). These tubes differ from the structures known generally as "Caunopora-tubes" in not being connected together, so far as I have seen, by horizontal tubes. They are also peculiar in the fact that they are very variable in point of size—in the same specimen, that is to say—and they exhibit at intervals dark transverse lines, which *may* be of the nature of "tabulæ," though I do not feel clear on this point.

Another noticeable feature about *A. astroites*, Rosen sp., is that its vertical sections, especially when in poor preservation, present a singular resemblance to similar sections of certain specimens of *Stromatopora typica,* Rosen. Some examples of this latter species exhibit a peculiar structure of the skeleton-fibre—probably a sort of decomposition—in consequence of which the thick and reticulated skeleton-fibre becomes broken up into innumerable minute, dark-coloured, vertical and horizontal lines. This remarkable alteration of the skeleton-fibre from its normal porous condition is well figured by von Rosen ('Ueber die Nat. der Strom.,' pl. i, fig. 2) in a vertical section of *S. typica.* So close is the resemblance thus produced between vertical sections of *A. astroites* and corresponding sections of certain specimens of *S. typica*, that I was at first

("Introduction," p. 12) led to think that *A. astroites* would turn out to be only a highly altered condition of *S. typica*. The examination, however, of well-preserved specimens of *A. astroites* has shown that this conjecture is quite unfounded.

The Devonian Stromatoporoid described by Bargatzky as *Stromatopora astroites*, Rosen, I have previously shown to be a distinct species of *Actinostroma*, to which I have given the name of *A. hebbornense*.

Distribution.—Actinostroma astroites is only known as occurring in the Silurian Rocks. Von Rosen's original specimens are from Kaugatoma Pank in the Island of Oesel, and I have collected precisely similar specimens in the same formation (Upper Oesel Group) at the same locality, and also at Hoheneichen. The species also occurs at Kattentack in Esthonia, in the zone of *Pentamerus esthonus*. In the Wenlock Limestone of Wisby, in Gotland, the species seems to be not uncommon, but all the examples I have seen are highly altered. In Britain, *A. astroites* is only known as occurring in the Wenlock Limestone, and I have collected examples of it at Ironbridge and at Much Wenlock. In the latter locality it is not rare, and is often in a state of excellent preservation.

8. Actinostroma fenestratum, n. sp. Pl. XVII, figs. 8 and 9.

The cœnosteum in this species is apparently massive, but the mode of growth, general form, and superficial characters are entirely unknown. Well developed astrorhizæ are sometimes present, but in other examples do not appear to be developed, or, at any rate, are not conspicuous.

As regards internal structure, the cœnosteum is composed of remarkably stout and strong radial pillars, which appear to run without a break for indefinite distances. About three pillars occupy the space of 1 mm. Not only are the pillars exceptionally thick, but they generally show large axial canals traversing their substance, these canals appearing as dark dots (Plate XVII, fig. 8) or as clear spaces, in tangential sections. The concentric laminæ are thick, and somewhat irregularly developed, about four interlaminar spaces occupying the space of 1 mm. The connecting-processes or "arms" given out by the pillars are stout and few in number, and the "hexactinellid" network shown by tangential sections (Plate XVII, fig. 8) is, therefore, coarse and irregular.

Obs.—The few examples of this species which I have examined are all from the pebbles of Devonian Limestone in the Triassic conglomerates of South Devon, and are all comparatively small. I am, therefore, unable to give any particulars as to the general form and mode of growth of the species. Moreover, they have all undergone extensive crystallisation and distortion by pressure, so that their internal structure cannot be satisfactorily studied in thin sections. In spite of these drawbacks, I think there is no reason to doubt that the present form is a perfectly distinct species. In its general structure it does not differ essentially from *A. clathratum*, Nich., but it is at once separated from this, as from all other recorded species of the genus *Actinostroma*, by the remarkable thickness of the radial pillars and the general coarseness of the skeletal framework. Its general aspect is exceedingly similar to that of the form described by Dr. Maurer from the Devonian Rocks of Giessen, under the name of *Stromatopora turgidecolumnata* ('Fauna der Kalke von Waldgirmes,' p. 112, Taf. iii, fig. 4). Dr. Maurer was, however, good enough to send me a minute fragment of this species, and so far as I can judge from this— which is unfortunately in a very bad state of preservation —I am disposed to think it is a true *Stromatopora*, with a porous skeleton-fibre, allied to, or identical with, *Stromatopora Beuthii*, Barg. In the meanwhile, therefore, I have thought it safest to describe the present species—which is unquestionably referable to the genus *Actinostroma*—as distinct.

Distribution.—Rare in the pebbles of Devonian Limestone in the Triassic Conglomerates of Teignmouth.

Genus 2.—Clathrodictyon, *Nicholson* and *Murie*, 1878.

(Introduction, p. 77.)

9. Clathrodictyon vesiculosum, *Nich.* and *Mur.* Pl. XVII, figs. 10—13, and Pl. XVIII, fig. 12.

? Stromatopora striatella, *M'Coy*. Brit. Pal. Foss., p. 12, 1851. (Non *Stromatopora striatella*, D'Orb.)

Clathrodictyon vesiculosum, *Nich.* and *Mur.* Journ. Linn. Soc. Zool., vol. xiv, p. 220, pl. ii, figs. 11—13, 1878.

— — *Nich.* and *R. Eth., jun.* Mon. Sil. Foss. Girvan, p. 238, pl. xix, fig. 2, 1880.

Stromatopora minuta, *Rominger*. Proc. Acad. Nat. Sci. Phil., p. 49, 1886.

Clathrodictyon vesiculosum, *Nich.* Ann. Nat. Hist., ser. 5, vol. xix, p. 1, pl. i, figs. 1—3, 1887.

The cœnosteum in this species is in the form of a laminar expansion, having the lower surface covered with a concentrically striated or wrinkled epitheca (Plate XVIII, fig. 12), and attached at one point to some foreign body. Adult specimens grow to a size of half a foot or more in diameter, with a thickness in the centre of an inch or more. The upper surface is irregularly undulating, without "mamelons," and exfoliating concentrically round the elevated points. Small, but well-developed astrorhizæ, the centres of which are from 3 to 5 mm. apart, are present; but the central canals of these do not open on the surface by prominent apertures.

As regards internal structure, the cœnosteum is made up of closely concentric laminæ, which are only slightly or not at all undulated, and of which from nine to eleven in general occupy the space of 1 mm. The laminæ are minutely crumpled, so as to give rise to more or less perfect radial pillars; but these structures are invariably confined to their respective interlaminar spaces, and are, therefore, not "continuous." In this way the interlaminar spaces become broken up into minute, often imperfect, lenticular cells (Plate XVII, figs. 10 and 12), which are formed by the curved inflections of the concentric laminæ conjoined with the more or less incomplete radial pillars. In general from eight to ten interlaminar spaces occupy the space of 1 mm. The cells formed by the radial pillars or by the bendings of the laminæ are very variable in size, but are mostly from $\frac{1}{8}$ to $\frac{1}{10}$ mm. in length.

Obs.—*C. vesiculosum* is the type-species of the genus *Clathrodictyon*, Nich. and Mur. As in all the species of the genus, therefore, the radial elements of the skeleton are incompletely developed, and never extend from one interlaminar space into adjoining ones. While the radial pillars are thus imperfect, the concentric laminæ of the cœnosteum are minutely undulated, and the interlaminar spaces thus become broken up and subdivided into vesicles, the size and shape of which are exceedingly variable. Hence vertical sections of *C. vesiculosum* (Plate XVII, figs. 10 and 12) show a minutely vesicular structure, the cœnosteum appearing to be made up of exceedingly small lenticular cells, arranged in horizontal or slightly curved rows. On the other hand, tangential sections (Plate XVII, figs. 11 and 13) show the cut ends of the isolated and imperfect radial pillars, together with the irregularly divided edges of the concentric laminæ. The radial pillars, as seen in tangential sections, show no traces of radiating "arms" or connecting-processes, but they may sometimes become conjoined in short vermiculate rows. Small astrorhizæ are seen in tangential sections, and these usually are arranged in vertical groups, and have wall-less axial canals, but the openings of the latter on the surface are not prominently elevated.

C. vesiculosum, Nich. and Mur., belongs to a series of forms, the specific determination of which is exceptionally difficult. The forms in question, viz. *C. vesiculosum*, Nich. and Mur., *C. variolare*, Rosen sp., *C. Linnarssoni*, Nich., and *C. crassum*, Nich., are all easily recognised as distinct when typical examples are selected for examination. It is, therefore, expedient to distinguish them by separate specific names. At the same time, there are close relationships between all these forms, and examples are not uncommon which show intermediate or transitional characters, and which, therefore, it is difficult to refer definitely to any one of the four. In a less striking form, a passage may also be traced between this group of types and *C. fastigiatum*, Nich.

From all of the allied forms above mentioned *C. vesiculosum* is best distinguished by the extreme closeness with which the concentric laminæ are set, and the resulting minuteness of the cells which compose the cœnosteum. Not only are the laminæ exceedingly close, but the interlaminar spaces are nearly equal in width, and the cellular tissue of the skeleton is thus approximately uniform. On the other hand, in typical examples of *C. variolare*, Rosen sp., the interlaminar spaces are unequal in size—wide spaces alternating tolerably regularly with spaces which are much narrower than the average, and which are usually arranged in groups (Plate XVIII, fig. 1). Trivial as this difference is, it is one which gives a very different aspect to vertical sections of these two forms. In other examples of *C. variolare*, in which this alternation of wide and narrow interlaminar spaces is not so marked, all the interlaminar spaces are wider and the cellular structure is coarser than in the present species. In *C. Linnarssoni*, Nich., again, the concentric laminæ are much less crumpled and the cells of the interlaminar spaces are, therefore, much more nearly quadrangular than is the case in *C. vesiculosum*. The form which I have named *C. crassum* is sufficiently distinguished from the present species—when characteristic examples of the two are compared with one another—by the comparatively small number of concentric laminæ in a given space, and by the much thicker and coarser structure of the skeleton-fibre. Lastly, *C. fastigiatum*, Nich., is in general readily separated from *C. vesiculosum* by the much greater width of the interlaminar spaces and the chevron-like foldings of the concentric laminæ.

Distribution.—*Clathrodictyon vesiculosum*, so far as known, is exclusively confined to the Silurian Rocks, and is especially characteristic of the lower portion of the Silurian (May Hill and Wenlock zones). In strata of this age the species has, in fact, an extraordinarily wide range. In England *C. vesiculosum* is of comparatively common occurrence in the Wenlock Limestone, and I have collected examples of it at Much Wenlock, Dudley, Ironbridge, and Dormington. In Scotland it has been collected by Mrs. Robert Gray in the Silurian Rocks (Woodland-beds) of Woodland Point, near Girvan. In North America the species seems to be abundant in the Clinton and Niagara formations, and I have personally collected examples in the Clinton-beds of Yellowsprings, Ohio, and the Niagara Limestone of Canada (Thorold). By the kindness of Mr. Whiteaves I have also recently had submitted to me examples of this species collected by the Geological Survey of Canada in the Clinton formation of Anticosti (Junction Cliff and west side of Gamache Bay). I have, further, collected examples of this species in the

Silurian Limestones of Esthonia, in the "*Zone of Pentamerus esthonus*" at Kattentack, and in the "Raiküll-beds" at Raiküll. The prevailing species of *Clathrodictyon* in the Silurian Rocks of Esthonia is, however, not the present form, but *C. variolare,* Rosen, and I have not seen any examples of this species from Gotland though I entertain no doubt of its occurrence there.

10. CLATHRODICTYON VARIOLARE, *Rosen* sp. Pl. XVIII, figs. 1—5, and Pl. XVII, fig. 14.

STROMATOPORA VARIOLARIS, *von Rosen.* Ueber die Natur der Stromatoporen, p. 61, pl. ii, figs. 2—5, 1867.
CLATHRODICTYON VARIOLARE, *Nicholson.* Ann. Nat. Hist., ser. 5, vol. xix, p. 4, pl. i, figs. 4—6, 1887.

The cœnosteum in this species is laminar, hemispherical or massive, with a concentrically wrinkled basal epitheca, and often attaining a large size. The surface may be smooth, or may exhibit numerous "mamelons," which are sometimes small and pointed, or, more commonly, low and rounded (Plate. XVII, fig. 14). There are numerous astrorhizæ, but these are small in point of size, and do not appear to correspond in any special way with the surface-eminences or "mamelons," when these latter structures are present. Generally, the astrorhizæ are arranged in vertical groups or systems, each group having a wall-less axial canal, but this arrangement does not appear to be constant.

The internal structure of *C. variolare* is very similar to that of *C. vesiculosum,* the skeleton being composed of close-set concentric laminæ, which are horizontal, or, more usually, gently undulated, and are minutely crumpled, so as to give rise, along with the incomplete radial pillars, to a fine vesicular tissue. From eight to ten laminæ occupy the space of 1 mm.; but the interlaminar spaces are of unequal size, rows of large vesicles alternating with rows of much smaller cells (Plate XVIII, figs. 1 and 3). As a rule, rows of large vesicles are separated by from one to three rows of much more minute vesicles; but there may be only a single row of the latter or they may even be wanting in places. Tangential sections (Plate XVIII, figs. 2 and 5) show the cut ends of the irregular radial pillars and the divided edges of the crumpled laminæ, but show no characteristic features. The radial pillars, especially in the rows of large cells, are very commonly imperfect, thus allowing contiguous cells to communicate freely with one another.

Obs.—*Clathrodictyon variolare,* Rosen sp., is very closely allied to *C. vesiculosum,* Nich. and Mur., on the one hand, and to *C. crassum,* Nich., on the other; and it is connected with both of these species by transitional forms. The character which most decisively separates it from *C. vesiculosum* is the alternation of rows of large cells with wider or narrower zones of exceedingly minute vesicles. In other respects the two forms stand very close to one another. Some of the British specimens are absolutely typical, and differ in no respect from the ordinary Russian examples of the species. Other British specimens which I regard as referable to this species show a marked diminution in the rows of small vesicles which normally separate the rows of large cells. In such cases (Plate XVIII, fig. 4) the vertical section of the cœnosteum shows only rows of comparatively large-sized cells with few or no rows of small vesicles. Such examples show an approximation to the type of *C. crassum*, Nich., this being further accentuated by the fact that the skeleton-fibre is decidedly coarser in these cases than it is in thoroughly typical specimens of *C. variolare*. The only other species of the genus with which the present form could well be confounded is *C. Linnarssoni*, Nich. In this latter species, however, the concentric laminæ are not crumpled, and as a result of this the interlaminar vesicles are quadrangular rather than lenticular in form, while the interlaminar spaces are approximately uniform in width.

Distribution.—*C. variolare* has not hitherto been detected out of the Silurian Rocks in Britain; but it occurs in the Ordovician (Borckholm'sche Schichten) at Borckholm and Worms in Esthonia. With this exception its vertical range seems to be much the same as that of the preceding species. I have not, however, met with any examples of it in the Clinton and Niagara formations of North America, where *C. vesiculosum* is very abundant. Von Rosen's type-specimen of *C. variolare* (which I have examined) is from Errinal in Esthonia. I have also collected the species abundantly in the "zone of *Pentamerus esthonus*" at Kattentack in Esthonia, and elsewhere in the same region. In Britain the species is by no means uncommon in the Wenlock Limestone, and I have collected examples of it at Ironbridge, Dormington, and Much Wenlock.

11. CLATHRODICTYON CRASSUM, *Nich.* Pl. XVIII, figs. 6 and 7.

CLATHRODICTYON CRASSUM, *Nicholson.* Ann. Nat. Hist., ser. 5, vol. xix, p. 8, pl ii, figs. 1 and 2, 1887.

The cœnosteum in this species is in the form of a thin laminar expansion (about a centimètre or thereabouts in thickness) and of small size. The under side is covered with a concentrically wrinkled epitheca. The upper surface is studded with vermiculate tubercles, and exhibits well-marked branching astrorhizal canals.

No "mamelons" are present, though the astrorhizæ are often superposed in vertical systems.

As regards internal structure, the cœnosteum is seen in vertical sections (Plate XVIII, fig. 6) to be composed of nearly horizontal or gently bent concentric laminæ, of which five or six occupy the space of 1 mm. The laminæ are minutely inflected and become blended with the thick radial pillars, by which the interlaminar spaces are divided into irregularly-sized, oval, or rounded cells. In tangential sections (Plate XVIII, fig. 6) the divided edges of the interlaminar cells and the cut ends of the radial pillars form a coarse and loose reticulation in which the ends of the pillars are seen as dark dots or granules. Such sections also show numerous large-sized branching astrorhizal canals. The skeleton-fibre is of unusual thickness, and the width of the interlaminar spaces is therefore proportionately reduced as compared with the width of the concentric laminæ.

Obs.—Clathrodictyon crassum is most nearly related to *C. variolare*, Rosen, and, as before mentioned, some examples of the latter make a decided approach to the present species. Typical examples of these two species cannot, however, possibly be confounded with one another. As regards its general characters *C. crassum*, Nich., is sufficiently distinguished by its constantly small size and the fact that it grows in thin laminæ. The coarse tuberculation of the surface and the comparatively large development of the astrorhizæ are also good distinctive characters. The characteristic features of the internal structure are the excessive thickness of the skeleton-fibre, the complete reticulation of the laminæ and radial pillars, and the peculiar coarse granular reticulation presented by tangential sections. The largest specimen I have seen had a long diameter of about 8 cm., and a thickness in the centre of rather more than 1 cm.

Description.—C. crassum is only known as occurring in the Wenlock Limestone of Britain, in which it is a rare form. I have collected examples at Ironbridge and Dormington, and Mr. William Madeley, to whom I am indebted for much friendly assistance, has been good enough to give me a specimen from Dudley.

12. Clathrodictyon fastigiatum, *Nich.* Pl. XIX, figs. 1—5.

Clathrodictyon fastigiatum, *Nicholson.* Introduction, p. 43, fig. 3 (figure only), 1886.

— — *Nicholson.* Ann. Nat. Hist., ser. 5, vol. xix, p. 8, pl. ii, figs. 3 and 4, 1887.

The cœnosteum in this species is laminar and cake-like, of variable size, but of small thickness, full-grown examples having a diameter of 15 cm. or more, with a thickness in the centre of from 2 to 3 cm. The under surface (Plate XIX, fig. 2) is covered with a concentrically-wrinkled epitheca. The superior side of the cœnosteum is flat, or slightly undulated (Plate XIX, fig. 1), but is quite free from "mamelons." The surface exhibits, when well preserved, numerous vermiculate and inosculating ridges formed by rows of elongated tubercles (Plate XIX, fig. 3). Small and remote astrorhizæ may sometimes be recognised in thin sections; but their development is imperfect, and I have not detected their presence on the free surface.

As regards its internal structure, the cœnosteum is composed of bent and crumpled concentric laminæ, of which about five (or four interlaminar spaces) usually occupy the space of 1 mm. As shown by vertical sections (Plate XIX, fig. 5) the laminæ are bent in two ways. In the first place they are bent into numerous chevron-like foldings, no traces of which appear on the surface of the cœnosteum. In the second place each lamina is minutely crumpled or inflected in such a way that the interlaminar spaces are constricted into rows of very imperfect and more or less open vesicles. The radial pillars are developed from the point of inflection of the laminæ, but are thin and largely imperfect. Hence, in vertical sections, the bent and crumpled laminæ are far more conspicuous than the radial pillars. Tangential sections (Plate XIX, fig. 4) exhibit the irregularly sinuous and vermiculate edges of the transversely-divided and folded laminæ, the cut ends of the radial pillars appearing in these as dark rounded dots. Occasionally we may also recognise in tangential sections scattered points round which rows of dots are disposed in a radiating manner. Such points represent the centres of small astrorhizæ.

Obs.—*C. fastigiatum* has certain relationships with *C. variolare*, Rosen sp., and specimens occasionally occur which present a mixture of the characters of the two forms. In typical examples, however, the present beautiful species cannot readily be confounded with any other known member of the genus *Clathrodictyon*. It is distinguished from its nearest allies (viz. *C. variolare,* Rosen, and *C. vesiculosum,* Nich. and Mur.) by the greater remoteness of the concentric laminæ, and by the peculiar and constant chevron-like and angular folds into which the laminæ are thrown. The appearances presented by tangential sections are also exceedingly characteristic, and quite unlike those seen in any other species of *Clathrodictyon* with which I am acquainted. The very imperfect development of the astrorhizæ is also a point in which the present species is separated from the forms above alluded to. Lastly, as far as I have seen, the cœnosteum of *C. fastigiatum* always has the form of a thin, cake-like expansion, with a concentrically wrinkled epitheca below.

Distribution.—*C. fastigiatum* occurs abundantly in the Wenlock Limestone of Britain, and I have specimens of it from Ironbridge, Dudley, Much Wenlock, and

Dormington. I have also collected examples of this species in the Silurian ("zone of *Pentamerus esthonus*") of Kattentack, Esthonia. By the kindness of Mr. Whiteaves, I have also been enabled to examine specimens of this species belonging to the collection of the Geological Survey of Canada. The specimens in question are from Glenelg Township, near Durham, Ontario, and occur in a Magnesian Limestone belonging to the Guelph formation.

13. Clathrodictyon confertum, n. sp. Pl. XVIII, figs. 13 and 14.

Cœnosteum massive; the base, surface, and mode of growth unknown. The growth is by means of "latilaminæ," each of which is composed of excessively close-set concentric laminæ, which are so inflected as to form with the radial pillars an exceedingly fine vesicular tissue (Plate XVIII, fig. 13). The concentric laminæ seem to be incompletely developed, and tangential sections show simply a minute reticulation, interspersed with minute dark dots and lines (Plate XVIII, fig. 14). Astrorhizæ appear to be wanting.

I have hesitated greatly in founding a distinct species for this form, as I have only a single incomplete example of it, which I owe to the kindness of my friend the late Mr. Champernowne, and its state of preservation is exceedingly poor. In spite of this, there seems to be no reason to doubt that we have to deal with a species of *Clathrodictyon*, of the type of *C. vesiculosum* and *C. variolare;* and a special interest thus attaches to the specimen, as no other example of a *Clathrodictyon*[1] of this type has hitherto been detected in the Devonian Rocks in Britain. In its general aspect this form approaches in fact very closely to *C. vesiculosum*, but its skeletal tissue is even finer than in the latter. Vertical sections, indeed, show simply a congeries of excessively small cells arranged obscurely in lines, and disposed in successive strata or "latilaminæ" of a millimètre in thickness, or thereabouts (Plate XVIII, fig. 13). Owing partly to its fineness, and partly to its very poor state of preservation, I have found it impossible to make reliable measurements of the number of interlaminar spaces in a given space. Moreover, the concentric laminæ do not seem to be so well developed as in *C. vesiculosum*, and the general structure is therefore more thoroughly vesicular than is the case in the latter species. The same feature is observable in tangential sections. Another character which distinguishes it from *C. vesiculosum* is the apparent absence of

[1] Among some fossils submitted to me for examination from the Devonian Rocks of France by Dr. Daniel Œhlert, I find more than one form of *Clathrodictyon*. One of these approaches very close to *C. vesiculosum*, Nich. and Mur., which is so characteristic a type in the Silurian Rocks. The specimen in question is found in the Devonian deposits of St. Jean, Laval, Mayenne.

astrorhizæ. Lastly, though the fragmentary nature of my material precludes my forming a clear notion as to the mode of growth of the species, the cœnosteum may be stated with certainty to be massive and not laminar.

Distribution.—The only known example of this form was collected by Mr. Champernowne in the Middle Devonian Limestones of Pit Park Quarry, Dartington, South Devon.

14. Clathrodictyon regulare, *Rosen* sp. Pl. XVIII, figs. 8—11*a*.

Stromatopora regularis, *von Rosen*. Ueber die Natur der Stromatoporen, p. 74, pl. ix, figs. 1—4, 1887.
Clathrodictyon regulare, *Nicholson*. Ann. Nat. Hist., ser. 5, vol. xix, p. 10, pl. ii, figs. 5 and 6, 1887.

The cœnosteum in this species is of small size; sometimes laminar and discoidal, with a basal epitheca, sometimes encrusting foreign bodies. The largest specimen examined is less than 5 cm. in diameter, with a maximum thickness of little more than a centimètre. As the concentric laminæ are nearly horizontal, or only slightly undulated, the surface is smooth, and "mamelons" are absent. The surface, however, often exhibits the edges of the exfoliated laminæ (Plate XVIII, fig. 8); and in well-preserved examples (fig. 9) it is seen to be studded with small rounded tubercles representing the free ends of the radial pillars, which often send out radiating horizontal prolongations, enclosing minute interstitial pores.

As regards internal structure, the skeleton is made up of horizontal or slightly flexuous concentric laminæ, of which about six (or five interlaminar spaces) occupy the space of 1 mm. The laminæ (Plate XVIII, figs. 10 and 10 *a*) are thick, often traversed horizontally by a median dark line and slightly crumpled. At each point of inflection the lamina sends down from its under surface a stout radial pillar, which may only project a short way downwards into the interlaminar space, but more commonly becomes connected with the lamina next below. The interlaminar spaces thus become broken up into rows of regular oblong cells, which are upon the whole slightly convex on their superior aspect, and which, though very variable in this respect, are mostly about one-third of a millimètre in length. Tangential sections (Plate XVIII, figs. 11, 11 *a*) exhibit large dark rounded dots, representing the cut ends of the radial pillars. These are often connected together by distinct radiating "arms," thus showing an imperfect form of the "hexactinellid" structure so characteristic of the species of the genus *Actinostroma.* Astrorhizæ do not appear to be developed at all.

Obs.—*Clathrodictyon regulare*, Rosen sp., is readily recognised by its slightly inflected, thick laminæ, its stout radial pil ars, the oblong, superiorly convex form of the very regularly disposed interlaminar cells (as seen in vertical sections), and the presence of a limited number of radiating "arms" connecting the radial pillars. In its general characters, both external and internal, it most nearly resembles *C. striatellum*, D'Orb, sp., with which alone it could possibly be confounded. It is, however, an altogether smaller form; its skeletal tissue is much finer, and the form of the radial pillars and interlaminar cells is quite different.

Distribution.—This species is of rare occurrence in the Wenlock Limestone of Britain, and I have not seen any specimens from any locality except Dudley. It occurs also in the Wenlock Limestone of Wisby, Gotland. Von Rosen's original specimen (which I have examined) is from the Silurian (" zone of *Pentamerus esthonus* ") of Kleine-Ruhde, Esthonia.

15. Clathrodictyon striatellum, *D'Orb.* sp. Pl. I, fig. 1; Pl. V, fig. 3, and Pl. XIX, figs. 6—12.

Stromatopora concentrica, *Lonsdale.* Silurian System, p. 680, pl. xv, fig. 31, 1839.
— striatella, *D'Orbigny.* Prodrome de Paléontologie, t. i, p. 51, 1850.
— mammillata, *Fr. Schmidt.* Sil. Form. von Ehstland, p. 232, 1858.
— — *von Rosen.* Ueber die Natur der Stromatoporen, p. 71, pl. viii, figs. 1—5, 1867.
— — *Ferd. Roemer.* Lethæa Palæozoica, part 1, p. 531, fig. 125, 1883.
Clathrodictyon striatellum, *Nicholson.* Ann. Nat. Hist., ser. 5, vol. xix, p. 6, pl. i, figs. 9 and 10, 1887.

The cœnosteum in this species is mostly laminar or hemispherical, with a concentrically wrinkled epitheca. The surface is more or less undulated, but without definite eminences or "mamelons," the concentric laminæ usually exfoliating concentrically round elevated points (Plate XIX, fig. 6). In well-preserved examples, the surface shows innumerable minute rounded tubercles, between which are small circular or oval pores (Plate XIX, fig. 7). Astrorhizæ are apparently wanting.

As regards internal structure, vertical sections (Plate XIX, fig. 8) show that the concentric laminæ are comparatively remote, about four interlaminar spaces, and therefore five laminæ, occupying the space of 1 mm.; but the interlaminar spaces are wider over the convexities of the undulated laminæ. The concentric laminæ are thrown into successive undulations, which are more pronounced in some specimens than in others, but are always gentle and regularly curved. The laminæ are also regularly crumpled in the same manner as in *C. vesiculosum*, but less completely, so that there is no appearance in vertical sections of rows of lenticular vesicles, such as are so characteristic of the latter species. Each infolding of the lamina is, however, prolonged *downwards*[1] into the interlaminar space below in the form of a more or less complete radial pillar. Some of the radial pillars are quite short, others project about half-way into the interlaminar space; others cross the space and become connected with the lamina below; finally, a few spring from the *upper* sides of the laminæ. A further very characteristic point about the radial pillars is that they are very commonly double at their bases, where they spring from their producing lamina.

Tangential sections (Plate XIX, fig. 9) of this species are much more characteristic than is usual in the genus *Clathrodictyon*. Where such a section traverses an interlaminar space, the cut ends of the radial pillars are seen in the form of dark granular masses, of considerable size, and usually of a more or less elongated or oval shape. Where the section more or less closely coincides with a concentric lamina, the cut ends of the radial pillars are more closely set and larger in size, and often form a sort of mosaic pavement, or at other times a loose reticulation. Tangential sections are also unlike similar sections of most species of this genus in the apparent absence of astrorhizal canals.

Obs.—In its general features *Clathrodictyon striatellum* can hardly be confounded with any other member of the genus. In external and superficial characters it makes a close approach to *C. regulare*, Rosen but its size is usually much greater, its general texture is coarser, and its internal structure is quite different. Its most distinctive characters are the gentle and regular undulation of the concentric laminæ, and the peculiar form of the radial pillars which spring, very commonly by a double base, from the under sides of the laminæ, and often fall short of the upper surface of the lamina next below. The exposed surfaces of the concentric laminæ in well-preserved examples show, much more clearly than is usual in the genus, the presence of innumerable zoöidal pores. The radial pillars produce no connecting-processes or "arms;" whereas these structures are occasionally developed in *C. regulare*. Lastly, the present form shows a more complete absence of the astrorhizal system—so far as my observation goes—than is the case in any related form of *Clathrodictyon*.

My identification of this form as the one which D'Orbigny had in view in establishing his *Stromatopora striatella* is based upon an examination of Lonsdale's original specimen, which served as the type of the species to the French palæonto-

[1] In the illustrations which I formerly gave of vertical sections of this species (Pl. I, fig. 1, and Pl. V, fig. 3), the figures were inadvertently reversed in position, so that the radial pillars are represented as growing from the *upper* sides of the laminæ, instead of from the lower as is really the case.

logist, and which is now in the British Museum. My identification of *Stromatopora mammillata*, Fr. Schmidt, with D'Orbigny's species, is based upon specimens of the former kindly given me by Magister Schmidt himself. I have figured a portion of the surface, and also tangential and vertical sections of one of these specimens (Plate XIX, figs. 10—12). These will show that there exists no substantial difference between the Russian and the British specimens, which I have here included in the present species. Any apparent differences which are present may probably be accounted for by the fact that the Esthonian specimens are silicified, and have therefore undergone considerable alteration.

Distribution.—*Clathrodictyon striatellum*, D'Orb., occurs in the Ordovician Rocks of Esthonia (in the "Borkholm'sche Schichten"); but elsewhere it is only known as a Silurian species. It is common in the Wenlock Limestone of Britain (Dudley, Ironbridge, Dormington, &c.), and it is also found in the Wenlock Limestone of Wisby, Gotland.

Family—LABECHIIDÆ.

Genus 1.—Labechia, *Edwards and Haime*, 1851.

(Introduction, p. 81.)

1. Labechia conferta, *Lonsd.* sp. Pl. III, figs. 7—15, and Pl. XX, figs. 1 and 2.

Monticularia	conferta,	*Lonsdale.*	In Murchison, Silurian System, p. 688, pl. xvi, fig. 5, 1839.
Labechia	—	*Milne-Edwards* and *Haime.*	Polypiers foss. des Terr. Pal., p. 280, 1851.
—	—	—	Brit. Foss. Corals, p. 269, pl. lxii, figs. 6, 6 *c*, 1855.
—	—	*Nicholson.*	Ann. and Mag. Nat. Hist., ser. 5, vol. xviii, p. 11, 1886.

Cœnosteum usually in the form of a laminar expansion of variable thickness, attached by a basal peduncle, and having the rest of the lower surface covered by a concentrically wrinkled epitheca (Plate III, figs. 7 and 8). Upper surface without monticules, covered with prominent, rounded or elongated, often conical tubercles, the apices of which may be imperforate, or which exhibit a minute circular summit-aperture. Often the tubercles become coalescent to a greater or less extent, and give rise to vermiculate ridges (Plate III, fig. 13). The surface between the tubercles is smooth, and no astrorhizal grooves are developed.

PLATE XII.

[The figures representing the minute structure of the specimens are based upon photographs, and the scale of magnification, even with the same objective, is therefore not absolutely constant. In most cases a two-inch objective has been used, and the scale of enlargement may be taken as varying from ten to twelve times, though as a matter of convenience I have generally stated it at being twelve times the natural size. Very often, however, the enlargement is only ten or eleven times the natural size. Where a higher objective has been used this is specially stated.]

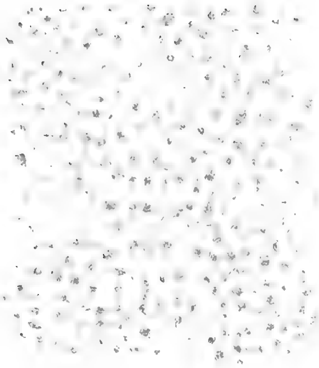
Fig. 1.—Under surface of an example of *Actinostroma clathratum*, Nich., of the natural size. Middle Devonian, Dartington. Presented to the author by Mr. Champernowne. (Page 131.)

Fig. 2.—Tangential section of *Actinostroma clathratum*, Nich., enlarged 10—12 times. Middle Devonian, Dartington.

Fig. 3.—Vertical section of the same specimen, similarly enlarged.

Fig. 4.—Portion of the surface of a weathered specimen of *Actinostroma clathratum*, Nich., enlarged, showing the radial pillars and their connecting "arms." Middle Devonian, Hebborn (Paffrath District).

Fig. 5.—Portion of the surface of a weathered example of *A. clathratum* from the Middle Devonian of Dartington enlarged. The specimen is dolomitised, and the stellate pores are the spaces left by the solution out of the matrix of the pillars and their connecting "arms."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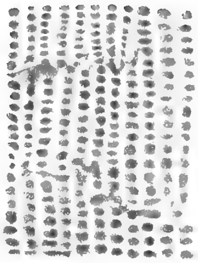
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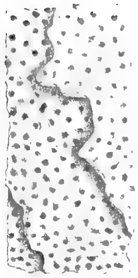
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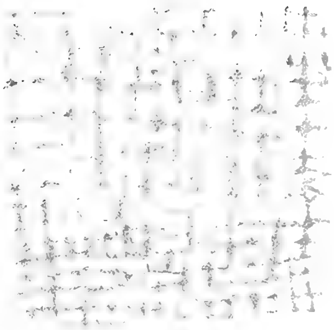
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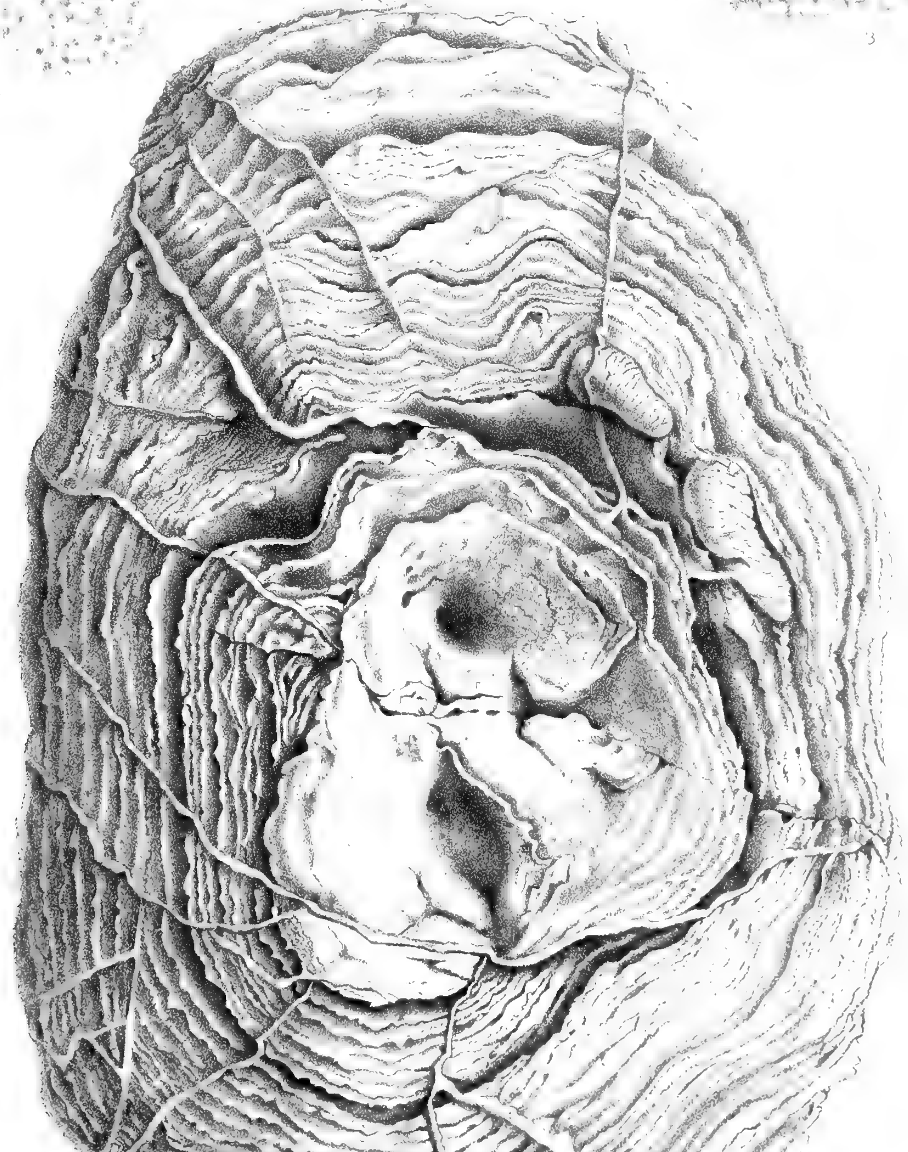
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West, Newman & C° imp.

PLATE XIII.

Fig. 1.—Tangential section of a specimen of *Actinostroma clathratum*, Nich., enlarged 10—12 times. This form possesses strong but irregularly developed radial pillars. Middle Devonian, Teignmouth. (Page 133.)

Fig. 2.—Vertical section of the same specimen similarly enlarged.

Fig. 3.—Portion of a polished specimen of *Actinostroma bifarium*, Nich., of the natural size. Middle Devonian, Teignmouth. (Page 136.)

Fig. 4.—Tangential section of *Actinostroma bifarium*, Nich., enlarged 10—12 times. Middle Devonian, Teignmouth.

Fig. 5.—Vertical section of the same, similarly enlarged.

Fig. 6.—Tangential section of a specimen of the same from the Middle Devonian of Büchel (Paffrath District), enlarged 10—12 times.

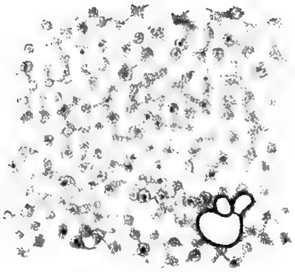
Fig. 7.—Vertical section of the preceding, similarly enlarged.

Fig. 8.—Upper surface of a broken discoidal specimen of *Actinostroma intertextum*, Nich., of the natural size. Wenlock Limestone, Ironbridge. (Page 138.)

Fig. 9.—Part of the surface of the same, enlarged twice. The specimen shows much more conspicuous astrorhizæ than is usually the case in this species.

Fig. 10.—Tangential section of *Actinostroma intertextum*, Nich , enlarged 12 times. Wenlock Limestone, Ironbridge.

Fig. 11.—Vertical section of the same, similarly enlarged.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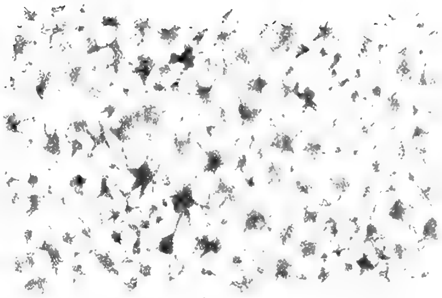
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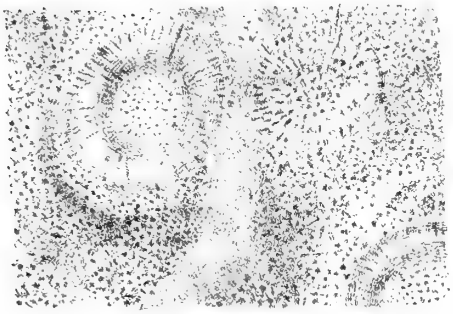
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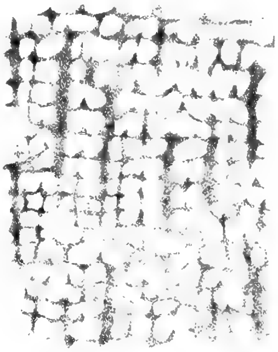
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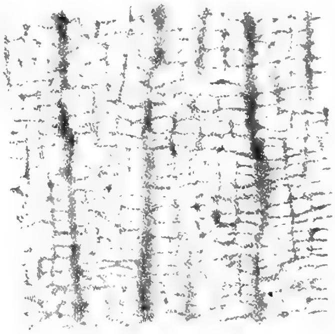
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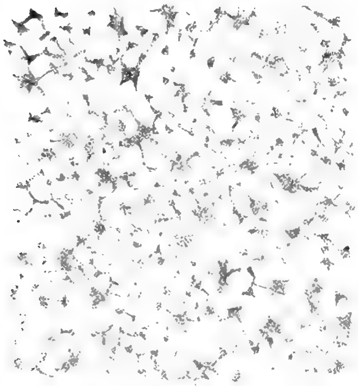
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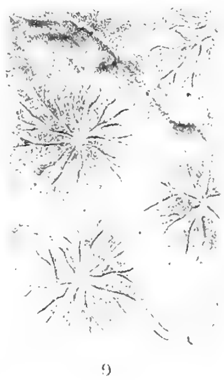
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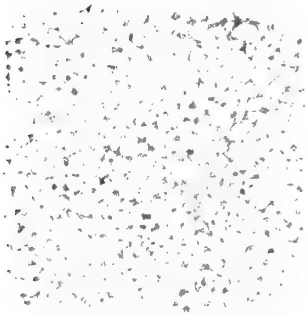
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H. A. Nicholson del.
A. T. Hollick lith.

West, Newman & Co imp.

PLATE XIV.

Fig. 1.—Portion of a polished slab of *Actinostroma stellulatum*, Nich., from the Middle Devonian, Lummaton, Devonshire, of the natural size. (Page 140.)

Fig. 2.—Portion of another polished slab of the same species, from the Middle Devonian Limestone of Dartington, Devonshire, of the natural size. The specimen is composed of parallel columns, each of which is traversed by one of the vertical canals of the astrorhizal system. Presented to the author by Mr. Champernowne.

Fig. 3.—Tangential section of *Actinostroma stellulatum*, Nich., enlarged 10—12 times. The specimen is a massive one. Middle Devonian, Teignmouth, Devonshire.

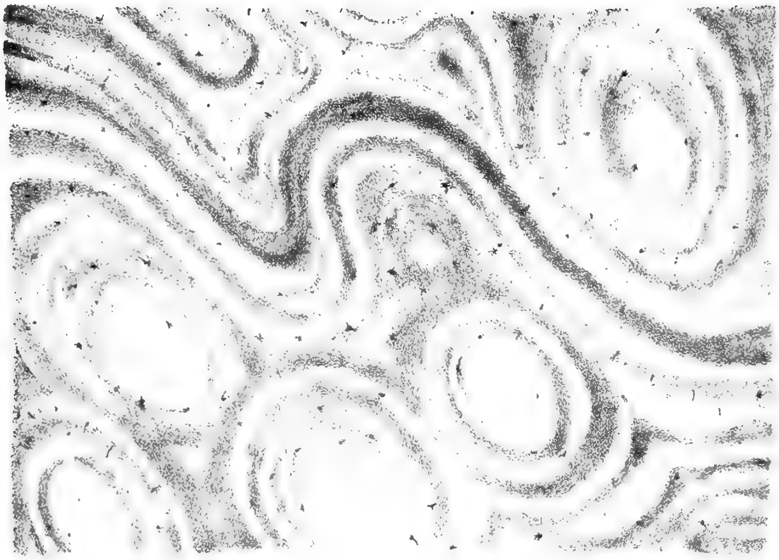
Fig. 4.—Vertical section of the same specimen, similarly enlarged. The larger rounded openings are the cut ends of the radiating astrorhizal canals.

Fig. 5.—Tangential section of a laminar example of the same species from Gerolstein, similarly enlarged. The section shows numerous capillary "arms," given off from the radial pillars.

Fig. 6.—Vertical section of the same specimen, similarly enlarged.

Fig. 7.—Tangential section of an example of the same species from the Middle Devonian of Dartington, similarly enlarged. The specimen is formed of numerous parallel columns, and the section shows part of the centre of one column.

Fig. 8.—Vertical section of the preceding specimen, similarly enlarged. The art figured embraces half of one of the columns.



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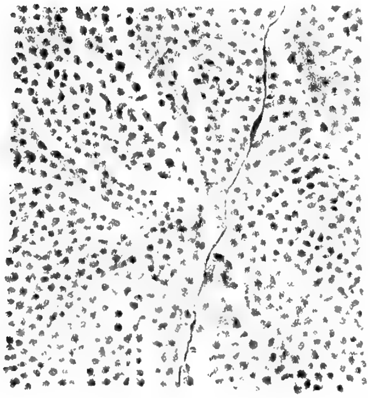

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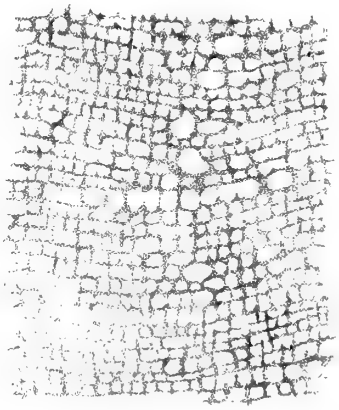

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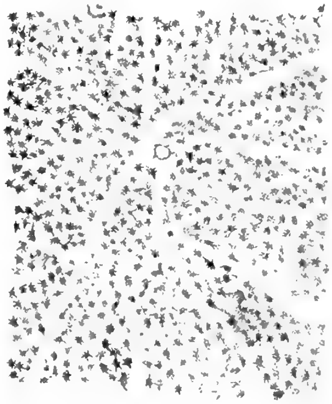

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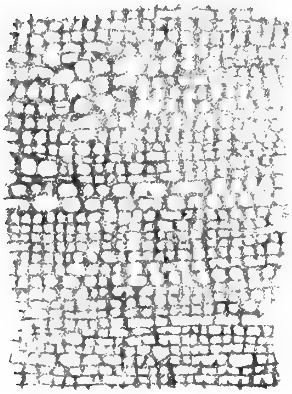

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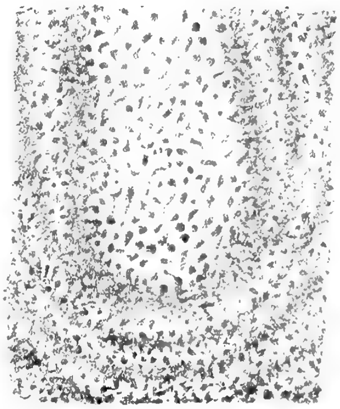

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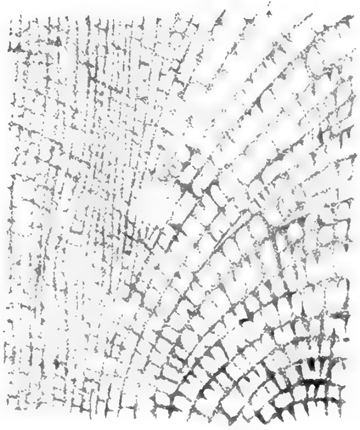

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H.A.Nicholson del.
A.T.Hollick lith.

West Newman & Co imp.

PLATE XV.

A large, partially exfoliated specimen of *Actinostroma stellulatum*, Nich., of the natural size, from the collection of Mr. Vicary. Middle Devonian, Chircombe Bridge Quarry, Newton Abbot, Devonshire. So far as the British Devonian series is concerned, this beautiful specimen is probably unique, but very similar examples occur in the Eifel. It belongs to a variety of *A. stellulatum*, in which the cœnosteum is massive and the surface is covered with small pointed eminences corresponding with the centres of the astrorhizæ. (Page 140.)

PLATE XV

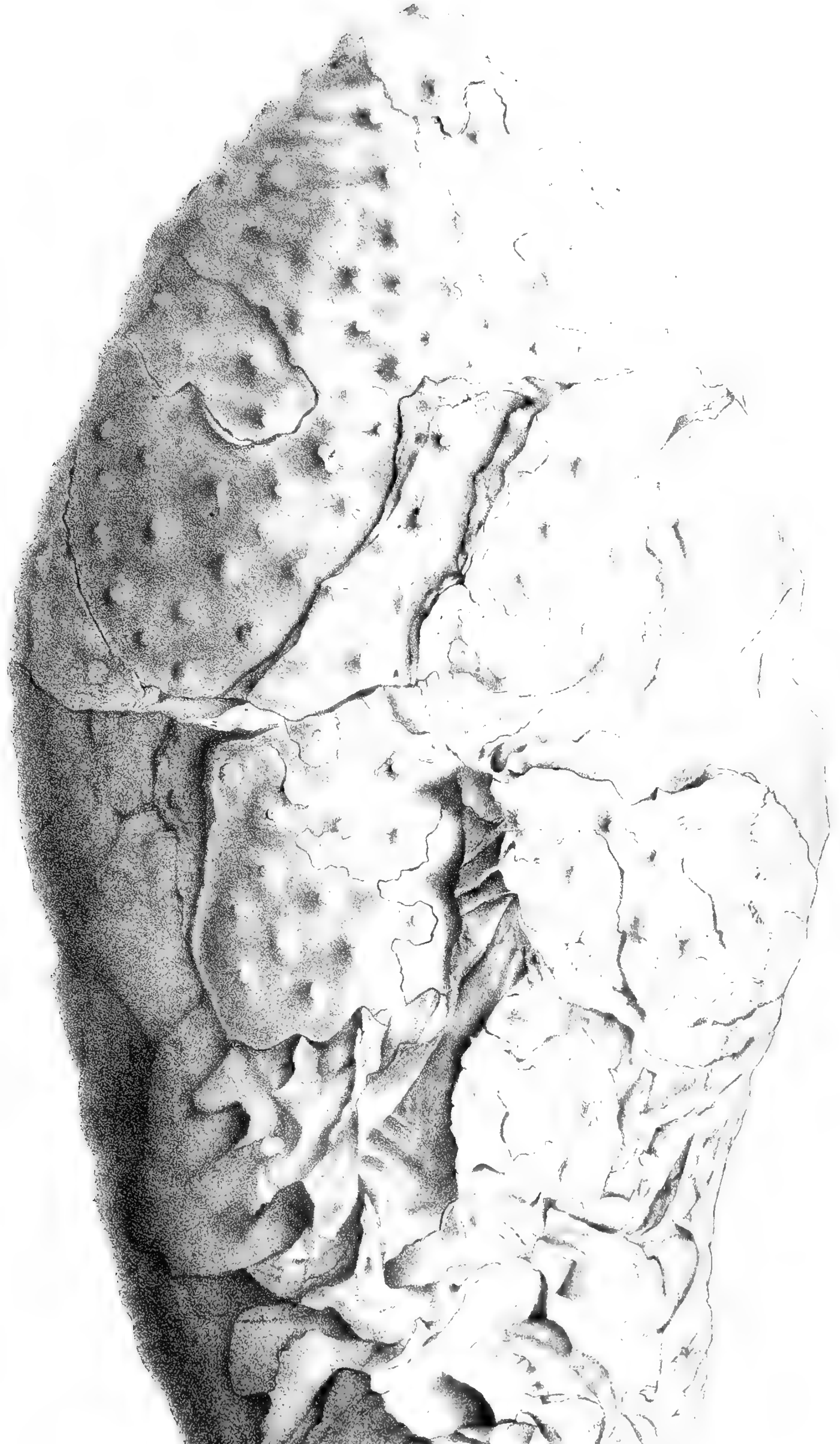

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PLATE XVI.

Fig. 1.—Part of a polished slab of *Actinostroma verrucosum*, Goldf. sp., of the natural size. Middle Devonian, Teignmouth. (Page 134.)

Fig. 2.—Tangential section of the same, enlarged 10—12 times. The skeleton (as so commonly is the case in specimens from the Devonian Limestones of Britain) has undergone crystallization, and has been distorted by pressure.

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

Fig. 4.—A specimen of *Actinostroma verrucosum*, Goldf. sp., from the Middle Devonian of Büchel (Paffrath district), of the natural size.

Fig. 5.—Tangential section of the same, enlarged 10—12 times. The section traverses one of the astrorhizal cylinders.

Fig. 6.—Vertical section of the same, similarly enlarged.

Fig. 7.—Tangential section of another example of the same species from Büchel, enlarged 24 times, showing the axial canals of the radial pillars.

Fig. 8.—One of the "mamelons" of *Actinostroma verrucosum*, enlarged about 3 times, showing the central opening of a vertical astrorhizal canal, and the radiating canals of the last astrorhiza.

Fig. 9.—Fragment of *Actinostroma hebbornense*, Nich., from the Middle Devonian of Hebborn (Paffrath district), of the natural size. The specimen shows the surface of one of the concentric laminæ as exposed by fracture. (Page 137.)

Fig. 10.—Tangential section of the same, enlarged 10—12 times.

Fig. 11.—Portion of the preceding section, enlarged 24 times.

Fig. 12.—Vertical section of the same specimen, enlarged 10—12 times.

Fig. 13.—Tangential section of *Actinostroma hebbornense*, Nich., from the Middle Devonian of Teignmouth, enlarged 10—12 times. The structure of this specimen is finer and closer than is usual in the species, and the skeleton has been distorted by pressure, and partially obliterated by crystallization.

Fig. 14.—Vertical section of the same, similarly enlarged.

Fig. 15.—Tangential section of another example of *Actinostroma hebbornense*, Nich., from the Middle Devonian of Teignmouth, enlarged 10—12 times. This specimen agrees with the type of the species in the proportions of its skeleton, and likewise exhibits astrorhizæ; but, like the preceding, it has been much affected by crystallization and pressure.

Fig. 16.—Vertical section of the same, similarly enlarged.

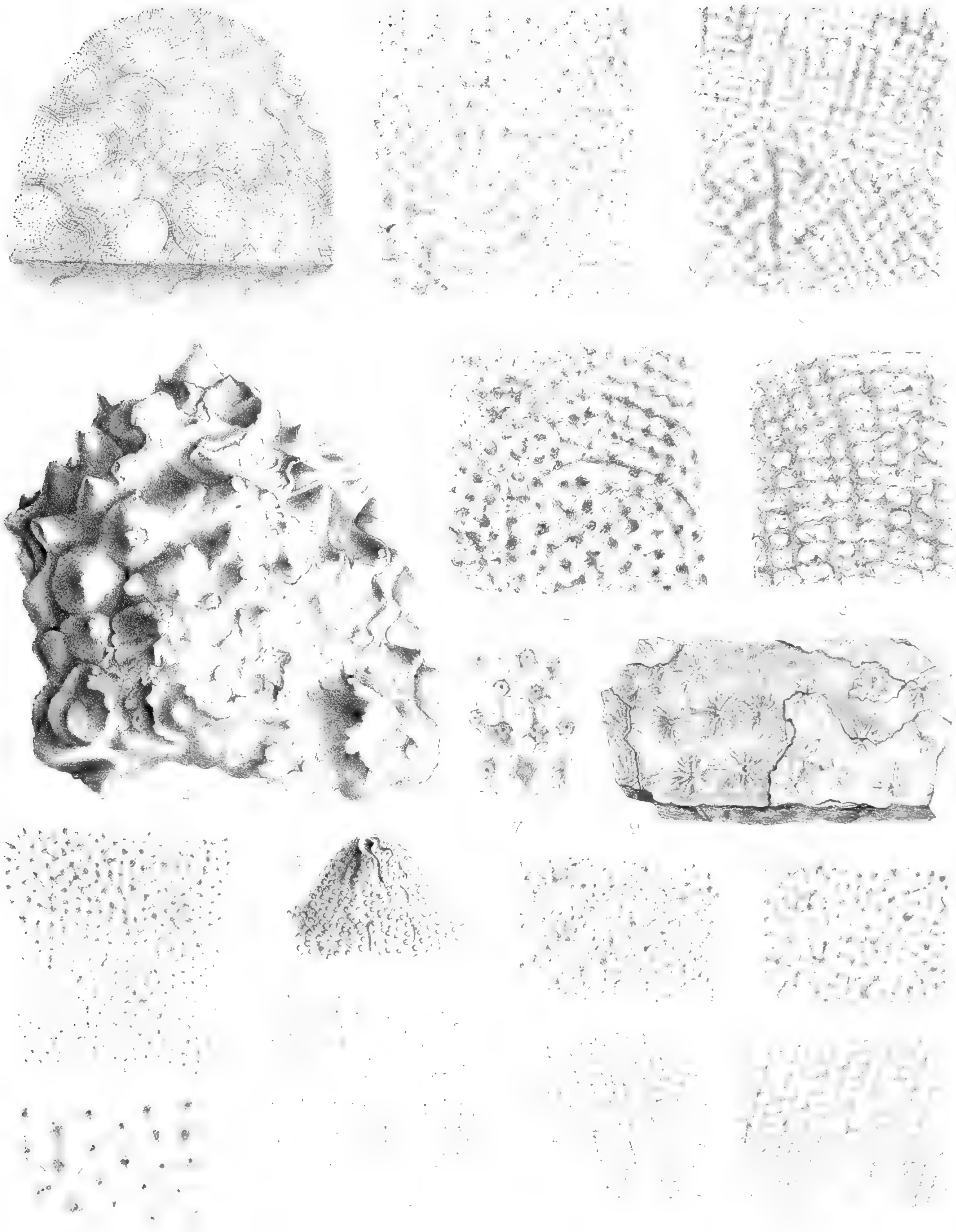

PLATE XVII.

Fig. 1.—Fragment of *Actinostroma astroites*, Rosen sp., from the Silurian (Upper Oesel Group) of Kaugatoma-Pank, Esthonia, of the natural size. The specimen shows the surface of one of the concentric laminæ as exposed by fracture, and exhibits the faintly-marked astrorhizæ. (Page 143.)

Fig. 2.—Tangential section of a specimen of *Actinostroma astroites*, Rosen, from the Wenlock Limestone of Much Wenlock, enlarged 10—12 times. The minute structure is better preserved in this than in any Russian specimen which I have examined.

Fig. 3.—Vertical section of the same, similarly enlarged, showing the dark concentric lines of growth.

Fig. 4.—Portion of the preceding section, enlarged about 24 times.

Fig. 5.—Tangential section of another specimen of *Actinostroma astroites*, Rosen, from the Wenlock Limestone of Much Wenlock, enlarged 10—12 times. The specimen is traversed by numerous minute "Caunopora-tubes."

Fig. 6.—Vertical section of the preceding, similarly enlarged.

Fig. 7.—Vertical section of specimen of *Actinostroma astroites*, Rosen, sp., from the Wenlock Limestone of Ironbridge, enlarged 10—12 times. The minute structure of the skeleton, as in most examples of the species, is imperfectly preserved, and the cœnosteum contains embedded in it numerous *Spirorbes*, arranged in vertical rows as they became successively buried in the growing Stromatoporoid.

Fig. 8.—Tangential section of *Actinostroma fenestratum*, Nich., from the Middle Devonian of Teignmouth, enlarged 10—12 times. (Page 146.)

Fig. 9.—Vertical section of the same, similarly enlarged. The minute structure of the skeleton is much obscured by crystallization and pressure.

Fig. 10.—Vertical section of the type-specimen of *Clathrodictyon vesiculosum*, Nich. and Mur., from the Clinton Formation, Yellow Springs, Ohio. Enlarged 10—12 times. (Page 147.)

Fig. 11.—Tangential section of the same, similarly enlarged.

Fig. 12.—Vertical section of a specimen of *Clathrodictyon vesiculosum*, Nich. and Mur., from the Wenlock Limestone of Much Wenlock, enlarged 10—12 times. (P. 147.)

Fig. 13.—Tangential section of the same, similarly enlarged.

Fig. 14.—A fragment of *Clathrodictyon variolare*, Rosen sp., of the natural size, from the Silurian ("Raiküllsche Schichten") between Saage and Ridaka, Esthonia. The laminæ in this specimen exhibit rounded "mamelons," but these are by no means invariably present in this species. (Page 150.)

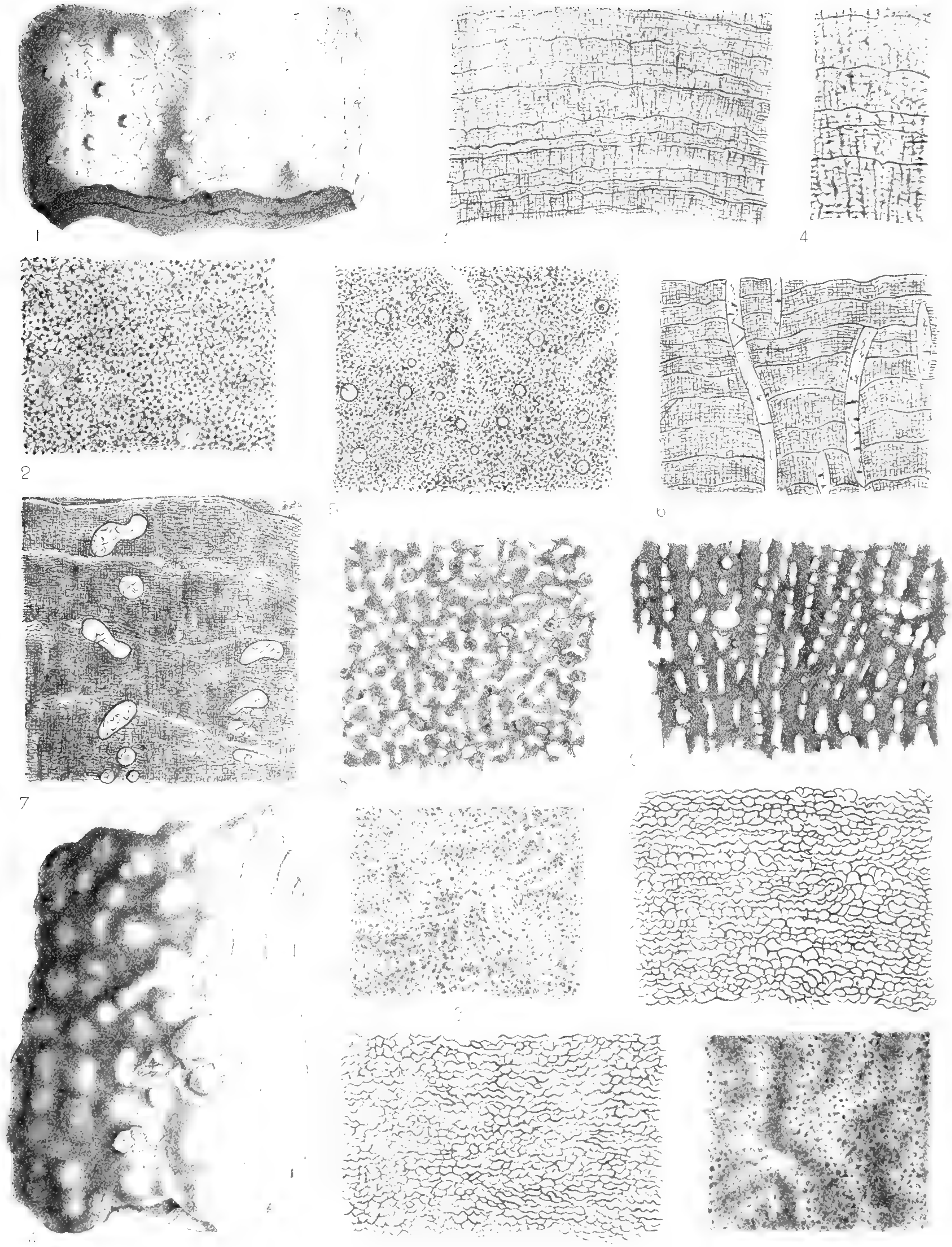
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PLATE XVIII.

Fig. 1.—Vertical section of *Clathrodictyon variolare*, Rosen, enlarged 10—12 times. From a specimen from the Silurian Limestones (zone of *Pentamerus esthonus*) Kattentack, Esthonia. (Page 150.)

Fig. 2.—Tangential section of the type specimen of the same species enlarged 10—12 times, from the Silurian Rocks of Errinal, Esthonia, from a fragment presented to the author by Magister Friedrich Schmidt.

Fig. 3.—Vertical section of the preceding, similarly enlarged.

Fig. 4.—Vertical section of a variety of *Clathrodictyon variolare*, Rosen, from the Wenlock Limestone of Dormington, enlarged 10—12 times.

Fig. 5.—Tangential section of the preceding specimen, similarly enlarged. The section traverses one of the astrorhizæ.

Fig. 6.—Vertical section of *Clathrodictyon crassum*, Nich., from the Wenlock Limestone of Ironbridge, enlarged 10—12 times. (Page 151.)

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

Fig. 8.—Half of a specimen of *Clathrodictyon regulare*, Rosen, from the Wenlock Limestone of Dudley of the natural size. (Page 155.)

Fig. 9.—Portion of the surface of the same, similarly enlarged.

Fig. 10.—Vertical section of the same, enlarged 10—12 times.

Fig. 10 *a*.—Small portion of the preceding, enlarged 22 times.

Fig. 11.—Tangential section of the same, enlarged 10—12 times.

Fig. 11 *a*.—Small portion of the preceding, enlarged about 22 times.

Fig. 12.—Under surface of a small specimen of *Clathrodictyon vesiculosum*, Nich. and Mur., from the Wenlock Limestone of Dudley, of the natural size. The missing half of the specimen is restored in outline. (Page 147.)

Fig. 13.—*Clathrodictyon confertum*, Nich., Middle Devonian, Dartington. Vertical section, enlarged 10—12 times. From a specimen presented to the author by Mr. Champernowne. (Page 154.)

Fig. 14.—Tangential section of the same, similarly enlarged.

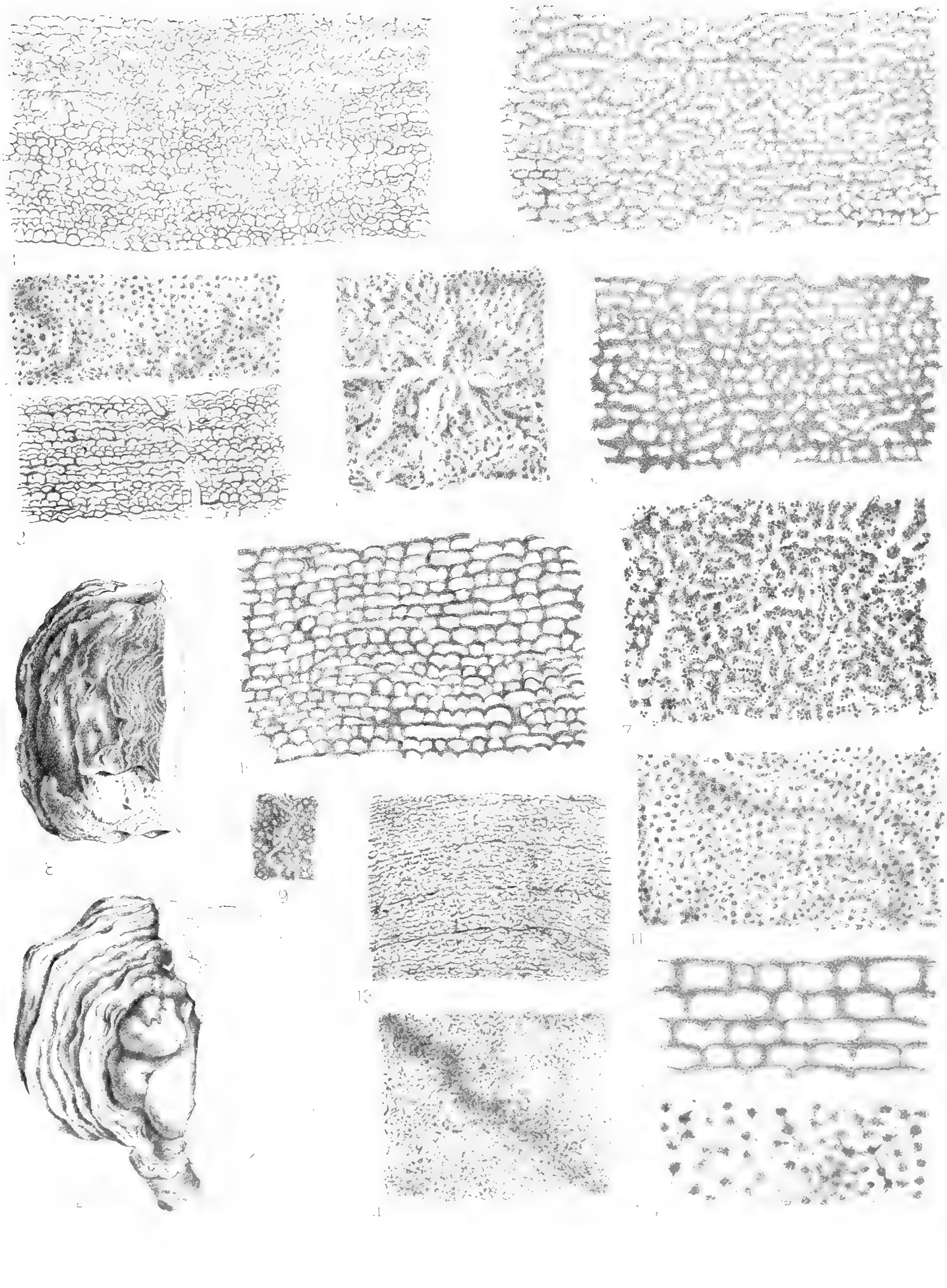
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PLATE XIX.

Fig. 1.—*Clathrodictyon fastigiatum*, Nich., a small specimen from the Wenlock Limestone of Ironbridge, showing the upper surface, of the natural size. (Page 152.)

Fig. 2.—Under surface of the same, showing the wrinkled epitheca.

Fig. 3.—Surface of a specimen of the same from the Wenlock Limestone of Dudley, of the natural size.

Fig. 4.—Tangential section of a specimen of the same from the Wenlock Limestone of Ironbridge, enlarged 10—12 times.

Fig. 5.—Vertical section of the preceding, enlarged 10—12 times.

Fig. 6.—A specimen of *Clathrodictyon striatellum*, D'Orb. sp., from the Wenlock Limestone of Dudley, showing the upper surface, of the natural size. (Page 156.)

Fig. 7.—Portion of the weathered surface of another specimen of the same from Dudley, showing zoöidal pores, enlarged.

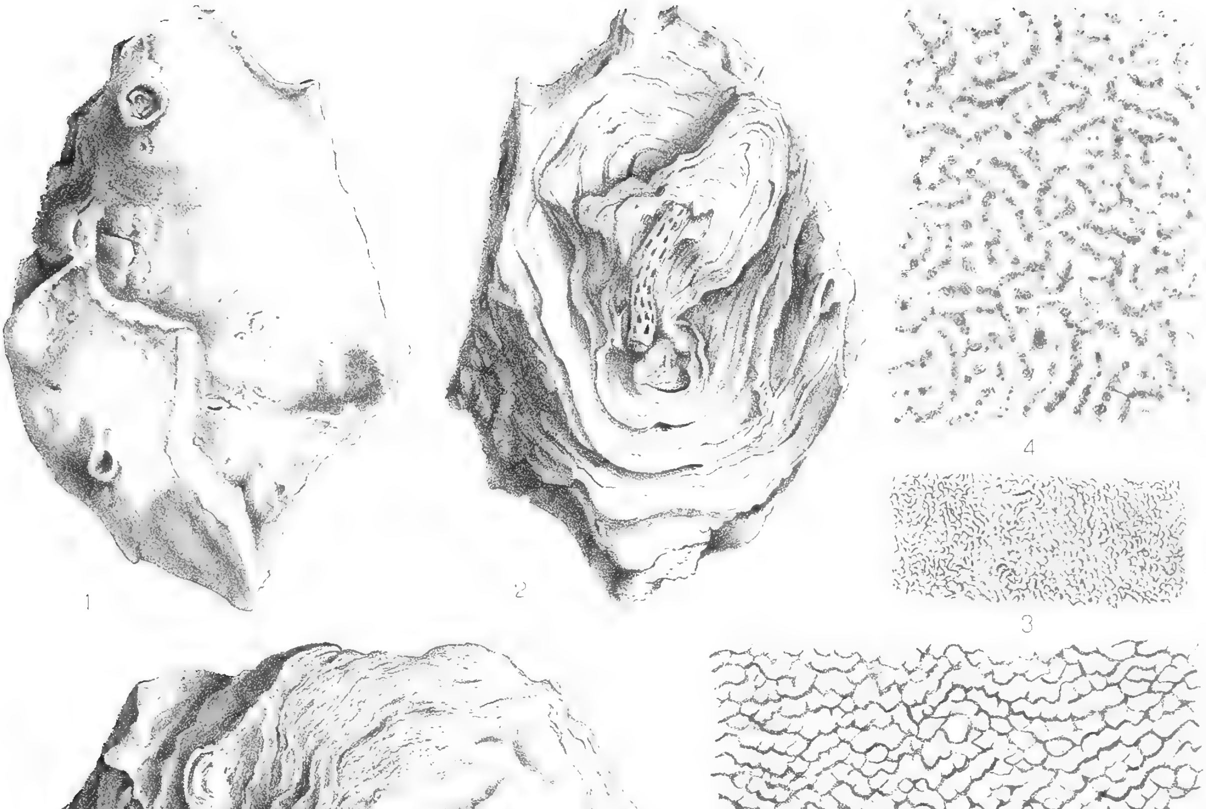
Fig. 8. Vertical section of a specimen of the same, from the Wenlock Limestone of Ironbridge, enlarged 10—12 times. The vertical sections of this species figured in Part 1 of this Monograph (Plate I, fig. 1, and Plate V, fig. 3) have been inadvertently reversed in position, and their lower margin should properly be placed uppermost.

Fig. 9.—Tangential section of the preceding specimen, enlarged 10—12 times. Part of the section corresponds with an interlaminar space, and part corresponds with one of the concentric laminæ.

Fig. 10.—Part of the surface of a silicified specimen of *Stromatopora mammillata*, Fr. Schmidt, from the "Borkholm'sche Schichten" of Esthonia, enlarged 3 times. From a specimen presented to the author by Magister Schmidt. (Page 158.)

Fig. 11.—Vertical section of the preceding specimen, enlarged about 14 times.

Fig. 12.—Tangential section of the same, enlarged 14 times. The appearance of a dark centre to the radial pillars is the result of silicification.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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1888.

LONDON:
MDCCCLXXXIX.

A SUPPLEMENTARY MONOGRAPH

OF THE

TERTIARY ENTOMOSTRACA

OF

ENGLAND.

BY

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

AND

C. DAVIES SHERBORN, F.G.S.

PAGES 1—55. PLATES I—III.

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A SUPPLEMENTAL MONOGRAPH

OF THE

TERTIARY ENTOMOSTRACA OF ENGLAND.

THE Tertiary Entomostraca (Ostracoda) of England, at first treated of in a Monograph for the Palæontographical Society in 1857, were revised by one of us in the 'Geological Magazine,' 1870, pp. 155—159. The researches of G. O. Sars and G. S. Brady, with D. Robertson and others, elucidating the relationships of the genera and species among recent forms, gave effect in a great degree to that revision; and their continued labours have further helped us.

Since the publication of the Revision, eighteen years ago, besides there being some additional corrections to be noticed, several new species have come to hand, late research in the fossiliferous deposits of Tertiary age having enabled our friends to add to the collections we have made for ourselves, so that the known English Tertiary forms are now upwards of one hundred in number. The British Post-Tertiary species are still more numerous.[1] Some of the latter were described in the Monograph for year 1855 (dated on title-page 1856, but issued in 1857), and what relates to them in the new researches is here noticed.

The notices and descriptions of revised and new forms will be arranged according to their alliances, and as far as possible in a Natural Order, in accordance with the grouping of genera adopted by Dr. G. S. Brady in his latest memoirs on recent Ostracoda.

[1] See the 'Monograph of the Post-Tertiary Entomostraca,' by Brady, Crosskey, and Robertson, Palæontographical Society, 1874.

List of the Cyprididæ in their Natural Order.

Cypris, *Müller*, 1785.
Chlamydotheca, *De Saussure*, 1858.
Cypridea, *Bosquet*, 1852. (Fossil.)
Cyprinotus, *Brady*, 1886.
Cypridopsis, *Brady*, 1867.
Potamocypris, *Brady*, 1870.
Paracypris, *G. O. Sars*, 1865.
Phlyctenophora, *Brady*, 1880.
Aglaia, *Brady*, 1867.
Notodromas, *Lilljeborg*, 1853.
Argillœcia, *G. O. Sars*, 1865.
Candona, *Baird*, 1850.
Pontocypris, *G. O. Sars*, 1865.
Macrocypris, *Brady*, 1867.
Bythocypris, *Brady*, 1880.
Bairdia, *M'Coy*, 1844.

List of the Cyprididæ, of Freshwater and of Marine Habitats respectively.

Freshwater Genera (sometimes Estuarine):
Cypris, *Müller*, 1785.
Chlamydotheca, *De Saussure*, 1858.
Cyprinotus, *Brady*, 1886.
Cypridopsis, *Brady*, 1867.
Potamocypris, *Brady*, 1870.
Notodromas, *Lilljeborg*, 1853.
Candona, *Baird*, 1850.
Cypridea, *Bosquet*, 1852. Fossil only.

Marine Genera:
Paracypris, *G. O. Sars*, 1865.
Phlyctenophora, *Brady*, 1880.
Aglaia, *Brady*, 1867.
Argillœcia, *G. O. Sars*, 1865.
Pontocypris, *G. O. Sars*, 1865.
Macrocypris, *Brady*, 1867.
Bythocypris, *Brady*, 1880.
Bairdia, *M'Coy*, 1844.

Darwinulidæ, represented by the following freshwater genus:[1]
Darwinula, *Brady & Robertson*, 1870 and 1885.

CYTHERIDÆ.—These are marine with very few exceptions.

[1] Possibly *Cyprione*, found in the Wealden strata ('Quart. Journ. Geol. Soc.,' vol. xli, 1885, p. 344), belongs to this family.

List of the British Tertiary (and some Post-Tertiary) Ostracoda.

(The Illustrations referred to are in the Supplement. Figures of the other species are in the Monograph.)

A. CYPRIDIDÆ.

I. Cypris, *Müller.*

Page 9. 1. Cypris Browniana, *Jones.* Post-Tertiary and Pliocene.
,, 1*. — — var. tumida, *Jones.* Post-Tertiary.
,, 9. 2. — lævis (*olim* C. ovum), *Müller.* Post-Tertiary.
,, 9. 3. — gibba, *Ramdohr.* Post-Tertiary, Pliocene, and Oligocene.
,, 10. 4. — reptans (*olim* Candona reptans) (*Baird*). Post-Tertiary and Pliocene.

II. Cypridopsis, *Brady & Robertson.*

Page 10. 1. Cypridopsis vidua (*Müller*). Post-Tertiary.
,, 10. 2. — obesa, *Brady & Robertson.* Post-Tertiary and Pliocene.

III. Potamocypris, *Brady.*

Page 11. 1. Potamocypris trigonalis, *Jones.* Post-Tertiary and Pliocene.
,, 11. 1*. — — var. lævis, *Jones.* Post-Tertiary and Pliocene.
,, 11. 2. — tuberculata, *Jones.* Pliocene.
,, 11. 3. — Brodiei, *sp. nov.* Oligocene. Woodcut, fig. 1.

IV. Aglaia, *Brady.*

Page 12. 1. ? Aglaia cypridoides, *Jones & Sherborn.* Pliocene. Pl. III, figs. 2 *a*, *b*, *c*.

V. Candona, *Baird.*

Page 12. 1. Candona compressa (*olim* Cypris setigera) (*Koch*). Post-Tertiary.
,, 13. 2. — candida, *Müller.* Post-Tertiary and Pliocene.
,, 13. 3. ? — subæqualis, *Jones.* Post-Tertiary.
,, 13. 4. — Forbesii, *Jones.* Oligocene.
,, 13. 5. — Richardsoni, *Jones.* Eocene (Woolwich and Croydon).

VI. Cypridea, *Bosquet.*

Page 14. 1. Cypridea spinigera (*olim* Cytherideis ? unicornis) (*Sowerby*). Oligocene and Wealden. Pl. I, figs. 8—11; Pl. III, figs. 1 *a*, *b*.

VII. Pontocypris, *Sars*.

Page 16. 1. ? Pontocypris, sp. Oligocene. Pl. I, fig. 13 *a*.

VIII. Bythocypris, *Brady*.

Page 16. 1. Bythocypris subreniformis, *Jones & Sherborn*. Eocene (Bracklesham). Pl. I, figs. 19 *a*, *b*.

IX. Bairdia, *M'Coy*.

Page 16. 1. Bairdia subdeltoidea (*Münster*). Eocene (Bracklesham) and Cretaceous. Pl. I, figs. 15 *a*, *b*.
,, 17. 2. — sp. Pliocene.
,, 17. 3. — sp. ? Eocene (Bracklesham).
,, 17. 4. — subtrigona (*olim* subdeltoidea), *Bornem*. Eocene (London).
,, 17. 5. — fusca (*olim* subdeltoidea), *Brady*. Pliocene.
,, 17. 6. — contracta, *Jones*. Eocene (Barton).
,, 17. 7. — Londinensis, *Jones & Sherborn*. Eocene (London). Pl. II, figs. 18 *a*, *b*.
,, 18. 8. — rhomboidea, *Jones & Sherborn*. Pliocene. Pl. I, figs. 3, *a*, *b*.
,, 18. 9. — ovoidea, *Jones & Sherborn*. Eocene (London). Pl. III, figs. 3 *a*, *b*.

B. DARWINULIDÆ.

X. Darwinula, *Brady & Robertson*.

Page 18. 1. Darwinula Stevensoni, *Brady & Robertson*. Pliocene.

C. CYTHERIDÆ.

XI. Cythere, *Müller*.

a. Subtriangular or peachstone forms.

Page 19. 1. Cythere convexa (*olim* punctata), *Baird*. Pliocene.
,, 19. 2. — trigonula, *Jones*. Pliocene.
,, 19. 3. — striatopunctata, *Jones*. Oligocene and Eocene (Barton and Bracklesham).
,, 20. 4. — Wetherelli, *Jones*. Oligocene and Eocene (Barton).

f. Oblong forms, with longitudinal wrinkles or ridges.

g. Oblong forms, with longitudinal ridges and reticulation.

h. Subquadrate forms, with marginal ridges and central swelling; often reticulated.

XII. Cythereis, *Jones.*

XIII. Cytheridea, *Bosquet.*

Page 37. 2.*Cytheridea Muelleri, var. torosa, *Jones.* Oligocene and Eocene (Woolwich).
,, 37. 3. — montosa, *sp. nov.* Oligocene. Woodcut, fig. 4.
,, 38. 4. — debilis, *Jones.* Oligocene and Eocene (Bracklesham). Pl. I, fig. 16.
,, 38. 5. — pinguis, *Jones.* Pliocene.
,, 38. 6. — elongata, *Brady.* Pliocene. Pl. III, figs. 20 *a*, *b*, 21, 22.
,, 38. 7. — Sorbyana, *Jones.* Post-Tertiary.
,, 39. 8. — punctillata, *Brady.* Post-Tertiary and Pliocene. Pl. I, fig. 2.
,, 39. 9. — perforata (*Roemer*). Oligocene, Eocene (Barton), and Cretaceous. Pl. I, fig. 14.
,, 39. 9.* — — var. insignis, *Jones.* Eocene (London).
,, 39. 10. — glabra, *Jones.* Eocene (London).
,, 40. 11. — sp. Eocene (Woolwich).
,, 40. 12. ? — barbata, *Sowerby.* Eocene (Highgate).

XIV. Krithe, *Brady, Crosskey, & Robertson.*

Page 40. 1. Krithe Bartonensis (*Jones*). Post-Tertiary and Eocene (Barton and Highcliff).
,, 41. 2. — glacialis, *Brady, Crosskey, & Robertson.* Post-Tertiary and Eocene (London).
,, 41. 3. — Londinensis, *Jones & Sherborn.* Eocene (London). Pl. II, figs. 20 *a*, *b*.

XV. Xestoleberis, *G. O. Sars.*

Page 41. 1. Xestoleberis Colwellensis, *Jones & Sherborn.* Oligocene. Pl. I, figs. 13 *b*, *c*.
,, 42. 2. — aurantia (*Baird*). Var. *nov.* Oligocene. Pl. III, figs. 23 *a*, *b*.

XVI. Loxoconcha, *G. O. Sars.*

Page 42. 1. Loxoconcha tamarindus, *Jones.* Pliocene.

XVII. Pseudocythere, *G. O. Sars.*

Page 42. 1. Pseudocythere attenuata, *Jones.* Eocene (Barton).
,, 43. 2. — Bristovii, *sp. nov.* Oligocene. Woodcut, fig. 5.

XVIII. Cytherura, *G. O. Sars.*

Page 43. 1. Cytherura Prestwichiana, *Jones & Sherborn.* Eocene (Bracklesham). Pl. I, figs. 20 *a*, *b*.
,, 44. 2. — clathrata, *Sars.* Pliocene. Pl. III, figs. 24 *a*, *b*.

XIX. Cytheropteron, *G. O. Sars.*

Page 44. 1. Cytheropteron triangulare (*Reuss*). Eocene (London) and Cretaceous (Europe). Pl. II, figs. 19 *a*, *b*, *c*.

XX. Cytherideis, *Jones*.

Page 45. 1. Cytherideis Colwellensis, *Jones*. Oligocene.
,, 45. 2. — botellina, *Jones*. Pliocene.
,, 45. 3. — sp. Oligocene.
,, 45. 4. — gracilis (*Reuss*). Oligocene. Pl. I, fig. 12.
,, 46. 5. ? — unisulcata, *Jones*. Oligocene.
,, 46. 6. ? — ren, *Jones*. Pliocene.

D. CYTHERELLIDÆ.

XXI. Cytherella, *Jones & Bosquet*. (The figures in both Monograph and Supplement are quoted.)

Page 47. 1. Cytherella compressa (*Münster*). Eocene (London). Monogr., Pl. V, figs. 20, 23.
,, 47. 2. — — Var. Eocene (London). Monogr., Pl. V, fig. 19.
,, 47. 3. — Muensteri (*Roemer*). Oligocene and Eocene (Bracklesham). Suppl. Pl. II, fig. 10.
,, 47. 4. — — var. (smooth). Eocene (Bracklesham and Barton). Monogr., Pl. V, fig. 13.
,, 47. 5 — — var. rectipunctata, *Jones*. Eocene (Bracklesham). *Ibid.*, fig. 12.
,, 47. 6. — Roemeri, *Jones & Sherborn*. Eocene (Bracklesham). Suppl., Pl. II, figs. 3 *a*, *b*, *c*.
,, 47. 7. — Reussii, *Jones & Sherborn*. Eocene (Bracklesham). Suppl., Pl II, figs. 4 and 8 *a*, *b*.
,, 47. 8. — fabacea, *Bornemann*. Eocene (London). Monogr., Pl. V, figs. 21, 23.
,, 47. 9. — Dixoni, *Jones & Sherborn*. Eocene (Bracklesham). Suppl., Pl. I, figs. 24 *a*, *b*, *c*.
,, 47. 10. — sp. (Small.) Pliocene. Suppl., Pl. III, figs. 25 *a*, *b*.
,, 47. 11. — Beyrichi (*Reuss*). Eocene (London). Monogr., Pl. V, fig. 18.
,, 48. 12. — — var. 1, lævis, *Jones & Sherborn*. Eocene (Bracklesham). Suppl., Pl. II, figs. 1 *a*, *b*.
,, 48. 13. — — ,, 2. Eocene (Bracklesham). *Ibid.*, figs. 2 *a*, *b*.
,, 48. 14. — — ,, 3. *Ibid.*, figs. 5 *a*, *b*.
,, 48. 15. — — ,, 4. *Ibid.*, figs. 6 *a*, *b*.
,, 48. 16. — — ,, 5. *Ibid.*, figs. 7 *a*, *b*.
,, 48. 17. — — ,, 6. *Ibid.*, figs. 9 *a*, *b*.
,, 48. 18. — sp. (Small.) Oligocene.

I. CYPRIS, *Müller*, 1785.

1. Cypris Browniana, *Jones*, 1850.

Cypris Browniana, *Jones*. Monogr. Tert. Entom., 1857, p. 13, pl. i, figs. 1 *a—e*; Geol. Mag., 1870, p. 158; and 1887, p. 459.

Besides the Post-Tertiary bed at Clacton, in Essex, the Uppermost Pliocene Unio-bed at Sidestrand has yielded this species (Mr. Clement Reid, F.G.S.). It has been quoted from the old land-drift at Chesilton, Portland.[1] (British Museum and Museum Practical Geology.)

Dr. G. S. Brady has lately received *C. Browniana* from Loch Fadd, near Rothesay. It is described and figured in Appendix F, No. XI, to the 'Fifth Annual Report of the Fishery Board for Scotland,' 1887, p. 330, Pl. XIX, figs. 3 and 4.

2. Cypris lævis, *Müller*, 1785.

Cypris ovum, *Jones* (non *Jurine*). Monogr. Tert. Entom., 1857, p. 14, pl. i, figs. 4 *a*, *b*.

— lævis, *Brady*. Trans. Linn. Soc., vol. xxvi, 1868, p. 374, pl. xxiv, figs. 21—26; Jones, Geol. Mag., 1870, p. 155; Brady, Crosskey, and Robertson, Monogr. Post-Tert. Entom., 1874, p. 126, pl. i, figs. 25—28 (with synonyms and references; also localities).

This little *Cypris* is known as a recent and Post-Tertiary species. (Brit. Mus., &c.)

3. Cypris gibba, *Ramdohr*, 1808.

Cypris gibba, *F. A. Ramdohr*. Magaz. Gesellsch. Naturforsch. Berlin, 1808, Quartal ii, p. 91, t. 3, figs. 13, 14, 17; Jones, Monogr. Tert. Entom., 1857, p. 15, pl. i, figs. 3 *a—f* (see this reference for other synonyms); Brady, Trans. Linn. Soc., vol. xxvi, 1868, p. 369, pl. xxiv, figs. 47—54; B., C., and R., Monogr. Post-Tert. Entom., 1874, p. 127, pl. xv, figs. 5, 6, with several Post-Tertiary localities for this species; Robertson, Fauna of Scotland (Western), Nat. Hist. Soc. Glasgow, February, 1880, p. 16.

Also 'Geol. Mag.,' 1887, p. 459, where Mundesley and Sidestrand are additional localities. It occurs in the old land-drift at Chesilton, Portland (Prestwich). It has also been obtained by the Geological Survey from the Middle

[1] 'Quart. Journ. Geol. Soc.,' vol. xxxi, p. 39.

Hamstead Beds of the Isle of Wight (Specimen, No. 4430, Borehole, No. 109, at Staples, near Newport, one of the trial-borings made in 1887).[1] This species is very common in the recent state. (Brit. Mus. and Mus. Pract. Geol.)

4. CYPRIS REPTANS (CANDONA, *Baird*, 1835).

CYPRIS REPTANS, *G. S. Brady*. Trans. Linn. Soc., vol. xxvi, 1868, p. 370 (for synonyms, &c.), pl. xxv, figs. 10—14; Jones, Geol. Mag., 1870, p. 158; Robertson, Fauna W. Scotl., 1880, p. 20.

This species was referred by Baird to *Candona*, but its pediform antennæ bear setæ long enough to give it the character of a *Cypris* rather than that of a *Candona*, and its second pair of jaws also approximate to those of *Cypris* (G. S. B.).

Localities additional to those given in the 'Monogr. Tert. Entom.' and 'Post-Tert. Entom.' are Mundesley and Sidestrand, and near Hitchin ('Geol. Mag., 1887, p. 459); also Barnwell, near Cambridge (Mrs. Hughes, *Ibid.*, 1888, p. 200). (British Museum, &c.)

II. CYPRIDOPSIS, *Brady*, 1867.[2]

1. CYPRIDOPSIS VIDUA (CYPRIS, *Müller*, 1785).

CYPRIDOPSIS VIDUA, *Brady*. Trans. Linn. Soc., vol. xxvi, 1868, p. 375, pl. xxiv, figs. 27—30, 46.

This common freshwater species occurs in a Post-Tertiary Chara-marl near Hitchin (W. Hill, jun., Esq., F.G.S.).

2. CYPRIDOPSIS OBESA, *Brady & Robertson*, 1869.

CYPRIDOPSIS OBESA, *Brady, Crosskey & Robertson*. Monogr. Post-Tert. Entom., 1874, p. 128, pl. i, figs. 1—4

This rather common species occurs at Mundesley and Sidestrand, as well as at the localities recorded elsewhere ('Geol. Mag.,' 1887, p. 459). (Mus. Pract. Geol.)

III. POTAMOCYPRIS, *Brady*, 1870.

This genus was instituted in 1870 by Dr. G. S. Brady in the 'Nat. Hist. Trans. Northumberland,' &c., vol. iii, p. 365. See also 'Monogr. Post.-Tert. Entom.,' 1874, p. 129.

[1] See Note by Mr. C. Reid in the 'Geol. Mag.,' November, 1887, p. 510.

[2] 'Intellectual Observer,' September, 1867, vol. xii, p. 117.

Among other characters it has rather thick valves, and the right is larger than the left valve.

1. POTAMOCYPRIS TRIGONALIS, et var. LÆVIS (*Cytherideis*, Jones, 1856).

CYTHERIDEIS TRIGONALIS, et var. LÆVIS, *Jones.* Monogr. Tert. Entom., 1857, p. 47, pl. ii, figs. 2 *a*—*h*.
POTAMOCYPRIS — — *Jones & Sherborn.* Geol. Mag., 1887, p. 586.

Besides those mentioned in the 'Monogr. Tert. Entom.,' we have two examples of this species from Mr. Clement Reid's collection,—one from the Norwich Crag at Bramerton,—and one from the Weybourn Crag at East Runton.[1] The latter specimen is the large and smooth form distinguished as *var.* LÆVIS. (Brit. Mus. and Mus. Pract. Geol.)

2. POTAMOCYPRIS TUBERCULATA (*Cytherideis*, Jones, 'Monogr. Tert. Entom.,' 1856, p. 47), from the Crag of Suffolk and Essex, is also to be noted as belonging to this genus. (British Museum.)

3. POTAMOCYPRIS BRODIEI, *sp. nov.* Woodcut, Fig. 1.

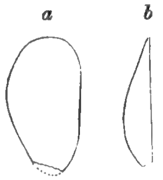


FIG. 1.—*Potamocypris Brodiei*, sp. nov. *a.* Right valve (slightly broken at the posterior margin). *b.* Edge view. Magnified 20 diameters.

This very neat subtriangular valve, 1 mm. long, cream-coloured, and polished, is delicately punctate with exquisitely fine pittings. It is related to the recent

[1] Mr. Clement Reid, F.G.S., has given a detailed account of the Norfolk deposits in the 'Mem. Geol. Survey: The Geology of the Country around Cromer,' 1882. The Weybourn Crag is described at pp. 11—19; and the Entomostraca from that deposit are mentioned at p. 66. See also Prof. Prestwich's "Memoir on the Crag Beds of Suffolk and Norfolk," 'Quart. Journ. Geol. Soc.,' vol. xxvii, p. 457, 460, &c.; and H. B. Woodward's 'Geology of England and Wales,' 2nd edit., pp. 465—474, for Bramerton, Weybourn, &c. The Bramerton Crag is also treated of in H. B. Woodward's 'Geol. Surv. Mem.: The Geology of the Country around Norwich,' 1881, pp. 33—55, 82, &c. The list of Ostracoda from Weybourn referred to above does not agree with our determination in all respects. Thus we have not found *Cythere tuberculata*, Sars, nor *C. pellucida*, Baird, among the specimens we have seen; and probably *C. concinna*, Jones, is represented by the set of the closely allied *C. angulata*, Sars, which we have met with. Other species in our series are not indicated in the printed list referred to.

and Pliocene *Potamocypris trigonalis* (*Cytherideis*, Jones, 'Monogr. Tert. Entom.,' p. 46, Pl. II, fig. 2), but is narrower (lower) in the posterior region—that is, it tapers more quickly with a strong slope along the postero-dorsal edge, herein somewhat resembling *P. tuberculata* (*Cytherideis*, Jones, *loc. cit.*).

The genus lives in fresh and brackish waters.

This specimen was collected (with some smaller specimens of possibly the same species) by the Rev. P. B. Brodie, M.A., F.G.S., from an Insect-bed in the marls above the Bembridge Limestone at Gurnet Bay.

IV. AGLAIA, *Brady*, 1867.[1]

1. Aglaia ? cypridoides, *Jones & Sherborn.* Plate III, figs. 2 *a*, *b*, *c*.

Aglaia ? cypridoides, *Jones & Sherborn.* Geol. Mag., 1887, p. 386.

The genus *Aglaia*, G. S. Brady, one of the *Cyprididæ*, is here made to receive a fossil form on account of the similarity of shape and condition of the valves. The muscle-spot, however, is like that of *Bairdia.* Our example is from the Norwich Crag of Bramerton, and was collected by Mr. Clement Reid, F.G.S. It has the usual curved form, and is delicately pitted. It is too broad in shape for either *A. ? glacialis*, G. S. Brady, 'Post-Tert. Entom.,' p. 132, pl. xi, figs. 54—56; or *A. ? obtusata*, G. S. Brady, 'Report Challenger Ostrac.,' p. 35, pl. xxx, fig. 8. (Mus. Pract. Geol.)

V. CANDONA, *Baird*, 1850.

1. Candona compressa (*Koch*).

Cypris setigera, *Jones.* Monogr. Tert. Entom., 1857, p. 12, pl. i, fig. 6.
Candona compressa (*Koch*). Brady, Trans. Linn. Soc., vol. xxvi, 1868, p. 382; Jones, Geol. Mag., 1870, p. 155; 1888, p. 199.
Cypris incongruens, *Ramd.* Geol. Mag., 1887, p. 386.

To the localities of Berkshire and Cambridgeshire mentioned in the Monographs of 1857 and 1874, we have to add the Valley-drift of Fisherton, at Salisbury (Dr. Blackmore's collection), the old land-drift at Chesilton, Portland (Prestwich), the Chara-marl near Hitchin (Hill), and the gravels at Barnwell, near Cambridge (Mrs. Hughes). (British Museum, &c.)

[1] 'Les Fonds de la Mer,' vol. i, p. 90.

2. CANDONA CANDIDA (*Müller*, 1785).

CANDONA CANDIDA, *Jones*. Monogr. Tert. Entom., 1857, p. 19, pl. i, figs. 8 *a—f;* and figs. 5 *a, b* (figured upside down), var. *tumida*, B., C., and R., Monogr. Post-Tert. Entom., p. 136, pl. ii, figs. 29, 30.

To the localities recorded in the Monographs of 1857 and 1874, we have to add Mundesley, Sidestrand, and near Hitchin ('Geol. Mag.,' 1887, p. 459); also the old land-drift at Chesilton (Prestwich), the peat-bed at Tilbury, Essex (Mr. Spurrell); and Barnwell, near Cambridge (Mrs. Hughes, 'Geol. Mag.,' 1888, p. 200). (Mus. Pract. Geol., &c.)

3. ? CANDONA SUBÆQUALIS, *Jones*, 1857. 'Monogr. Tert. Entom.,' p. 20, pl. i, fig. 9.

This Post-Tertiary form, from Copford, remains as before. (Brit. Mus.)

4. CANDONA FORBESII, *Jones*, 1856.

CANDONA FORBESII, *Jones*. Mem. Geol. Surv., 1856, p. 157, pl. vii, fig. 22; and Monogr. Tert. Entom., 1857, p. 18, pl. iv, figs. 8, 9, 11.

This form is nearly allied in general appearance to the recent *Cypris* (*Candona*) *reptans,* Baird. It occurs in the shales of the Upper, Middle, and Lower Hamstead series at Hamstead Cliff, and in better preservation in the pyritous bands of that series. It has been found in the Middle Hamstead Beds at Parkhurst Forest (Borehole, No. 32), Isle of Wight; also in the shales of the Osborne series at Cliff End, Colwell Bay. Mr. F. E. Edwards met with it in the cliffs at Hordwell. (Mus. Pract. Geol., and Brit. Mus.)

This is the species referred to by Prof. Prestwich, 'Report British Association' for 1846, 'Trans. Sect.,' p. 56, as occurring at "Hampstead Cliff, one and a half miles east of Yarmouth;" and remains still in his collection. It is also probably the species noticed in a freshwater-bed of Hordwell Cliff, Hampshire, by Sir C. Lyell ('Trans. Geol. Soc.,' ser. 2, vol. ii, 1829, p. 291).

5. CANDONA RICHARDSONI, *Jones*, 1857.

CANDONA RICHARDSONI, *Jones*. Monogr. Tert. Entom., p. 18, pl. iv, figs. 12 *a, b*.

Another locality for this species is the Woolwich-and-Reading beds of the Railway-cutting near Croydon. See Mr. Klaasen's paper "On a Section at Park Hill, Croydon," 'Proc. Geol. Assoc.,' vol. viii, 1884, p. 241.

This species, and *Candona Forbesii*, were referred to the genus *Candona* on account of their general likeness to "*Candona reptans*," which has since then been transferred to *Cypris* on account of some slight differences in the limbs. This doubt as to their generic relationship was indicated in the 'Geol. Mag.,' 1870, p. 158, but it is not yet strong enough to lead us to alter the present arrangement. (British Museum.)

VI. CYPRIDEA, *Bosquet*, 1852.

This genus is described at large in the 'Quart. Journ. Geol. Soc.,' vol. xli (1885), p. 336. Remarks on the possible alliance existing between *Cypridea* and *Chlamydotheca* have been made by G. S. Brady, in the 'Proceed. Zool. Soc. Lond.,' 1886, p. 90; and in the 'Journ. Linn. Soc.,' vol. xix (1886), pp. 200, 201.

In the early days of geology, naturalists could offer only *Cythere* and *Cypris* for recent analogues of the fossil Entomostraca, since recognised as Ostracoda; *Cypris* being taken as the type for freshwater, and *Cythere* for marine, forms. Hence the Ostracoda of the Weald Clay were called *Cyprides*, and, when differentiated, Bosquet gave them the name of *Cypridea.* We have now found such forms in the Tertiary Beds of the Isle of Wight. We know nothing of the soft parts; their shell-structure need not remove them from the *Cyprididæ*, and we place them after *Candona*, in the freshwater series (p. 2), although in their shell-structure they have some relationship with *Chlamydotheca*, which is closely allied to *Cypris* anatomically.

1. Cypridea spinigera (*Sowerby*, 1836). Plate I, figs. 8—11; and Plate III, figs. 1 *a*, *b*.

Cypris spinigera, *Sow.* In Fitton's Memoir 'On the Strata below the Chalk,' Trans. Geol. Soc., ser. 2, vol. iv, 1836, p. 345, pl. xxi, fig. 3.

Cypridea — *Jones.* In Morris's Catal. Brit. Foss., 1854, p. 104.

Cytherideis unicornis, *Jones.* Mem. Geol. Surv., 1856, p. 158, pl. vii, figs. 24—26; Monogr. Tert. Entom., 1857, p. 48; and *Cytherideis? unicornis*, Jones, Geol. Mag., 1870, pp. 157, 159.

Cypridea spinigera, *Jones.* Quart. Journ. Geol. Soc., vol. xli, 1885, pp. 316, 333, and 334.

— — *Jones & Sherborn.* Geol. Mag., 1887, p. 386.

This is referred to 'Quart. Journ. Geol. Soc.,' *loc. cit.*, as a species common in the upper part of the Weald Clay at Compton Bay, Atherfield, and Sandown, in the Isle of Wight, and as occurring in other Wealden Beds, but more rarely, in Sussex and Surrey.

We now find that it occurs abundantly in Tertiary beds at Hamstead Cliff, in the Isle of Wight. Specimens, young or imperfect, from this locality were described and figured in the 'Geological Survey Memoir on the Isle of Wight,' 1856, under the name of *Cytherideis unicornis*, as a sub-reniform Ostracod, sulcate and tuberculate when young, but with a sharp spine on each valve when adult (see also 'Monogr. Tert. Entom.,' p. 48). Careful examination of a further series of specimens leaves no doubt that it is the same species as that found in the Wealden beds. The Hamstead specimens are not so well preserved as those in the Wealden Clays, nor are they so abundant; but with the many individuals that have come under our notice, we have been able to match old and young perfect examples from the Tertiary and Wealden formations.

The Tertiary specimens of this species are very plentiful in a crushed state on the laminæ of a dark-grey marl ("D 6" of the Geol. Survey) in the Lower Hamstead series, Hamstead Cliff. (Mus. Pract. Geol.)

Description of CYPRIDEA SPINIGERA.

Length 1 mm.

Valves obovate, or more generally subtriangularly obovate, varying in the protuberance of the anterior hinge-joint, which is usually strongly marked and angular. Front and hind margins unequally rounded; the anterior broadly rounded, and with a strong notch and beak; the posterior contracted. Valves slightly convex; edge view narrow-oval, with its outline broken by the spines. Surface usually strongly punctate all over, but sometimes nearly smooth. A short and blunt but distinct spine is present in mature specimens on the postero-dorsal region of each valve (Pl. I, figs. 8—11.). In immature specimens (Pl. III, figs. 1 *a*, Tertiary, and 1 *b*, Wealden) the dorsal region has one or more small knobs with transverse sulci, the spine being undeveloped.

The right valve is the largest, its ventral edge overlapping that of the left valve. (In Pl. I, fig. 8, the valves have been modified and misplaced by pressure.)

Note.—This curious species, or one very much like it, has turned up in a specimen given to me by the late Dr. Mantell as coming from the Oxford Clay of Wiltshire, and also in a piece of the Oxford Clay of Skye, collected by Messrs. Geikie and Young, and there associated with *Estheria*. If its freshwater habitat in the Hamstead series be a criterion, and if these other specimens prove trustworthy, it points to more freshwater or estuarine conditions in the Oxfordian series than are usually thought of.—T. R. J.

VII. PONTOCYPRIS, *G. O. Sars*, 1865.

1. PONTOCYPRIS (?), sp. Plate I, fig. 13 *a*.

A single, small, pitted valve, of uncertain alliance, but approximately like some members of the genus *Pontocypris*, G. O. Sars, occurs in a collection from the Tertiary beds at Colwell Bay, 'Geol. Mag.,' 1887, p. 387. (British Museum.)

VIII. BYTHOCYPRIS, *Brady*, 1880.

1. BYTHOCYPRIS SUBRENIFORMIS, *Jones & Sherborn*. Plate I, figs. 19 *a*, *b*.

BYTHOCYPRIS SUBRENIFORMIS, *Jones & Sherborn*. Geol. Mag., 1887, p. 387.

In the genus *Bythocypris*, determined by G. S. Brady, 'Report Challenger Ostrac.,' p. 45, the left valve is described as much larger than the right, and overlapping it above and below. In this character, and other features, a specimen from the "Belosepia-bed" at Bracklesham (British Museum[1]) coincides. It approaches *Cytherina abbreviata*, Reuss, 'Haidinger's Nat. Abh.,' vol. iii, p. 52, pl. viii, fig. 10; but it is too short and too high, and is not so truly reniform. It has, however, the usual kidney-shape, and is also near *B. reniformis*, G. S. Brady, 'Report Challenger Ostrac.,' p. 46, pl. v, fig. 1; but this figured form is too short, and more incurved on the ventral edge than is our specimen.

IX. BAIRDIA, *M'Coy*, 1844.

1. BAIRDIA SUBDELTOIDEA (*Münster*). Plate I, figs. 15 *a*, *b*.

CYTHERE SUBDELTOIDEA, *Münster*. Jahrbuch für Min., &c., 1830, p. 64; and 1835, p. 446.
BAIRDIA SUBDELTOIDEA, *Jones & Sherborn*. Geol. Mag., 1887, p. 387. For synonyms see Monogr. Tert. Entom., p. 52.

As mentioned in the 'Geological Magazine' for 1870, p. 157, the little *Bairdia* from the Sutton Crag ('Monogr. Tert. Entom.,' 1857, p. 52, pl. iv, fig. 2) may be

[1] This and other Ostracoda from Bracklesham were presented by Professor Judd, F.R.S., to the British Museum in June, 1888.

B. fusca, G. S. Brady, 'Trans. Zool. Soc.' vol. v, p. 364, pl. lvii, fig. 9 (from Australia); and the fine species from the London Clay ('Monogr.,' p. 52, pl. vi, figs. 1 and 2), though like Brady's *B. formosa* ('Ann. Mag. Nat. Hist.,' ser. 4, vol. iii, p. 221, pl. 14, figs. 5—7, from Tenedos), is probably *B. subtrigona*, Bornemann ('Zeitschr. deutsch. geol. Ges.,' vol. vii, p. 357, pl. xx, fig. 4), from the Oligocene Septarium-clay of Hermsdorf.

We have now seen from the Belosepia-bed of Bracklesham (British Museum) a very fine example of the real *B. subdeltoidea*, which we have compared with authentic specimens (from Osnabrück) sent by Count Münster to London many years ago.

2. The very small *Bairdia* ('Monogr.,' *loc. cit.*, fig. 3), from the Red Crag is difficult of determination.

3. With the Bracklesham specimen is a smaller individual, relatively thicker and rounder; it may belong to a different species, but for the present we leave it as a probable variety.

4. BAIRDIA SUBTRIGONA, *Bornemann.*

BAIRDIA SUBTRIGONA, *Bornemann.* Zeitschr. d. g. Ges., vol. vii, 1855, p. 357, pl. xx, fig. 4.
— SUBDELTOIDEA, *Jones.* Monogr. Tert. Entom., 1857, p. 52, pl. vi, figs. 1, 2.
— SUBTRIGONA, *Bornemann.* Jones, Geol. Mag., 1870, pp. 157, 159; 1887, p. 387, pl. xi, fig. 1.

This specimen from the London Clay (British Museum) is referred to above in our note on *B. subdeltoidea*, as belonging to Bornemann's *B. subtrigona.*

5 and 6. BAIRDIA FUSCA, *Brady* (see above); and BAIRDIA CONTRACTA, *Jones.* These follow next in order. (British Museum.)

7. BAIRDIA LONDINENSIS, *Jones & Sherborn.* Plate II, figs. 18 *a*, *b*.

BAIRDIA LONDINENSIS, *Jones & Sherborn.* Geol. Mag., 1887, p. 387, pl. xi, fig. 2.

This is a small neat *Bairdia*, of a not unusual form, but not exactly matching in shape any species known to us; it is, moreover, denticulated at the end margins, and punctate all over with very distinct, roundish, close-set pits. This valve is stained with numerous bright-orange irony spots, which possibly may be due to traces of the original colouring of the shell.

From the London Clay of Piccadilly, London; collected by Messrs. Sherborn and Chapman.[1] (British Museum.)

8. Bairdia rhomboidea, *Jones & Sherborn.* Plate I, figs. 3 *a, b, c.*

Bairdia rhomboidea, *Jones & Sherborn.* Geol. Mag., 1887, p. 388.

A stiff-looking *Bairdia,* broadly angular in front, nearly parallel above and below; narrow behind, with a curve on the ventral, and a slope on the dorsal edge of this end. The antero-ventral margin is suddenly nipped in, leaving a projection behind the antero-ventral slope. The surface is very delicately punctate.

From the White Crag of Sutton, Suffolk. (British Museum.)

9. Bairdia ovoidea, *Jones & Sherborn.* Plate III, figs 3 *a, b.*

Bairdia ovoidea, *Jones & Sherborn.* Geol. Mag., 1887, p. 388, pl. xi, fig. 3.

A very small roundish *Bairdia,* triangularly obovate, pitted, rosetted at the muscle-spot, with a rather unusual subcircular pattern. The valve is somewhat like fig. 2, pl. iv, 'Monogr. Tert. Entom.,' but much less of a subdeltoidal shape, being well rounded on the anteroventral margin, and curved without any angle behind; both ends are somewhat obliquely rounded; the anterior half of the valve is broader (higher) than the hinder portion.

From the London Clay of Piccadilly, London. Collected by Messrs. Sherborn and Chapman. (British Museum.)

X. DARWINULA[2] (*Darwinella*), *Brady & Robertson,* 1870 and 1885.

1. Darwinula Stevensoni, *Brady & Robertson.*

Darwinella Stevensoni, *Brady & Robertson.* Monogr. Post-Tert. Foram., 1874, p. 141, pl. ii, figs. 13—17.

This species belongs to the brackish water of tidal rivers, and has been found in the Forest-bed series of Norfolk, at Mundesley, by Mr. Clement Reid, F.G.S. See 'Geol. Mag.,' 1887, p. 459. (Museum Practical Geology.)

[1] In the 'Journ. Roy. Microsc. Soc.,' ser. ii, vol. vi, p. 740, this specimen was doubtfully collated with Sowerby's *Cythere barbata* ('Trans. Geol. Soc.,' ser. 2, vol. v, 1834, p. 131, pl. ix, fig. 1), but this latter was probably a *Cytheridea.* See 'Monogr. Tert. Entom.,' 1857, p. 61, *footnote.*

[2] The generic name has been changed, owing to priority of use, from *Polycheles* to *Darwinella* and *Darwinula* (see 'Quart. Journ. Geol. Soc.,' vol. xli, 1885, p. 346).

XI. CYTHERE, *Müller*, 1875.

Valves unequal (left valve usually somewhat larger than the right), oblong-ovate to quadrate in shape, smooth or rough, mostly highest in front; hinge with teeth and sockets at anterior and posterior angles, variously developed.

The quadrate and rough forms have been classed as *Cythereis* ('Monogr. Cretac. Entom.,' 1849, p. 14); and, although this group will not hold its own as a true genus, Dr. G. S. Brady having shown that the animals do not sufficiently differ from other *Cytheræ*,[1] yet it is a very convenient grouping for palæontologists, who have for study only the valves of these small fossil Crustacea.

1. CYTHERE CONVEXA, *Baird.*

CYTHERE PUNCTATA (non *Münster*). Jones, Monogr. Tert. Entom., 1857, p. 24, pl. ii, figs. 5 *a*—*h*; Geol. Mag., 1870, p. 156.
— CONVEXA, *Baird.* Brady, Trans. Linn. Soc., 1868, p. 401, pl. xxix, figs. 19—27, and pl. xxxix, fig. 4; Brady, Crosskey, and Robertson, Monogr. Post-Tert. Entom., 1874, p. 150, pl. iii, figs. 14—17.

Owing to the poorness of the published figures of the German specimens, Dr. G. S. Brady is unwilling to accept Münster's appellation for the *Cythere* represented in the Monograph under the name of "*punctata*," and refers it ('Trans. Linn. Soc.,' 1868, p. 401) to *Cythere convexa*, Baird. Fig. 5 *a* (broken posteriorly) differs, however, from the usual *C. convexa* in its concentrically ridged anterior region and its very coarse punctation. (British Museum.) *Cypridina punctatella*, Reuss (*Cythere punctatella*, Bosq.), referred to in the synonymy at p. 24 of the 'Monograph Tert. Entom.,' belongs to *Loxoconcha*, according to Dr. Brady.

2. C. TRIGONULA, *Jones*, 1856, from the Crag, is the next in order. (British Museum.)

3. CYTHERE STRIATOPUNCTATA, *Jones.*

CYTHERE STRIATOPUNCTATA, *Jones.* Monogr. Tert. Entom., 1857, p. 27, pl. v, figs. 6, 7, 10.

This species has been found at the base of the Barton Clay at Alum Bay, in the Bed "No. 29" of Prof. Prestwich's section ('Quart. Journ. Geol. Soc,' vol. ii,

[1] 'Trans. Linn. Soc.,' vol. xxvi, p. 395.

p. 257, pl. ix), with *Nummulites elegans*, Sow. (*N. Wemmelensis*, var. *Prestwichiana*); it is abundant in the Barton Clay at Barton and Highcliff. It occurs also at Colwell Bay and Bracklesham. (British Museum.)

4. CYTHERE WETHERELLI, *Jones*.

CYTHERE WETHERELLI, *Jones*. Quart. Journ. Geol. Soc., vol. x, 1854, p. 161, pl. iii, fig. 9; Monogr. Tert. Entom., 1857, p. 27, pl. iv, fig. 6; Brady, Trans. Zool. Soc., vol. x, 1878, p. 390, pl. lxiv, figs. 7 *a—d*.
LOXOCONCHA — — Geol. Mag., 1870, pp. 156 and 158.

This has somewhat of the shape and profile of a *Loxoconcha*. Its hinge is almost the same as that referred to *Cyprideis* in the 'Monogr. Tert. Entom.,' p. 21, but modifications of such a hingement are found also in both *Cythere* and *Cytheridea*; it cannot, therefore, be taken as a differential character.

This neat and delicate species is not uncommon in the Tertiary Sands (Headon Series) of Colwell Bay, and in an oyster-band of this formation at the same locality. It has been found also at Barton. (British Museum.) It is rare in the Antwerp Crag.

5. CYTHERE CONSOBRINA, *Jones*. Plate III, figs. 4 *a*, *b*.

CYTHERE CONSOBRINA, *Jones*. Monogr. Tert. Entom., 1857, p. 27.

This form, from the Barton Clay, described but not figured in the Monograph of 1857, is now figured from the original specimen preserved in the British Museum. We may remark that its supposed alliance to *C. attenuata* (*Ibid.*, p. 28) does not hold good; the latter is a *Pseudocythere*.

6. CYTHERE VENUSTULA, *Jones & Sherborn*. Plate I, figs. 23 *a*, *b*.

CYTHERE VENUSTULA, *Jones & Sherborn*. Geol. Mag., 1887, p. 388.

Oblong, rounded at the ends, broadly oblique in front, semicircular behind; straight on the ventral, oblique dorsally by the swelling of the anterior hinge-joint. Depressed on the front half, but more convex behind. Surface ornamented with a neat open network of delicate meshes, lying obliquely from the postero-dorsal to the antero-ventral region.

From the Belosepia-bed at Bracklesham. (British Museum.)

7. Cythere recurata,[1] *Jones & Sherborn.* Plate I, fig. 1.

Cythere recurata, *Jones & Sherborn.* Geol. Mag., 1887, p. 388.

Oblong-reniform, nearly equal at the ends in the outline, but thickest posteriorly, as seen in edge view. Approximating to fig. 7 *g* of G. S. Brady's *C. demissa*, in pl. xii of the 'Report Challenger Ostracoda,' but more even in outline. Coarsely punctate; the pits somewhat in lines, but with a tendency to assume a concentric arrangement on the front half of the valve. There are others of the same outline, but differing in the ornament.

From the "Norwich Crag" of Southwold. (British Museum.)

8. Cythere ? amissa, *Jones.*

Cythere Kostelensis (non *Reuss*). Jones, Q. J. G. S., vol. x, 1854, p. 161, pl. iii, fig. 10; Monogr. Tert. Entom., 1857, p. 28, pl. vi, figs. 14 *a*, *b*.
— amissa, *Jones.* Geol. Mag., 1870, p. 156.

The doubt with which this was referred to Reuss' *C. Kostelensis* was confirmed when a better figure of that species was published by Egger ('Neues Jahrb., &c.,' 1858, p. 429, pl. iv, fig. 4. The Woolwich specimen was named *C. amissa* in 1870. Its generic relationship is somewhat doubtful. (British Museum.)

9. Cythere Charlesworthiana, *Jones & Sherborn.* Plate III, fig. 10.

Cythere Charlesworthiana, *Jones & Sherborn.* Geol. Mag., 1887, p. 390.

A neat small *Cythere*, oblong, with front end rather obliquely rounded, and the posterior nearly square. Ventral edge slightly incurved, dorsal faintly arched. Broadest at the anterior third near the front hinge-joint. Surface ornamented with very delicate elongate pits, arranged in lines lengthwise, but curving in front, parallel with the margin. The anterior margin is neatly denticulate, especially on its dorsal third. This differs from our *Cythere recurata* in being truncated posteriorly, broader and denticulated in front, and also in its ornament. The form nearest to this that we know of is *C. tenera*, G. S. Brady, 'Trans. Linn. Soc.,' vol. xxvi, p. 399, pl. xxviii, figs. 29—32; but in shape and ornament it differs.

From the Weybourn Crag of East Runton, collected by Mr. Clement Reid, F.G.S. (Museum Practical Geology.)

[1] "Finished in a workman-like manner."

In memory of his early researches in the Crag, we name this species after Mr. Edward Charlesworth, F.G.S.

10. CYTHERE ANGULATOPORA (*Reuss*). Plate III, figs. 15 *a*, *b*, *c*.

CYPRIDINA ANGULATOPORA, *Reuss*. Haidinger's Nat. Abth., vol. iii, 1854, p. 86, pl. x, fig. 32.
CYTHERE — *Jones & Sherborn*. Geol. Mag., 1887, p 450.

An oblong valve, with parallel dorsal and ventral margins, and rounded ends. Surface with numerous small, more or less angular pits, arranged in parallel rows. A series of pits, almost independent of the other ornament, follows the semicircular outline of the anterior end, just within the margin. The hinder margin is oblique and toothed. A single valve, associated with *Nummulites elegans*, in a bed regarded as at the bottom of the Barton, or the top of the Bracklesham series, Hunting Bridge, New Forest, was collected by Mr. Keeping. (British Museum.)

The specimens figured and described as *C. angulatopora* in the 'Monogr. Tert. Entom.,' 1857, p. 34, are not referable to that species. Figs. 17 and 18 of pl. iv correspond with the form to which we have given the name *C. transenna* (p 31); and fig. 18, pl. vi, figured by Bosquet (we think, erroneously) as *C. angulatopora* of Reuss, we now regard also as a new species, and have named it *C. Bosquetiana* (see below).

11. CYTHERE BOSQUETIANA, *Jones & Sherborn*. Plate III, figs. 17 *a*, *b*, *c*.

CYTHERE ANGULATOPORA (non *Reuss*). Bosquet, Mém. Couronnés, &c., Entom. Tertiair., 1852, p. 68, pl. iii, fig. 5.
— — — Jones, Monogr. Tert. Entom., 1857, p. 34, pl. vi, fig. 18 (only).
— BOSQUETIANA, *Jones & Sherborn*. Geol. Mag., 1887, p. 451.

One of the oblong species of *Cythere*, with rounded ends, well-marked hinges, and convex valves, ornamented with a strong reticulation, the longitudinal meshes of which are stronger than the transverse. Just in front of the centre of the valve the meshes show an inclination to assume a concentric arrangement. These features are strongly marked in fig. 18, pl. vi, of the 'Monogr.,' 1857.

The specimen figured in 1857 was from a Tertiary bed at Colwell Bay (rare), and was re-named in 1887. One valve, occurring with *Nummulites elegans*, in the uppermost bed of the Bracklesham series, or lowest Barton, at Hunting Bridge, New Forest, has been collected by Mr. Keeping. (British Museum.)

12. Cythere Reidii, *Jones & Sherborn.* Plate III, figs. 5 *a*, *b*.

Cythere Reidii, *Jones & Sherborn.* Geol. Mag., 1887, p. 389.

Valves suboblong, obliquely rounded at the ends, broader in front than behind, straight on the back, slightly sinuous below, nearly flat; rising into a median knob in the anterior third. Surface covered with very coarse punctation, making a rough reticulation. The nearest published species appears to be *Cythereis tuberculata*, Sars, as figured by G. S. Brady, 'Trans. Linn. Soc.,' vol. xxvi, p. 406, pl. xxx, figs. 25—29.

Our species is named after Mr. Clement Reid, F.G.S., who collected this and many other previously undescribed Ostracoda from the Crag Beds of Norfolk.

From the Weybourn Crag of East Runton. (Museum of Practical Geology.)

13, 14, 15. Cythere Woodiana, laqueata, and macropora.

These ('Monograph,' 1857) succeed here in the order of their shape and general relationship. (British Museum.)

16. Cythere Woodwardiana, *Jones & Sherborn.* Plate III, figs. 14 *a*, *b*.

Cythere Woodwardiana, *Jones & Sherborn.* Geol. Mag., 1887, p. 390.

Subtrigonal, obliquely rounded in front, nearly semicircular behind; broad across the anterior third by the projection of the hinge-joint. Surface slightly convex; ventral surface somewhat flattened. Superficial ornament, a coarse, irregular pitting, becoming linear and concentric at the ends.

We name this species after Dr. Samuel Woodward, one of the earliest workers in these late Tertiary deposits.

From the Weybourn Crag, East Runton. Mr. C. Reid, F.G.S. (Mus. Pract. Geol.)

17 and 17*. Cythere retifastigiata, *Jones*, var. æquior, *nov.* Plate III, figs. 6 *a*, *b*.

Mr. Clement Reid has met with a good variety, with less prominent ridges than in the figure in the 'Monograph,' 1857, p. 36, pl. iii, fig. 7, and with a smaller, neater, and closer punctation. Though more swollen, the surface is less ridged, and hence we may term it *var.* ÆQUIOR.

Weybourn Crag. (Mus. Pract. Geology.)

18. CYTHERE HARRISIANA, *Jones*. Woodcut, fig. 2.

CYTHEREIS INTERRUPTA, *Jones*. Monogr. Cretac. Entom., 1849, p. 16, pl. ii, fig. 6.
CYTHERE HARRISIANA, *Jones*. Geol. Mag., 1870, pp. 75, 76; and 1887, p. 452, woodcut, fig. 1.

This was found, as a Tertiary fossil, with *C. spiniferrima*, hereafter described, while looking over some washings of London Clay for a second time. We have

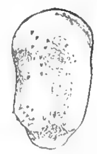


FIG. 2.—*Cythere Harrisiana*, Jones. Right valve. From the London Clay. Magnified 20 diam.

only this one valve, which agrees so closely in every particular with valves from the Gault, presenting the same isolated prickles and the pursed-up posterior end with its flattened margin, that we cannot separate them.

From Piccadilly, London; collected by Messrs. Sherborn and Chapman. (British Museum.)

19. CYTHERE DICTYOSIGMA, *Jones*. Plates III, figs. 8 *a*, *b*.

From the Crag. This was not figured in the 'Monogr. Tert. Entom.,' 1857, p. 30. (British Museum.)

20. CYTHERE TRACHYPORA, *Jones*. Plate III, figs. 9 *a*, *b*.

CYTHERE TRACHYPORA, *Jones*. Monogr. Tert. Entom., 1857, p. 36, pl. iii, figs. 9 *f*—*i*; Geol. Mag., 1870, p. 156.

The insides and edges only of the valves were shown in the 'Monogr.,' 1857; the outside is now figured. Several individuals from the Suffolk Crag have the marginal swellings much more definite and ridge-like than in Mr. C. Reid's specimen from the Norwich Crag here figured. We may remark that some of Dr. G. S. Brady's illustrations of his *Cythere mutabilis*, 'Trans. Zool. Soc.,' 1866, p. 377, pl. lix, figs. 14 *f*, *g*, approach very near to *C. trachypora*. (British Museum.)

21. CYTHERE CONCINNA, *Jones*.

CYTHERE CONCINNA, *Jones*. Monogr. Tert. Entom., 1857, p. 29, pl. iv. fig. 7; Brady, Trans. Linn. Soc., 1868, p. 408, pl. xxvi, figs. 28—33; pl. xxxviii, fig. 7; B., C., and R., Monogr. Post-Tert. Entom., 1874, p. 160, pl. iv, figs. 1—16.

The numerous localities where this species has been met with, either recent (North Atlantic and Arctic Oceans) or fossil (British area, Canada, and Norway), are enumerated in the memoirs referred to above. (British Museum.)

22. CYTHERE LÆSA, *Jones & Sherborn*. Plate III, figs. 13 *a*, *b*.

CYTHERE LÆSA, *Jones & Sherborn*. Geol. Mag., 1887, p. 390.

Ovate-oblong, straighter on the ventral than on the dorsal edge. Close to the ventral margin is a broad, longitudinal, somewhat sinuous ridge, widened, or rather doubled, with an oval interspace, at its posterior third, and irregular at the anterior third. In one specimen the surface is coarsely reticulate with angular meshes; in the other, the ornament consists of a smaller meshwork. In this latter individual the edge-view is less convex than in the other.

From the Norwich Crag of Bramerton. Collected by Mr. Clement Reid, F.G.S. (Mus. Pract. Geol.)

23 and 23*. CYTHERE VILLOSA, *G. O. Sars*; et Var. *nov*. Plate I, figs. 4 *a*, *b* (var.); and Plate III, figs. 12 *a*, *b*, *c*.

CYTHERE VILLOSA, *Brady, Crosskey, & Robertson*. Monogr. Post-Tert. Entom., 1874, p. 157, pl. iii, figs. 7—13; Jones and Sherborn, Geol. Mag., 1887, p. 390.

Subtriangular, straight on the ventral, and obliquely arched on the dorsal and front edges, but somewhat truncate behind. Surface bearing a somewhat concentric reticulation of coarse angular pittings. Three unequal tubercular swellings affect the valve just within its thickened rim, two behind (fig. 12 *c*), such as are frequent in this group of *Cytheræ*, and one in the antero-ventral third. The greatest convexity of the valves is central, making the edge-view acute-oval.

From the Weybourn Crag of East Runton. Collected by Mr. Clement Reid, F.G.S. (Mus. Pract. Geol.)

With this species we connect a variety (Plate I, figs. 4 *a*, *b*, from the "Norwich Crag" of Southwold), in which the tubercles are not so definitely marked. The places of the two near the ventral margin are occupied by irregular swellings, and the postero-dorsal tubercle is ill-defined. (Mus. Pract. Geol.)

24. Cythere lachrymalis, *Jones & Sherborn.* Plate III, figs. 7 *a*, *b*.

Cythere lachrymalis, *Jones & Sherborn.* Geol. Mag., 1887, p. 389.

One of the suboblong punctate *Cytheræ*, of a not uncommon shape, but rather more oblique anteriorly than usual. Surface slightly convex, swelling at the anterior third, and posteriorly bearing two separate ridges, which rise near the middle of the valve, and end each in a strong knob at the posterior border, thus forming two long, tear-shaped eminences, instead of the more usual pair of posterior swellings, such as we see in *C. bidentata*, Bosquet, 'Entom. Tert.,' 1852, p. 72, pl. iii, fig. 9, and several other Tertiary *Cytheræ*.

From the Norwich Crag, Bramerton; collected by Clement Reid, F.G.S. (Mus. Pract. Geol.)

25. Cythere baccata,[1] sp. nov. Plate III, figs. 11 *a*, *b*, *c*, *d*.

Cythere angulata (*G. O. Sars*), var., *Jones & Sherborn.* Geol. Mag., 1887, p. 389.

In some of their characters our little specimens agree with Dr. G. S. Brady's definition of *C. limicola*, Norman; but in them we also see a strong affinity to *C. angulata*, Sars: *C. globulifera*, Brady, and *C. concinna*, Jones, as described in full by G. S. Brady, are also near allies.

The specimens under notice are neater and more definitely marked than any of those referred to. The reticulation is better than in *angulata*, and the tubercles clearer and more symmetrically placed than in *limicola*.

Our specimens were obtained by Mr. C. Reid, F.G.S., from the Norwich Crag of Bramerton and the Weybourn Crag of East Runton (Mus. Pract. Geology.)

[1] Bacca, a berry or gem.

26. Cythere sublacunosa, *Jones.*

Cythere lacunosa, *Jones.* Monogr. Tert. Entom., 1857, p. 31, pl. iii, figs. 5 *a b.*
— sublacunosa, *Jones.* Geol. Mag., 1870, p. 156.

The original name for this cannot stand, as another and somewhat similar species has been so called by Reuss. *Sublacunosa* was proposed in 1870 as a fitting name for the Suffolk species. This form has many allies; for instance, some recent Norwegian specimens are mentioned in the Monograph (p. 31) as being of the same species; and these have been referred to by Mr. Brady (who at first thought them to be varieties of Reuss's *C. clathrata* and *lyrata*, and Speyer's *C. latimarginata*) to Sars' *C. angulata*, *abyssicola*, and *tuberculata* ('Trans. Linn. Soc.,' 1868, pp. 406, 409, and letters). (British Museum.)

27. Cythere latimarginata, *Speyer.* Plate I, fig. 6.

Cythere latimarginata, *Speyer.* Ostrac. Cassel. Tert.,[1] 1863, p. 22, pl. iii, fig. 3.
— abyssicola, *G. O. Sars.* Overs. Norg. Mar. Ostrac.,[2] 1865, p. 163.
— latimarginata, *Brady, Crosskey, and Robertson.* Monogr. Post-Tert. Entom., 1874, p. 163, pl. xvi, fig. 6.
— — — Tr. Zool. Soc., vol. x, p. 389, pl. lxiv, figs. 8 *a—d.*

Following Dr. Brady's determination of this species in the papers above mentioned, we refer this specimen to Speyer's species. The figure in the 'Monogr. Post-Tert. Entom.' comes nearest to our form, but is furthest from Speyer's original figure, to which the figures of the Antwerp-Crag specimens in 'Trans. Zool. Soc.,' 1878, nearly approximate.

One valve; White Crag. (British Museum.)

28. Cythere arenosa, *Bosquet.* Var. *nov.* Plate II, figs. 11 *a*, *b*.

Cythere arenosa, *Bosquet.* Crust. Foss. Terr. Crét. Limbourg,[3] 1854, p. 101, pl. vii, figs. 1 *a—d*; Jones and Sherborn, Geol. Mag., 1887, p. 391, pl. xi, fig. 1.

This weak variety of Bosquet's species is one of the papulated forms of *Cythere*, the surface having low, tubercular, and obscure meshes (fig. 11 *b*), which in other instances form strong tubercles. In some cases these become ragged warts

[1] 'Bericht Ver. Naturkunde Cassel,' 1860–62 (1863), pp. 1—63, pls. i—iv.
[2] 'Forhandl. Videnskabs-Selskabet Christiania,' Aar 1864 (1865).
[3] 'Mém. Commission Déscript. et Carte géol. Neerlande,' vol. ii.

(*C. scabra,* Münster; see Bosquet's 'Entom. Tertiair.,'[1] p. 103, pl. v, fig. 7); in others they pass into spines (*C. ericea, C. irpex,* and others; G. S. Brady, 'Challenger Ostrac.,' pls. xvii and xviii); we have also a passage-form.

The above and two following forms have a subovate edge view. They were found in the London Clay of Piccadilly, London, by Messrs. Sherborn and Chapman. (British Museum.)

29. CYTHERE SCABROPAPULOSA, *Jones.* Plate II, fig. 16.

CYTHERE SCABROPAPULOSA, *Jones.* Monogr. Tert. Entom., 1857, p. 31, pl. v, fig. 16; Jones and Sherborn, Geol. Mag., 1887, p. 391, pl. xi, fig. 5.

This specimen from the London Clay of Piccadilly is more uniformly convex and more rounded posteriorly than the Bracklesham specimen figured in the Monograph, 1857. Moreover, the anterior margin is strongly denticulated, but the dorsal edge is not quite so roughly tuberculated as seen in the valve from Bracklesham. (British Museum.)

Dr. G. S. Brady's "*C. scabropapulosa*" from the Antwerp Crag ('Trans. Zool. Soc.,' vol. x, 1878, p. 393, pl. lxvi, fig. 2), being much rougher and more warty, is nearer to *C. scabra*, Münster, and might be regarded as *C. scabropapulosa*, var. *rudis*.

29*. CYTHERE SCABROPAPULOSA, *Jones;* var. ACULEATA, *J. & S.* Plate II, figs. 17 *a*, *b*.

CYTHERE SCABROPAPULOSA, *Jones.* Geol. Mag., 1887, p. 391, pl. xi, fig. 6.

This is a well-grown valve of *C. scabropapulosa* becoming hispid, by the tubercles ending with a sharp prickle or spine. A further development of this spinose condition is seen in *C. irpex*, Brady, mentioned above. Our specimen, like the foregoing, is from the London Clay of Piccadilly. (British Museum.)

30. CYTHERE DELIRATA,[2] *Jones & Sherborn.* Plate III, figs. 16 *a*, *b*.

CYTHERE DELIRATA, *Jones & Sherborn.* Geol. Mag., 1887, p. 391.

A *Cythere* of the not uncommon suboblong form, but with the rare ornament of slight furrows diverging up and down from the median line of the posterior

[1] 'Mém. Couronnés, &c., Acad. Roy. Belg.,' vol. xxiv.

[2] Ploughed with divergent furrows.

region, and becoming more or less concentric or confused anteriorly. Edge view long-oval.

From the Fluvio-marine beds of Headon Hill, Isle of Wight. (F. E. Edwards' Collection in the British Museum.)

31. Cythere polyptycha, *Reuss*. Var. *nov*. Plate I, fig. 5.

Cythere polyptycha, *Reuss*. Geol. Mag., 1887, p. 451.

Somewhat trigonal-obvate; the antero-ventral angle and the opposite hinge both well developed. Anterior border nearly semicircular; the posterior somewhat contracted. Surface puckered with nearly parallel but irregular longitudinal ridges, with intermediate rough but obscure reticulation. The central region swollen into a round boss. Except that this specimen is less quadrate, possesses a boss, and is less distinctly reticulate, it closely resembles Reuss' original figure, Haidinger's 'Nat. Abth.,' vol. iii, 1854, p. 83, pl. x, fig. 22, from the Tertiary of Bohemia.

This *Cythere* belongs to a group of which *C. pusilla*, Bosquet, 'Entom. Tert.,' p. 85, pl. iv, fig. 7, may be taken as a type; possibly embracing the species referred by G. S. Brady, 'Trans. Zool. Soc.,' vol. v, 1866, p. 376, pl. lix, fig. 10, to Reuss' *C. clathrata* (which does not appear to us to be identical), and also *C. pumila*, G. S. B., op. cit., p. 378, pl. lx, fig. 7. The latter, though near to our specimen, has far more irregular ridges.

One valve, from the "Norwich Crag" of Southwold. (British Museum.)

32. Cythere plicata, *Münster*. Plate I, fig. 18.

Cythere plicata, *Münster*. Jones, Monogr. Tert. Entom., 1857, pp. 32, 33, pl. iv, fig. 16; pl. v, figs. 8 *a—d*; pl. vi, fig. 17; Geol. Mag., 1887, p. 450.

We have a narrow and compressed carapace, contracted posteriorly, from the Belosepia-bed, Bracklesham. (British Museum.) This species is noticed in the 'Geol. Mag.,' 1874, p. 479, as having been found in the London Clay of Copenhagen Fields, with two species of *Chara*.

The specimen of this common species here figured is a narrow right valve. *C. plicata* is found abundantly in the Upper Eocene of Colwell Bay, and its variety laticosta is plentiful in the Middle Eocene of Barton and Highcliff.

33 and 33*. CYTHERE COSTELLATA (*Roemer*), var. TRIANGULATA, *Jones & Sherborn.* Plate I, fig. 21.

CYTHERE COSTELLATA (*Roemer*), var. TRIANGULATA, *Jones & Sherborn.* Geol. Mag., 1887, p. 450.

The specimen under notice is relatively shorter, broader (higher), more triangular, and with sharper ridges than the figure in the 'Monograph,' 1857, p. 32, pl. vii, fig. 21. The anterior hinge is more prominent, and the front margin rather oblique. It is also narrower behind, ending with three small spines or denticles. The edge view is acute ovate.

From the Belosepia-bed, Bracklesham. (British Museum.)

Cythere costellata was figured and described in the 'Monograph Post-Tert. Entom.,' 1874, p. 152, pl. xvi, figs. 13—15, from Selsey, and there recognised as being probably of Tertiary date, though found in the superficial mud.

34. CYTHERE GYRIPLICATA, *Jones & Sherborn.* Plate I, figs. 17 *a*, *b*.

CYTHERE GYRIPLICATA, *Jones & Sherborn.* Geol. Mag., 1887, p. 391.

Narrow-suboval in outline, hinge-line slightly convex, and distinct. Ends rounded, narrow behind, somewhat oblique in front. Surface sculptured with delicate longitudinal ridges, arranged concentrically towards the margins, and united by smaller transverse ridges.

From the Belosepia-bed of Bracklesham. (British Museum.)

The nearest species we know of is Bosquet's *C. multicostata*, 'Entom. Tert.,' p. 59, pl. ii, fig. 12; but this is very much coarser and broader, and without any sign of reticulation.

35 and 35*. CYTHERE SCROBICULO-PLICATA, et var. RECTA, *Jones.*

CYTHERE SCROBICULO-PLICATA, et var. RECTA, *Jones.* Monogr. Tert. Entom., 1857, p. 33, pl. vi, figs. 4, 6, 9; Geol. Mag., 1887, p. 452.

A figure of this species was reproduced in the 'Geol. Mag.,' 1887, p. 452, pl. xi, fig. 8, from the 'Monograph Tert. Entom.,' 1857, as one of the forms belonging to the London Clay of Finchley and Copenhagen Fields; the species also belongs to the Barton Clay, in which deposit it occurs in greater abundance than in the London Clay. (British Museum.)

The variety RECTA (*loc. cit.*, fig. 9) makes a near approach to the next species, No. 36. (British Museum.)

36. CYTHERE TRANSENNA,[1] sp. nov. Plate II, fig. 12.

CYTHERE ANGULATOPORA (non *Reuss*). Jones, Monogr. Tert. Entom., 1857, p. 34, pl. iv, figs. 17, 18.
— SCALARIS,[2] *Jones & Sherborn.* Geol. Mag., 1887, p. 451, pl. xi, fig. 7.

Another oblong *Cythere* with nearly equal ends, but the front margin, sloping to the strongly marked anterior hinge, is more oblique than the other. The surface has longitudinal ridges, which on the hinder moiety of the valve are connected by transverse riblets, making irregular square meshes. In their disposition the ridges vary as to parallelism.

A fine series of allied forms, from Gaas, near Dax, have been described and figured by Reuss ('Sitz. k. Ak. Wiss. Wien,' vol. lvii, 1868, pp. 38—40, pl. vi, figs. 3, 4, 5, and 7); but the differences are sufficiently apparent.

This species is not uncommon in the Tertiary Sands and Oyster-bed at Colwell Bay, Isle of Wight. Two or three examples are known from the London Clay of Islington. (British Museum.)

37. CYTHERE FORBESII, *Jones & Sherborn.* Plate III, figs. 18 *a, b.*

CYTHERE FORBESII, *Jones & Sherborn.* Geol. Mag., 1887, p. 452.

A subquadrate form, approaching the more definitely squared *Cytheræ*, for which we keep the convenient subgeneric name of *Cythereis*. The valves are well rounded in front and behind, with nearly straight lower and upper margins, the latter marked with well-defined hinges. The posterior margin is usually denticulate. The surface bears six or seven crenulate and fenestrate ridges, those on the ventral region being more continuous than those on the dorsal. The interspaces of the ridges are deeply reticulated.

This distinct and well-defined species we dedicate to the late Edward Forbes, whose investigations in the fossil fauna of the Tertiaries of the Isle of Wight will ever be gratefully remembered.

[1] A lattice before a window.

[2] This name was preoccupied by a species in the 'Challenger Report.'

Specimens numerous, from the Fluvio-marine beds of Headon, Isle of Wight. (F. E. Edwards' Collection in the British Museum.)

XII. CYTHEREIS, *Jones*, 1849.

Monogr. Cretac. Entom., 1849 (subgenus), p. 14; Monogr. Tert. Entom., 1857, p. 37.

This quasi-generic form is conveniently kept apart on account of its easily recognisable valves. In the several species defined as belonging to *Cythereis* by G. O. Sars, the anatomical structure is not very different from that of *Cythere*, and the valves are in many cases like those of *Cythere*.[1] In other cases the valves are subquadrate, angular, and rough, and these are usefully separated, not as a natural, but as an artificial group, convenient for collectors and others.

1. Cythereis corrugata (*Reuss*). Var. *nov.* Plate III, figs. 19 *a, b*.

Cythereis corrugata (*Reuss*). *Jones & Sherborn*, Geol. Mag., 1887, p. 454.

This valve is rugosely reticulate, with the longitudinal meshes stronger and more persistent than the transverse. Several allies of this form are figured in plates xxi and xxii of the 'Report Challenger Ostracod.,' 1880. Of the previously published forms we find that *C. corrugata*, Reuss, 'Haidinger's Nat. Abth.,' vol. iii, p. 79, pl. x, fig. 14, is the nearest to ours, although it differs in being squarer, stronger, swollen at centre, and strongly rimmed on the front margin.

One specimen, collected by the late F. E. Edwards from the Fluvio-marine beds, Headon, Isle of Wight, is in the British Museum.

2. Cythereis senilis, *Jones*, 1857, from the Crag, takes its place here. (Brit. Mus.)

3. Cythereis Hoernesi (*Speyer*). Plate I, fig. 7.

Cythere Hoernesi, *Speyer*. Ostrac. Cassel. Tertiär.,[2] 1863, p. 32, pl. iii, fig. 7; pl. iv, fig. 1.
Cythereis — *Jones & Sherborn*. Geol. Mag., 1887, p. 454.

Oblong, swollen into a distinct boss in the centre, ends round, the front margin semicircular and deeply fenestrated, the hind margin depressed and slightly

[1] See Dr. G. S. Brady's remarks, 'Trans. Linn. Soc.,' vol. xxvi, pp. 395 and 401.
[2] 'Bericht Ver. Naturkunde Cassel,' 1860–62 (1863).

toothed. Surface reticulated, ornamented with two prominent ridges, the dorsal and most striking of which, strong, fenestrated, and somewhat convex, partly obscures the hinge-line, and curves forwards and downwards below the front hinge. The ventral ridge is not so strong; both are sharply angular posteriorly.

The only marked difference between our specimen and that figured by Dr. Speyer is—that the dorsal ridge in the former is much better developed, being higher, thinner, fenestrate, more delicate, and ending posteriorly in a much sharper angle.

A single valve from the White Crag. (British Museum.)

4. Cythereis Prestwichiana, *Jones & Sherborn.* Plate II, figs. 13, 14 *a*, *b*.

Cythereis Prestwichiana, *Jones & Sherborn.* Geol. Mag., 1887, p. 454, pl. xi, figs. 11 *a*, *b*.

A very small neat *Cythereis*, with well-developed marginal rim in front, which, passing along the ventral region, gradually rises higher, and ends in a sharp rectangle. A similar, but weaker, ridge follows the dorsal edge. Both are more or less crenulated. There is a central boss, and a short ridge behind it, ending, like the others, at the sudden posterior slope, which terminates in a narrow, produced, flat, and toothed edge. The surface of the valve is somewhat depressed, and is covered with a distinct lace-like reticulation. Edge-view subsagittate.

This form is clearly related to that figured in the 'Monogr. Cretaceous Entom.,' 1849, pl. v, fig. 13 *b*, which we propose to remove from *C. ornatissima* ('Geol. Mag.,' 1870, p. 75). We now have closely allied forms from the Chalk of other localities in the British Islands, and the distinctness of this new species, named after Prof. Prestwich, D.C.L., F.R.S., becomes more and more apparent.

Two valves from the London Clay of Whitecliff Bay, Isle of Wight. Collected by Mr. C. D. Sherborn, F.G.S. (British Museum.)

5. Cythereis aranea, *Jones & Sherborn.* Plate II, figs. 15 *a*, *b*.

Cythereis aranea, *Jones & Sherborn.* Geol. Mag., 1887, p. 453 pl. xi, figs. 10 *a*, *b*.

Oblong, with the front margin broader and rounder than the hinder, both more or less denticulate. The surface ornamented with a delicate raised network of irregular meshes, which extends over the flat ventral area. Two ridges, over which the network is traceable, are present. One, shorter than the other, occupies the median line from about the centre to the edge of the posterior slope, which makes a strong depression at the hind margin. The other and longer ridge commences in a curve inside the front margin, rises as it borders the ventral region, and dies out at the posterior slope, like the other. The ventral aspect of the carapace is cuneiform or almost sagittate. *C. Haidingeri*, Bosquet ('Entom. Tertiair.,' p. 125, pl. vi, fig. 10), is near to this species in general characters; but its more angular shape, and more symmetrical network, distinguish it. So also *C. Edwardsii* (Roemer), Reuss ('Haidinger's Nat. Abth.,' vol. iii, p. 84, pl. x, fig. 24), is like it to some extent; but its ridges extend the whole length of the valve, joining fore and aft, and, as figured by Bosquet ('Entom. Tert.,' p. 94, pl. iv, fig. 14), it appears still coarser or stronger, and with still more marked features.

Several specimens from the London Clay, Piccadilly, London. Collected by Messrs. Sherborn and Chapman. (British Museum.)

6. Cythereis Bowerbankiana, *Jones*.

Cythereis Bowerbankiana, *Jones*. Monogr. Tert. Entom., 1857, p. 39, pl. vi, figs. 7, 8; Geol. Mag., 1887, p. 452, pl. xi, fig. 9.

This is characteristic of the London Clay. One specimen has been found by Mr. C. D. Sherborn at Whitecliff Bay, and a few others have been long known from Copenhagen Fields and Wimbledon Common, near London. (British Museum.)

7. Cythereis horrescens, *Jones*, 1857, comes next in the order of form and ornament. It belongs to Barton and Bracklesham. The late Mr. F. E. Edwards found it also at Highcliff. (British Museum.)

8. Cythereis spiniferrima, sp. nov. Woodcut, Fig. 3.

Cythereis spinossissima,[1] *Jones & Sherborn*. Geol. Mag., 1887, p. 453, woodcut, fig. 2.

A right and left valve of this form were lately found, with *C. Harrisiana*, in some washings of the London Clay from Piccadilly. They are oblong, with the front margin broader and more semicircular than the hinder. Surface coarsely reticulate; the reticulations becoming more shallow and indistinct as they reach the central area. Many of the ridges of the meshes are pinched up at their junctions, and in most cases thus form bluntly-pointed spines; these spinous prolongations are partly the cause of the confusion of the reticulation in the central area. Approaching the margins, the spines become longer and more defined; and the anterior area bears, in addition to its marginal row of spines, a second row just within the other. In this form, related to *C. Bowerbankiana* on the one hand and to *C. horrescens* on the other, we note that the characteristic

[1] This name is preoccupied in the 'Trans. Zool. Soc.,' 1865, p. 386

ventral ridge of spines, which is present in both these forms, is absent, being merely represented by scattered spines, not arranged in a definite order except

FIG. 3.—*Cythereis spiniferrima*, sp. nov. Right valve. From the London Clay. Magnified 20 diam.

on the anterior area. The reticulation is also much more distinct,—a marked feature in the new form.

To this same group belongs a rather common, recent and Post-Tertiary species, namely, *Cythereis Dunelmensis*, Norman (the references are given in full in the 'Monogr. Post-Tert. Entom.,' 1874, p. 168). The chief differences between this and the older form from the London Clay are in the shape of the posterior margin, which is elliptically rounded in the latter instead of being square, and a more definitely spinose, instead of foliaceous, condition of the ornament, especially towards the margins.

Two valves only; from the London Clay of Piccadilly. Collected by Messrs. Sherborn and Chapman. (British Museum.)

9. CYTHEREIS JONESII, *Baird.*

CYTHEREIS CERATOPTERA (*Bosquet*). Jones, Monogr. Tert. Entom., 1857, p. 39, pl. iv, fig. 1; Geol. Mag., 1870, p. 156.

Dr. G. S. Brady ('Trans. Linn. Soc.,' vol. xxvi, pp. 418 and 476) has merged *C. ceratoptera* in the recent British species *C. Jonesii*, Baird, published about the same time as Bosquet's 'Mémoire,' 1850-52. (British Museum.)

10. CYTHEREIS CORNUTA (*Roemer*). Plate I, fig. 22.

CYTHEREIS CORNUTA (*Roemer*). Monogr. Tert. Entom., 1857, p. 39, pl. iv, fig. 19; and pl. v, fig. 15 (omitting the references to Reuss in the *synonymy*[1]); Geol. Mag., 1870, p. 156; 1887, p. 454.

This species occurs in the Tertiary sands of Colwell Bay, and in the blue clay of Bracklesham. A very closely allied form is found in the Chalk.

[1] Not *C. cornuta*, Reuss, in Haidinger's 'Nat. Abhandl.,' vol. iii, p. 81, pl. x, fig. 18 *a* (see

Three or four specimens of this form from Bracklesham, of which one is here figured, differ individually from those previously figured in the 'Monogr.,' 1856, and elsewhere, in their narrowness, the parallelism of their upper and lower margins, and in the replacement of the curved dorsal ridge by a uniform marginal rim. The very faint markings seen along the ventral ridge in the figures in the 'Monograph' of 1856, are more distinct in the specimens now under consideration, and are evidently due to alternate thick and thin rod-like divisions, forming minute light and dark squarish areas. The slight transverse dorsal notch in fig. 19 is also traceable in our present specimens, when carefully illuminated and strongly magnified.

Bracklesham. (British Museum.)

11. CYTHEREIS, *sp.* Thanet Sand. 'Monogr.,' 1857, p. 40, pl. vi, fig. 17.

XIII. CYTHERIDEA, *Bosquet*, 1852.

Valves generally subtriangular and usually punctate. Hinge-margins tuberculate or crenulate, chiefly towards the ends, but sometimes all along. See Jones ('Monogr. Tert. Entom.,' 1857, p. 41), Brady ('Trans. Zool. Soc.,' vol. v, 1866, p. 369), and Jones and Sherborn ('Proceed. Bath Nat. Hist. and Antiq. Field Club,' vol. vi, 1888, p. 251).

1 & 1*. CYTHERIDEA TOROSA (*Jones*), et var. TERES, *Brady & Robertson.*

CYPRIDEIS TOROSA, *Jones.* Monogr. Tert. Entom., 1857, p. 21, pl. ii, figs. 1 *a*—*i* (fig. 1 *e* being the smooth form "*teres*" = *Cytheridea littoralis*, Brady).

CYTHERIDEA TOROSA, *Brady, Crosskey & Robertson.* Monogr. Post-Tert. Entom., 1874, p. 178, pl. xv, figs. 11 and 12; and var. *teres*, Brady and Robertson, *ibid.*, p. 179, pl. 7, figs. 1 and 2.

There has been much confusion in the nomenclature of this species, and its history may be seen in the synonymy given in the above references. *C. torosa* is fossil at Mundesley in Norfolk, and at Grays, Essex; var. *teres* at Wear Farm and Chislet; and in the peat-bed at Tilbury. Several Post-Tertiary localities are quoted by Brady, Crosskey and Robertson, p. 179, for *C. torosa* and the var. *teres*. (Brit. Mus., &c.)

'Zeitschr. deutsch. geol. Ges.,' vol. vii, p. 282), which is possibly *C. coronata*, Roemer (?); fig. 18 *b* is a poor specimen probably of *C. ceratoptera*, Bosquet (see Bosquet, 'Entom. Tertiair.,' p. 117). It may be *C. alata*, Bosquet (Jones, 'Monogr. Cret. Entom.,' p. 21, pl. v, fig. 14).

2 & 2*. Cytheridea Muelleri (*Münster*), et var. torosa, *Jones*.

Cytheridea Muelleri, et var. torosa, *Jones*. Quart. Journ. Geol. Soc., vol. x, 1854, p. 160, pl. iii, figs. 7, 8;[1] Mem. Geol. Survey, Tert. Fluvio-Marine Form. Isle of Wight, 1856, p. 158, pl. vii, figs. 27, 28; Monogr. Tert. Entom., 1857, pp. 41—43, pl. v, fig. 4, and pl. vi, figs. 10—13; Brady, Trans. Zool. Soc., vol. x, 1878, pp. 397, 398, pl. lxii, figs. 4 *a—e*.

This well-marked species and its varieties are widely distributed in the Tertiaries of Europe. Especially in the Eocene at Woolwich and Newbury; in the Oligocene of the Isle of Wight; and the Antwerp Crag. It occurs, with the variety *torosa*, in myriads[2] in the Hamstead Beds (especially the Lower beds), tried by the boreholes of the Geological Survey in 1887. The trial-holes near Newport and Gunville also found it in the Bembridge Marls. This species is rarer in the Osborne series at Cliffend and in the Clay with oysters at Colwell Bay. It occurs also in the Headon Beds and at Highcliff (F. E. Edwards). Recent in the Zuyderzee (Bosquet), and "from Smyrna, the Levant, and Australia," G. S. Brady, *loc. cit.* (Brit. Mus. and Mus. Pract. Geol.)

3. Cytheridea montosa, *sp. nov.* Woodcut, Fig. 4.

a *b*

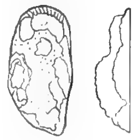


Fig. 4.—*Cytheridea montosa*, sp. nov. *a*. Right valve. *b*. Edge view, seen from the ventral margin. Magnified 20 diam.

This small *Cytheridea* (·75 mm. long) is, at first sight, not unlike some specimens of the var. *torosa* of *C. Muelleri*, but differs markedly in having, besides a strong subcentral swelling, a thick, rounded, interrupted, and sausage-like ridge nearly surrounding the surface, with numerous little shining tubercles scattered over the rest of the valve.

Rare in the Middle Hamstead Beds, Isle of Wight, at the Reservoir, half a mile west of Medina Mills. (Museum Practical Geology.)

[1] Figs. 9, 11, 12, illustrate species from the Isle of Wight, not from Woolwich.

[2] *C. Muelleri* inhabits fresh, brackish, and salt waters; and is sometimes found in similar abundance to that of these fossil multitudes.

4. Cytheridea debilis, *Jones*. Plate I, fig. 16.

Cytheridea debilis, *Jones*. Monogr. Tert. Entom., 1857, p. 43, pl. vi, fig. 13.

This occurs in numbers in the Oligocene Beds at Colwell Bay, Isle of Wight, and is referred to in the 'Geol. Mag.,' 1887, p. 455, as having been found also at Bracklesham. (British Museum.)

5. Cytheridea pinguis, *Jones*.

Cytheridea pinguis, *Jones*. Monogr. Tert. Entom., 1857, p. 43, pl. ii, figs. 4 *a—h*; Brady, Trans. Zool. Soc., vol. x, 1878, p. 397, pl. lxii, figs. 3 *a—d*; Jones and Sherborn, Geol. Mag., 1887, p. 455.

Mr. Clement Reid has collected this species from the Weybourn Crag at East Runton. It is rare in the Suffolk Crag, but abundant in the Antwerp Crag. (Brit. Mus. and Mus. Pract. Geol.)

6. Cytheridea elongata, *Brady*. Plate III, figs. 20 *a*, *b*, 21, 22.

Cytheridea elongata, *Brady*. Monogr. Recent Brit. Ostrac., Trans. Linn. Soc., 1868, vol. xxvi, p. 421, pl. xxviii, figs. 13—16, and pl. xl, fig. 6; Monogr. Post-Tert. Entom., 1874, p. 181, pl. ix, figs. 10—13; Jones and Sherborn, Geol. Mag., 1887, p. 456.

Numerous specimens from the Weybourn Crag of East Runton, varying slightly in individuality of growth and sex, are referable to Brady's *Cytheridea elongata*. Collected by Mr. Clement Reid, F.G.S. (Museum Practical Geology.) We have it also, not rare, in the Norwich Crag of Southwold. (British Museum.)

7. Cytheridea Sorbyana, *Jones*.

Cytheridea Sorbyana, *Jones*. Monogr. Tert. Entom., 1857, p. 44, pl. iv, figs. 6 *a—e*; B., C., and R., Monogr. Post-Tert. Entom., 1874, p. 180 (for synonyms and localities), pl. vii, figs. 7—12.

This species is abundant in Post-Tertiary Beds, and in the Northern seas. (British Museum, &c.)

8. Cytheridea punctillata, *Brady*. Plate I, fig. 2.

One damaged valve from the "Norwich Crag" at Southwold we refer to this species, which has been described and figured in full in the 'Monogr. Post-Tertiary Entom.,' 1874, p. 177, pl. vi, figs. 1—11. Our specimen, however, approaches most closely to another figure of the same species in Dr. G. S. Brady's paper, 'Trans. Linn. Soc.,' vol. xxvi (1868), p. 424, pl. xxvi, fig. 36.

This species is not rare in the Post-Tertiary Beds and the northern seas. (British Museum.)

9. Cytheridea perforata (*Roemer*). Plate I, fig. 14.

Cytheridea perforata, *Jones*. Monogr. Tert. Entom.,[1] 1857, pp. 44, 45, pl. iv, figs. 14 *a—e* (? *d*, *e*, young); Geol. Mag., 1870, pp. 74 and 157; J. and S., Geol. Mag., 1887, p. 445.

The specimen now figured is like fig. 14 *a*, pl. 4, in the 'Monogr.,' 1857, but is rather less triangular, much more coarsely punctate, and strongly marked at the anterior hinge. It was found, with numerous normal valves, in some washings of the clay from Barton, Hants. This species is known also from the Oligocene Sands at Colwell Bay, the London Clay, the Eocene Beds of the Paris Basin, and from some Cretaceous formations of England and the Continent. (Brit. Mus.)

9*. Cytheridea perforata, var. insignis, *Jones*.

Cytheridea perforata, var. insignis, *Jones*. Monogr. Tert. Entom., 1857, p. 46, pl. vi, fig. 3; J. and S., Geol. Mag., 1887, p. 455, pl. xi, fig. 12.

A figure of this fine variety, from the London Clay of Copenhagen Fields, was reproduced in the 'Geol. Mag.' from the original Monograph. (British Museum.)

10. Cytheridea glabra, *Jones*.

Cytheridea perforata, var. glabra, *Jones*. Monogr. Tert. Entom., 1857, p. 46, pl. v, fig. 24.

— glabra, *Jones & Sherborn*. Geol. Mag., 1887, p. 455, pl. xi, fig. 13.

[1] This species is not like *Bairdia subtrigona*, Bornemann, as quoted at p. 45 of the Monograph.

This angular and smooth form, related to *C. perforata*, should, we think, be regarded as a species. It came from the London Clay of Copenhagen Fields. (British Museum.)

There are several forms of this kind besides the var. *insignis* and the allied *glabra*, from the London Clay ('Monograph,' p. 46); such as *C. punctatella*, Bornemann, 'Zeitschr. deutsch. geol. Ges.,' vol. vii (1855), p. 360, pl. xxi, fig. 2, and *C. incrassata*, Bosquet, 'Entom. Tertiair.,' p. 44, pl. iii, fig. 11.

11. Cytheridea (?), sp.

Cytherideis (?), spec. Monogr. Tert. Entom., 1857, p. 49, pl. vi, fig. 15.

This obscure form from the Woolwich Beds may possibly belong to *Cytheridea*.

12. Cytheridea ? barbata (*Sowerby*).

Cythere barbata, *Sowerby*. Trans. Geol. Soc., ser. 2, vol. v, 1834, p. 131, pl. ix, fig. 1.

This specimen, once in the Wetherell Collection of London-Clay fossils, has been lost. It probably belonged to *Cytheridea*. See *footnote*, page 18.

XIV. KRITHE, *B.*, *C.*, *& R.*, 1874.

(*Cytherideis*, Jones, in part, 1857, *Ilyobates*, Sars, 1865.)

Monogr. Post-Tert. Entom., 1874, p. 183.

1. Krithe Bartonensis (*Jones*).

Cytherideis Bartonensis, *Jones*. Monogr. Tert. Entom., 1857, p. 50, pl. v, figs. 2 *a*, *b*, 3 *a*, *b*.
Ilyobates prætexta, *G. O. Sars*. Overs. Norg. mar. Ostrac., 1865, p. 60.
— Bartonensis, *Brady*. Trans. Linn. Soc., vol. xxvi, 1868, p. 432, pl. xxxiv, figs. 11—14, and pl. xl, fig. 5; Jones, Geol. Mag., 1870, p. 157.
Krithe — *Brady, Crosskey & Robertson*. Monogr. Post-Tert. Entom., 1874, p. 184, pl. ii, figs. 22—26.

This species lives in the North Atlantic, and is not rare in the Post-Tertiary deposits. Rare in the Middle Eocene of Barton Cliff (Jones) and Highcliff (Edwards), Hampshire. (British Museum.)

2. Krithe glacialis, *Brady, Crosskey, & Robertson.*

Krithe glacialis, *Brady, Crosskey, & Robertson.* Monogr. Post-Tertiary Entom., Pal. Soc., 1874, p. 184, pl. vi, figs. 21—24; Jones & Sherborn, Geol. Mag., 1887, p. 456, pl. xi, figs. 15 *a, b.*

A smooth specimen of *Krithe* from the London Clay of Piccadilly is so extremely close in every feature to *K. glacialis* from Scotland and Norway, except in the apparent papillæ of the latter, that we cannot separate it from this later form.

Collected by Messrs. Sherborn and Chapman. (British Museum.)

3. Krithe Londinensis, *Jones & Sherborn.* Plate II, figs. 20 *a, b.*

Krithe Londinensis, *Jones & Sherborn.* Geol. Mag., 1887, p. 456, pl. xi, figs. 14 *a, b.*

Carapace narrow-obovate, not quite semicircular in front, subacute posteriorly. In edge-view the anterior third is compressed and wedge-shaped, the middle is swollen, and the posterior third is compressed, and ends in the usual notch formed by the produced ends of the two valves. Surface smooth and shining. In this last feature it resembles other forms of this genus, but in its outlines it differs from any we know.

From the London Clay of Piccadilly. Collected by Messrs. Sherborn and Chapman. (British Museum.)

Bornemann's *Bairdia pernoides* ('Zeitschr. d. g. Ges.,' vol. vii, 1855, p. 358, pl. 20, fig. 7) is a somewhat similar *Krithe* of the same geological age.

XV. XESTOLEBERIS, *G. O. Sars*, 1865.

1. Xestoleberis Colwellensis, *Jones & Sherborn.* Plate I, figs. 13 *b, c.*

Xestoleberis Colwellensis, *Jones & Sherborn.* Geol. Mag., 1887, p. 456.

Carapace ovate in outline, and subovate in edge-view, with spinulose surface. This is near *X. aurantia* (Baird), but blunter anteriorly.

From the Tertiary of Colwell Bay. (British Museum.)

2. Xestoleberis aurantia (*Baird*). Var. *Jones & Sherborn*. Plate III, figs. 23 *a*, *b*.

Xestoleberis aurantia, *Brady, Crosskey, and Robertson*. Monogr. Post-Tert. Entom., Pal. Soc., 1874, p. 191, pl. xvi, figs. 32, 33 (full synonymy is there given).
— — var., *Jones & Sherborn*. Geol. Mag., 1887, p. 456.

Except in being minutely punctate, and not distinctly papillose, this specimen (from Headon) closely resembles the recent *X. aurantia* above quoted.

From the Fluvio-marine deposits of Headon Hill, Isle of Wight. Collected by the late F. E. Edwards, and now in the British Museum.

XVI. LOXOCONCHA, *G. O. Sars*, 1865.

1. Loxoconcha tamarindus (*Jones*).

Cytherideis tamarindus, *Jones*. Monogr. Tert. Entom., 1857, p. 49, pl. iii, figs. 4 *a*, *b*.
Loxoconcha — *Brady*. Trans. Linn. Soc., vol. xxvi, 1868, p. 435, pl. xxv, figs. 45—48; Jones, Geol. Mag., 1870, p. 157.

This species occurs in the White Crag of Suffolk, and it has been found at several places in the North Atlantic and the English Channel. Some of the recent specimens prove it to belong to *Loxoconcha* (Brady, *loc. cit.*). (Brit. Mus.)

XVII. PSEUDOCYTHERE, *G. O. Sars*, 1865.

1. Pseudocythere attenuata, *Jones*.

Cythere attenuata, *Jones*. Monogr. Tert. Entom., 1857, p. 28, pl. v, fig. 11.
Cytherura — — Geol. Mag., 1870, pp. 156, 158.

This probably belongs to the genus *Pseudocythere* of G. O. Sars ('Forhandl. Vidensk.-Selskab. Christiania,' Aar 1864 (1865), p. 87); see also G. S. Brady's 'Report Challenger,' &c., 1880, p. 144.

One specimen was obtained from the clay-bed "No. 29," of Prof. Prestwich's section at Alum Bay, at the base of the Barton Clay ('Quart. Journ. Geol. Soc.,' vol. ii, 1846, p. 257, pl. ix, fig. 1; also 'Quart. Journ. Geol. Soc.,' vol. xliii, 1887, pp. 132, 138, &c.). (British Museum.)

2. Pseudocythere Bristovii, *sp. nov.* Woodcut, Fig. 5.

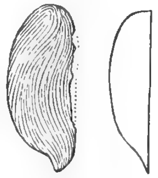


Fig. 5.—*Pseudocythere Bristovii*, sp. nov. *a.* Right valve (slightly broken along the ventral edge). *b.* Edge view. Magnified 20 diam.

Elongate, convex, especially at the front moiety, subrhomboidal; rather obliquely rounded in front, arched on the dorsal and straight on the ventral margin, between its anterior and posterior curves. The hinder extremity of the valve is suddenly narrowed to a subtriangular and flat point, which has a convex outline on its ventral, and is neatly incurved on its dorsal edge, much like the end of a *Bairdia*. The surface bears numerous delicate, longitudinal, sinuous, raised lines, which are somewhat interrupted and overlap in the mid-dorsal region, and branch into fine plumose groups here and there on the anterior part of the valve.

This elegant form is rare in the Bembridge Limestone of a brickyard south-east of West-Cowes Cemetery. It is named after H. W. Bristow, Esq., F.R.S., who has always taken great interest in the geology of the Isle of Wight.

This species is allied to, but differs in detail from, *Pseudocythere Fuegiensis*, G. S. Brady ('Report Challenger, &c.,' 1880, p. 145, pl. i, figs. 7 *a—d*).

The same piece of Bembridge Limestone yielded a few fragments of a form similar or allied to the foregoing, but ornamented with still more delicate and silky striæ, which, under a high power, are seen to be interrupted, or elegantly punctated, along their length.

XVIII. CYTHERURA, *G. O. Sars*, 1865.

Brady, Crosskey & Robertson, Monogr. Post-Tert. Entom., 1874, p. 191.

1. Cytherura Prestwichiana, *Jones & Sherborn.* Plate I, figs. 20 *a, b.*

Cytherura Prestwichiana, *Jones & Sherborn.* Geol. Mag., 1887, p. 456.

This belongs to the same type as *Cytherura nigrescens*, B., C., and R., 'Post-Tert. Entom.,' p. 192, pl. xi, figs. 28—32, but differs in its greater compression anteriorly, and in being less strongly notched behind. Allied forms are known to us from several Jurassic strata.

From the Belosepia-bed, Bracklesham. (British Museum.)

Named after Professor Prestwich, D.C.L., F.R.S., who has so greatly advanced our knowledge of the Tertiary deposits.

2. Cytherura clathrata, *G. O. Sars.* Plate III, figs. 24 *a*, *b*.

Cytherura clathrata, *G. O. Sars.* Brady, Trans. Linn. Soc., vol. xxvi, 1868, p. 446, pl. xxix, figs. 43—46; B., C., and R., Monogr. Post-Tert. Entom., 1874, p. 204, pl. xi, figs. 1—4; Jones & Sherborn, Geol. Mag., 1887, p. 457.

In this small and interesting form the oval carapace is somewhat sharper behind than before, and more compressed in front than behind. It has the surface ornamented with a strong median ridge, branching freely off towards the margin. The main branches in our specimen keep their entirety, but Dr. G. S. Brady figures individuals in which the branches lose themselves in a rough general reticulation over the surface.

From the Weybourn Crag of East Runton. Collected by Mr. Clement Reid, F.G.S. (Museum Practical Geology.)

XIX. CYTHEROPTERON, *G. O. Sars*, 1865.

G. S. Brady, Trans. Linn. Soc., vol. xxvi, 1868, p. 447.
Brady, Crosskey and Robertson, Monogr. Post-Tert. Entom., 1874, p. 201.

1. Cytheropteron triangulare (*Reuss*). Plate II, figs. 19 *a*, *b*, *c*.

Cythere triangularis, *Reuss.* Zeitschr. deutsch. geol. Ges., vol. vii, 1855, p. 279, pl. x, fig. 3.
— — *Jones.* Monogr. Tert. Entom., 1857, p. 25, pl. vii, fig. 5.
— tenuicristata, *Reuss.* Sitzungsb. k. Akad. Wiss. Wien, vol. lii, 1865, p. 467, pl. not numbered, fig. 12.
Cytheropteron triangulare, *Jones.* Geol. Mag., 1870, p. 156.
— — *J. & S.* Geol. Mag., 1887, p. 457, pl. xi, fig. 16.

This well-marked form has already been well described, as well as several allies, namely, *Cytheropteron mucronalatum*, Brady ('Challenger, &c.,' 1880, p. 140, pl. xxxiii, fig. 8); *C. fenestratum*, Brady (*Ibid.*, p. 139, pl. xxxiv, fig. 6), both recent; and *C. sphenoides* (Reuss), 'Denkschr. k. Akad. Wiss. Wien,' vol. vii, 1854, p. 141, pl. xxvii, fig. 2, from the Chalk of the Eastern Alps.

From the London Clay of Copenhagen Fields and Piccadilly (British Museum), and from the Chalk of Mecklenburg and the Dobrudscha.

XX. CYTHERIDEIS, *Jones*, 1857. (Restricted.)

Monogr. Tert. Entom., 1857, p. 46.

1. Cytherideis Colwellensis, *Jones*.

Cytherideis Colwellensis, *Jones*. Monogr. Tert. Entom., 1857, p. 49, pl. iv, figs. 13 and 20; *Cythere?*, Geol. Mag., 1870, pp. 157 and 159.

This (with the left valve larger than the right), now retained in *Cytherideis*, occurs at Colwell Bay in the Nucula-bed (*Nucula deltoidea*) and other deposits, but not abundantly. (British Museum.)

2. Cytherideis botellina, *Jones*.

Cytherideis flavida (*Müller*). Jones, Monogr. Tert. Entom., 1857, p. 50, pl. iv, figs. 4 *a—c*.
Cythere botellina, *Jones*. Geol. Mag., 1870, p. 157.

According to Dr. G. S. Brady, Müller's *C. flavida* differs materially from this Crag species. Dr. Baird's *C. flavida* is referred to *Cytherideis subulata* by Brady ('Trans. Linn. Soc.,' vol. xxvi, 1868, p. 454, pl. 35, figs. 43—46), which also differs from the species under notice. The new specific name was therefore proposed in 1870. *C. botellina* is known only from the Crag of Suffolk, where it is abundant. (British Museum.)

3. Cytherideis, sp.

Monogr. Tert. Entom., 1857, p. 51.

A form somewhat related to *Cytherideis botellina*, Jones, but shorter, occurs in the Tertiary Sands of Colwell Bay. It is referred to in the 'Monograph,' *loc. cit.* Possibly it may be *C. gracilis*. (British Museum.)

4. CYTHERIDEIS GRACILIS (*Reuss*). Plate I, fig. 12.

CYTHERINA GRACILIS, *Reuss*. Haidinger's Nat. Abh., vol. iii, 1850, p. 52, pl. liii, fig. 3.
CYTHERIDEIS — *Brady*. Trans. Zool. Soc., vol. v, 1866, p. 367, pl. lviii, figs. 1 *a—d*.
— — *Jones & Sherborn*. Geol. Mag., 1887, p. 457.

To this neat form, already described by Reuss and others, the following are more or less allied:—*C.* (*Bairdia*) *arcuata*, Bosquet ('Entom. Tert.,' 1852, p. 32, pl. i, fig. 14); *C.* (*Bairdia*) *lithodomoides*, Bosquet (Ibid., p. 36, pl. ii, fig. 3); *C.* (*Bairdia*) *difficilis*, Reuss ('Sitzungsb. k. Ak. Wiss. Wien,' vol. lvii, 1868, p. 35, pl. v, fig. 7).

The figure given in the 'Fonds de la Mer' (8vo., Paris, 1867–71), livr. 4, 1868, p. 94, pl. xii, figs. 1, 2, of Brady's *Aglaia pulchella*, reminds us of this form.

We have seen one small specimen from a Tertiary bed at Colwell Bay. In the closed carapace the right valve is the smallest; it is faintly toothed on the anterior margin. The longitudinal lines on the ventral surface are distinct, though faint. (British Museum.)

C. gracilis is not uncommon in some Tertiary formations on the Continent, and has many allies.

5. ? CYTHERIDEIS UNISULCATA, *Jones*.

Monogr. Tert. Entom., 1857, p. 48, pl. iv, fig. 10.

This doubtful species occurred with *Candona Forbesii* in the Osborne series at Cliff End, Colwell Bay. It may be a young *Cypridea spinigera* badly preserved, or possibly a *Metacypris*. (British Museum.)

6. ? CYTHERIDEIS REN, *Jones*.

Monogr. Tert. Entom., 1857, p. 51, pl. iv, figs. 5 *a*, *b*.

From the Crag. The generic relationship is doubtful. (British Museum.)

XXI. CYTHERELLA. Subgenus, *Jones*, 1848. Genus, *Bosquet*, 1852.

The members of this genus are separable with difficulty as to their probable specific identities (see 'Monogr. Carbonif. Entom.,' Part I, No. 2, Pal. Soc., 1884, pp. 57—69). For the recognition of the British Tertiary forms we propose to keep certain types in view, referring our specimens to one or the other of the several groups.

GROUP I.—Typified by CYTHERELLA COMPRESSA (Münster), as figured by Egger, ("Ostrak. Ortenburg," 'Neues Jahrb., &c.,' 1858, p. 404, pl. v, fig. 2), with its flat parallel sides and more or less wedge-like ends (in edge-view). To this we have relegated *C. Londinensis*, Jones ('Monogr. Tert. Entom.,' p. 55, pl. v, figs. 20 and 22), besides "*C. compressa*, var. 2," fig. 19, of the same plate. See also 'Geol. Mag.,' 1887, p. 450, pl. xi, fig. 19. (British Museum.)

GROUP II.—CYTHERELLA MUENSTERI (Roemer). These carapaces have their greatest convexity near the middle or towards the hinder part of the valves.

One of our specimens from Bracklesham belongs to this group, but we know of none exactly like it, in its symmetrical, broad, and oblong outline, with nearly equally rounded ends, median convexity toward the ventral edge, and broadly ovate edge-view. Plate II, figs. 3 *a, b, c*. We have called it C. ROEMERI ('Geol. Mag.,' 1887, p. 458).

Another is near Roemer's original figure ('Neues Jahrbuch für Min., &c.,' 1838, p. 516, pl. vi, fig. 13) in shape, though not so strongly punctate (Plate II, fig. 10). In the 'Monogr. Tert. Entom.,' p. 56, pl. v, fig. 13, is a *smooth variety*; but fig. 12 is even more strongly pitted than is Roemer's fig. 13, and was recognised as var. RECTIPUNCTATA in the 'Geol. Mag.,' 1870, p. 157.

Some allied forms, smooth and having the convexity more definitely in the hinder third of the valves, are remarkably ovate in outline, and lanceolate in edge-view. These are regarded as belonging to a new species (Plate II, figs. 4 and 8 *a, b*) called C. REUSSII, after the late eminent microzoist of Prague and Vienna ('Geol. Mag.,' 1887, p. 458). In the 'Monogr. Tert. Entom.,' p. 54, pl. v, figs. 21 and 23 are also smooth, and belong to this group; but they are obovate in outline, like Bornemann's C. FABACEA ('Zeitschr. deutsch. geol. Ges.,' vol. vii, 1855, p. 355, pl. xx, fig. 2), to which they must be referred, as in 'Geol. Mag.,' 1870, p. 157; and 1887, p. 458, pl. xi, fig. 17.

Another of our Tertiary *Cytherellæ* is ovate-oblong, lanceolate in edge-view, with acute-ovate end-view. This also we believe to be new (Pl. I, figs. 24 *a, b, c*), and have named it C. DIXONI ('Geol. Mag.,' 1887, p. 458), in memory of one of the most enthusiastic workers on the geology and fossils of Bracklesham, whence many of the *Cytherellæ* here described have been obtained. (All the above are in the British Museum.)

A very small *Cytherella*, smooth, subovate, and with lanceolate edge-view, belongs apparently to Group II; Pl. III, figs. 25 *a*, *b*. It was found by Mr. Clement Reid in the Weybourn Crag of East Runton. (Mus. Pract. Geol.)

GROUP III.—The type of this group is CYTHERELLA BEYRICHI (Reuss).

CYTHERINA BEYRICHI, *Reuss*. Zeitschr. deutsch. geol. Ges., vol. iii, 1851, p. 89, pl. vii, fig. 65.
— — *Bornemann*. Ibid, vii, 1855, p. 354, pl. xx, fig. 1.
CYTHERELLA COMPRESSA, var. 1, *Jones*. Monogr. Tert. Entom., 1857, p. 55, pl. v, fig. 18.
— BEYRICHI, *Speyer*. Ostrac. Cassel. Tertiär., 1863, p. 54, pl. i, fig. 1.
— — *Brady*. Trans. Zool. Soc., vol. v, 1866, p. 362, pl. lvii, fig. 3.
— — *Jones*. Geol. Mag., 1870, vol. vii, p. 157.
— — *Jones & Sherborn*. Geol. Mag., 1887, p. 458, pl. xi, fig. 18.

In this group the carapaces vary from round-ended oblong to ovate-oblong, with a flattening of the anterior portion, giving a wedge-shaped edge-view. The posterior end is full and more or less truncate, herein also differing from the members of Group II. Generally the surface is pitted, but we have a smooth example of this form (Pl. II, figs. 1 *a*, *b*). The last has been termed C. BEYRICHI, var. LÆVIS ('Geol. Mag.,' 1887, p. 458); but we consider that the others (Pl. II, figs. 2 *a*, *b*; 5 *a*, *b*; 6 *a*, *b*; 7 *a*, *b*; 9 *a*, *b*) do not offer differences sufficient to separate them from the type as named varieties. Fig. 9 *a*, however, is more ovate than oblong; and 9 *b* shows a very definitely truncate posterior, giving the edge-view a more strictly triangular appearance. (British Museum.)

Note.—A small indeterminable *Cytherella* occurs among some Ostracoda collected by the late Mr. F. E. Edwards from the Fluvio-marine beds of Headon (?). (British Museum.)

In the annexed Table the genera and species belonging to each Geological Formation are arranged, in their several groups, in the same order as that adopted in the Lists at pp. 3—8. The localities for the specimens will be found in the text of either the original or the Supplemental Monograph, the pages being easily referred to. In the Classified Lists (pp. 3—8) the different stages of the Eocene Formation are indicated by the addition of local names, as Woolwich, London, Bracklesham, &c. The indication of foreign localities for the Tertiary Entomostraca is not now attempted, for much closer examination will be required to ensure anything like accuracy in this direction.

TABLE OF THE BRITISH TERTIARY (AND SOME POST-TERTIARY) OSTRACODA, SHOWING THEIR GEOLOGICAL RANGE.

	Pages in the Supplemental Monograph.	Cretaceous Formations.	Woolwich and Reading Beds.[1]	London Clay.	Bracklesham Beds.	Barton Beds.	Headon Beds.	Osborne Beds.	Bembridge Beds.	Hamstead Beds.	White or Suffolk Crag.	Red Crag.	Norwich Crag.	Weybourn Crag, &c.	Post-tertiary Beds.	Recent Seas.
Bairdia subdeltoidea	16	×		...	×											
Cythere Harrisiana	24	×	...	×												
Cytheridea perforata	29	×	...	...	...	×	×									
Cytheropteron triangulare	44	×	...	×												
Candona Richardsoni	13	...	×													
? Cythere amissa	21	...	×													
Cytheridea Muelleri	37	..	×	.	...	×	...	...	...	×	...	...	...	...	×	×
— — var. torosa	37	..	×	...	...	...	...	...	...	×						
— sp.	40	...	×													
Bairdia subtrigona	17	...	...	×												
— Londinensis	17	...	...	×												
— ovoidea	18	...	...	×												
Cythere arenosa	27	...	.	×												
— scabropapulosa	28	...	...	×	×											
— — var. aculeata	28	...	...	...	×											
— plicata	29	...	...	×	×	×	×									
— scrobiculoplicata	30	...	...	×	...	×										
— — var. recta	30	...	...	...	×											
— transenna	31	...	...	×	...	...	×									
Cythereis Prestwichiana	33	...	...	×												
— aranea	33	...	...	×												
— Bowerbankiana	34	..	...	×												
— horrescens	34	...	...	×	...	×										
— spiniferrima	34	...	...	×												
Cytheridea perforata, var. insignis	39	...	...	×												
— glabra	39	...	...	×												
Krithe glacialis	41	...	...	×	...	...	...	...	...	...	...	...	...	...	×	
— Londinensis	41	...	...	×												
Cytherella compressa and var.	47	...	...	×												
— fabacea	47	...	...	×												
— Beyrichi	48	.	...	×												
Bythocypris subreniformis	16	...	..	...	×											
Bairdia, sp	17	...	...	...	×											
Cythere striatopunctata	19	...	...	...	×	×	×									
— venustula	20	...	...	...	×											
— costellata	30	...	...	...	×											
— — var. triangulata	30	...	...	...	×											
— gyriplicata	30	...	...	...	×											
Cythereis cornuta	36	...	...	...	×	...	×									
Cytheridea debilis	38	...	...	...	×	...	×									
Cytherura Prestwichiana	43	...	...	...	×											

[1] *Cythereis* sp., a fragment, has been found in the THANET SANDS of Pegwell Bay; p. 36.

	Pages in the Supplemental Monograph.	Cretaceous Formations.	Woolwich and Reading Beds.	London Clay.	Bracklesham Beds.	Barton Beds.	Headon Beds.	Osborne Beds.	Bembridge Beds.	Hamstead Beds.	White or Suffolk Crag.	Red Crag.	Norwich Crag.	Weybourn Crag, &c.	Post-tertiary Beds.	Recent Seas, &c.
Cytherella Muensteri	47	...	...	...	×	...	×									
— — var. (smooth)	47	...	...	...	×	×										
— — var. rectipunctata	47	...	...	...	×											
— Roemeri	47	...	...	...	×											
— Reussii	47	...	...	...	×											
— Dixoni	47	...	...	...	×											
— Beyrichi, var. lævis, &c.	47	..	...	...	×											
Bairdia contracta	17	...	...	...	...	×										
Cythere Wetherelli	20	...	...	...	...	×	×									
— consobrina	20	...	...	...	...	×										
— angulatopora	22	...	...	...	...	×										
— Bosquetiana	22	...	...	...	...	×	×									
Krithe Bartonensis	40	...	...	...	...	×	...	...	...	...	...	...	...	...	×	×
Pseudocythere attenuata	42	...	...	...	...	×										
Pontocypris, sp.	16	...	...	...	...	...	×									
Cythere Forbesii	31	...	...	...	...	...	×									
Xestoleberis Colwellensis	41	...	..	...	...	...	×									
— aurantia, var.	41	...	...	...	...	...	×									
Cytherideis Colwellensis	45	...	...	...	...	...	×									
— gracilis	45	...	...	...	...	...	×									
Cytherella, sp.	48	...	...	...	...	...	×									
Candona Forbesii	13	...	...	...	...	...	...	×	...	×						
? Cytherideis unisulcata	46	...	...	...	...	...	...	×								
Potamocypris Brodiei	11	...	...	...	...	...	...	...	×							
Pseudocythere Bristovii	43	...	...	...	...	...	...	...	×							
Cypris gibba	9	...	...	...	...	...	...	...	...	×	...	...	...	×	×	×
Cypridea spinigera [1]	14	..	...	...	...	...	...	...	...	×						
Cytheridea montosa	37	...	...	...	...	...	...	...	...	×						
Potamocypris tuberculata	11	...	...	...	...	...	...	...	...	...	×	×				
Bairdia fusca	17	...	...	...	...	...	...	...	...	...	×					
— rhomboidea	18	...	...	...	...	...	...	...	...	...	×					
Cythere convexa	19	...	...	...	...	...	...	...	...	...	×	...	...	...	...	×
— trigonula	19	...	...	..	...	...	...	...	...	...	×					
— Woodiana	23	...	...	...	...	...	...	...	...	...	×					
— laqueata	23	...	...	...	...	...	...	...	...	...	×	×				
— macropora	23	...	...	...	...	...	...	...	...	...	×					
— retifastigiata	23	...	...	...	...	...	...	...	...	...	×					
— dictyosigma	24	...	...	...	...	...	...	...	...	...	×					
— trachypora	24	...	...	...	...	...	...	...	...	...	×	×				
— sublacunosa	27	...	...	...	...	...	...	...	...	...	×					
— latimarginata	27	...	...	...	...	...	...	...	...	...	×	...	...	...	×	
Cythereis senilis	32	...	...	...	...	...	...	...	...	...	×					
— Hoernesi	32	...	...	...	...	...	...	...	...	...	×					
— Jonesii	35	...	...	...	...	...	...	...	...	...	×					
Cytheridea pinguis	38	...	...	...	...	...	...	...	...	...	×	...	...	×		
Cytherideis botellina	45	...	...	...	...	...	...	...	...	..	×					
? — ren	46	...	...	...	...	...	...	...	...	...	×					
Bairdia, sp.	17	...	...	...	...	...	...	...	...	...	...	×				
Cytheridea elongata	38	...	...	...	...	...	...	...	...	...	...	×	...	×	×	×
Loxoconcha tamarindus	42	...	...	...	...	...	...	...	...	...	...	×	...	...	...	×
? Aglaia cypridoides	12	...	..	...	...	...	...	...	...	...	...	...	×			

[1] *C. spinigera* occurs also in the Wealden beds.

	Pages in the Supplemental Monograph.	Cretaceous Formations.	Woolwich and Reading Beds.	London Clay.	Bracklesham Beds.	Barton Beds.	Headon Beds.	Osborne Beds.	Bembridge Beds.	Hamstead Beds.	White or Suffolk Crag.	Red Crag.	Norwich Crag.	Weybourn Crag, &c.	Post-tertiary Beds.	Recent.
Cythere recurata	21	...	...	...	...	...	...	...	...	...	...	...	×			
— læsa	25	...	...	...	...	...	...	...	...	...	...	...	×			
— villosa, var.	26	...	...	...	...	...	...	...	...	...	...	...	×			
— lachrymalis	26	...	...	...	...	...	...	...	...	...	...	...	×			
— baccata	26	...	...	...	...	...	...	...	...	...	...	...	×	×		
— polyptycha, var.	29	...	...	...	...	...	...	...	...	...	...	...	×			
Cytheridea punctillata	39	...	...	...	...	...	...	...	...	...	...	...	×	...	×	×
Cypris Browniana	9	...	...	...	...	...	...	...	...	...	...	...	..	×	..	×
— — var. tumida	9	...	...	...	...	...	...	...	...	...	...	...	...	...	×	
Cypridopsis obesa	10	...	...	...	...	...	...	...	...	...	...	...	...	×	×	
Potamocypris trigonalis	11	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×
— — var. lævis	11	...	...	...	...	...	...	...	...	...	...	...	...	×	×	
Cypris reptans	10	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×
Candona candida	13	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×
Darwinula Stevensoni	18	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×
Cythere Charlesworthiana	22	...	...	...	...	...	...	...	...	...	...	...	...	×		
— Reidii	23	...	...	...	...	...	...	...	...	...	...	...	...	×		
— Woodwardiana	23	...	...	...	...	...	...	...	...	...	...	...	...	×		
— retifastigiata, var. æquior	23	...	...	...	...	...	...	...	...	...	...	...	...	×		
— villosa	25	...	...	...	...	...	...	...	...	...	...	...	...	×		
Cytherura clathrata	44	...	...	...	...	...	...	...	...	...	...	...	...	×		
Cytheridea torosa	36	...	...	...	...	...	...	...	...	...	...	...	..	×	×	×
— — var. teres	36	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×
— Sorbyana	38	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×
Cypris lævis	9	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×
Cypridopsis vidua	10	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×
Candona compressa	12	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×
— subæqualis	13	...	...	...	...	...	...	...	...	...	...	...	...	...	×	

INDEX.

Names in capitals are *adopted*, in common Roman type are *referred to*, in italics are *synonyms*.

PLATE I.

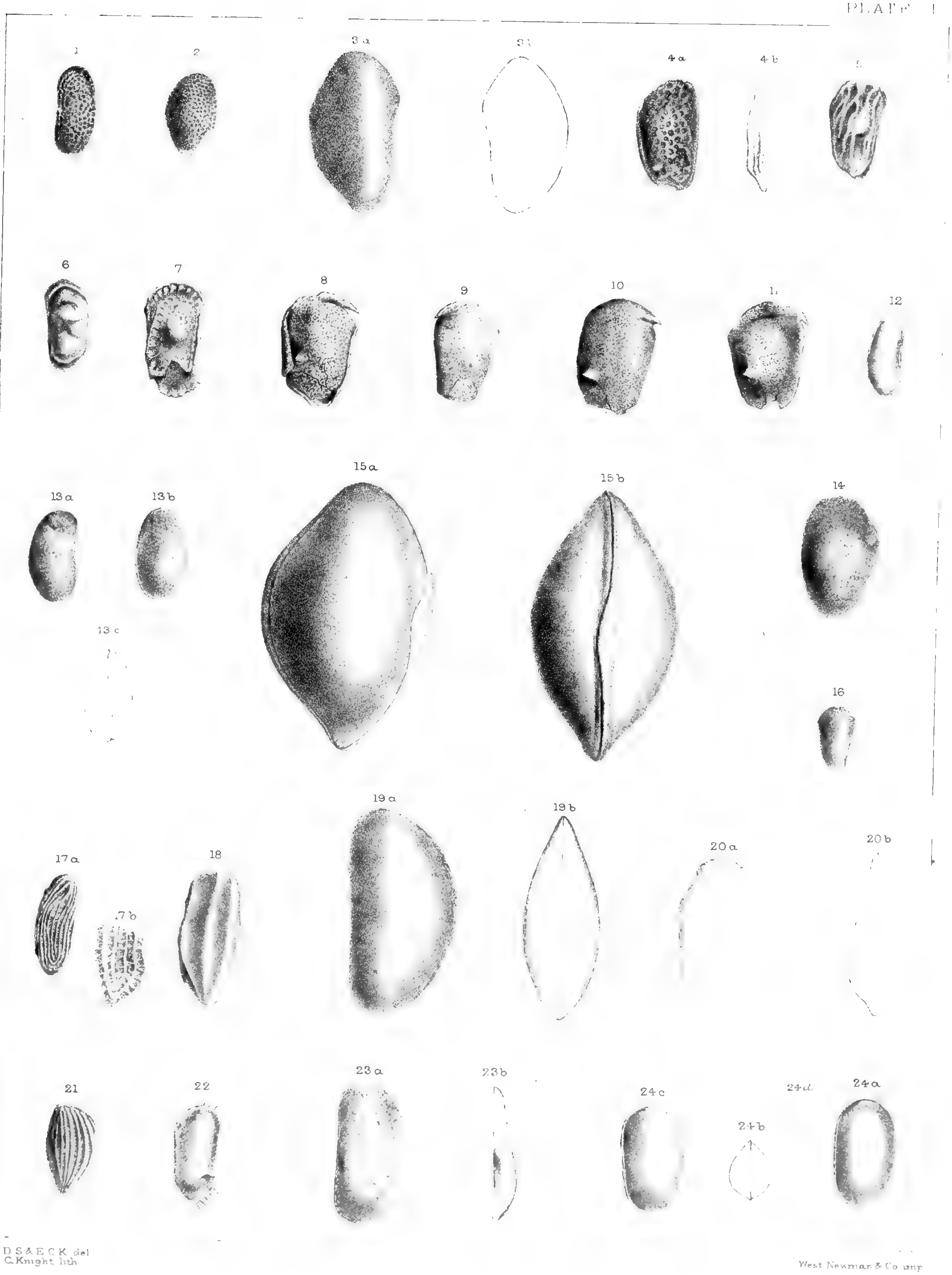
All the figures are magnified 25 diameters, except 17 *b*, × 75 diameters.

Fig.

1. *Cythere recurata*, Jones & Sherborn. Left valve. (Page 21.)
2. *Cytheridea punctillata*, Brady. Right valve. (Page 39.)
3. *Bairdia rhomboidea*, Jones & Sherborn. (Page 18.)
   a, Right valve; *b*, approximate outline of left valve.
4. *Cythere villosa*, G. O. Sars. Var. (Page 25.) See also Plate III, figs. 12, *a*, *b*, *c*.
   a, right valve; *b*, right valve, ventral aspect.
5. *Cythere polyptycha*, Reuss. Var. Right valve. (Page 29.)
6. *Cythere latimarginata*, Speyer. Left valve. (Page 27.)
7. *Cythereis Hoernesi*, Speyer. Right valve. (Page 32.)

8, 9, 10, 11. *Cypridea spinigera* (Sowerby). (Page 14.) See also Plate III, figs. 1 *a*, *b*.
   8, Carapace crushed, hence the apparent overlap; 9, left valve; 10, 11, right valves.

12. *Cytherideis gracilis* (Reuss). (Page 46.)
13. *Pontocypris*, sp., and *Xestoleberis Colwellensis*, Jones & Sherborn.
    a, *P.*, sp. Right valve. (Page 16.) *b*, *X. Colwellensis*, left valve; *c*, ventral aspect of the carapace. (Page 41.)
14. *Cytheridea perforata* (Roemer). Left valve. (Page 39.)
15. *Bairdia subdeltoidea* (Münster). (Page 16.)
    a, Carapace, right valve outwards; *b*, perfect, ventral aspect.
16. *Cytheridea debilis*, Jones. Right valve. (Page 38.)
17. *Cythere gyriplicata*, Jones & Sherborn. (Page 30.)
    a, Right valve; *b*, portion magnified.
18. *Cythere plicata*, Münster. Var. Right valve. (Page 29.)
19. *Bythocypris subreniformis*, Jones & Sherborn. (Page 16.)
    a, Carapace showing the left valve; *b*, perfect, ventral aspect.
20. *Cytherura Prestwichiana*, Jones & Sherborn. (Page 43.)
    a, Right valve; *b*, right valve, ventral aspect.
21. *Cythere costellata* (Roemer). Var. *triangulata*, J. & S. Left valve. (Page 30.)
22. *Cythereis cornuta* (Roemer). Right valve. (Page 35.)
23. *Cythere venustula*, Jones & Sherborn. (Page 20.)
    a, Left valve; *b*, left valve, ventral aspect.
24. *Cytherella Dixoni*, Jones & Sherborn. (Page 47.)
    a, Carapace showing the smaller (left) valve; *b*, end view of carapace; *c*, carapace showing the left valve; *d*, edge view of a right (large) valve.



C. D. S. & E. C. K. del.
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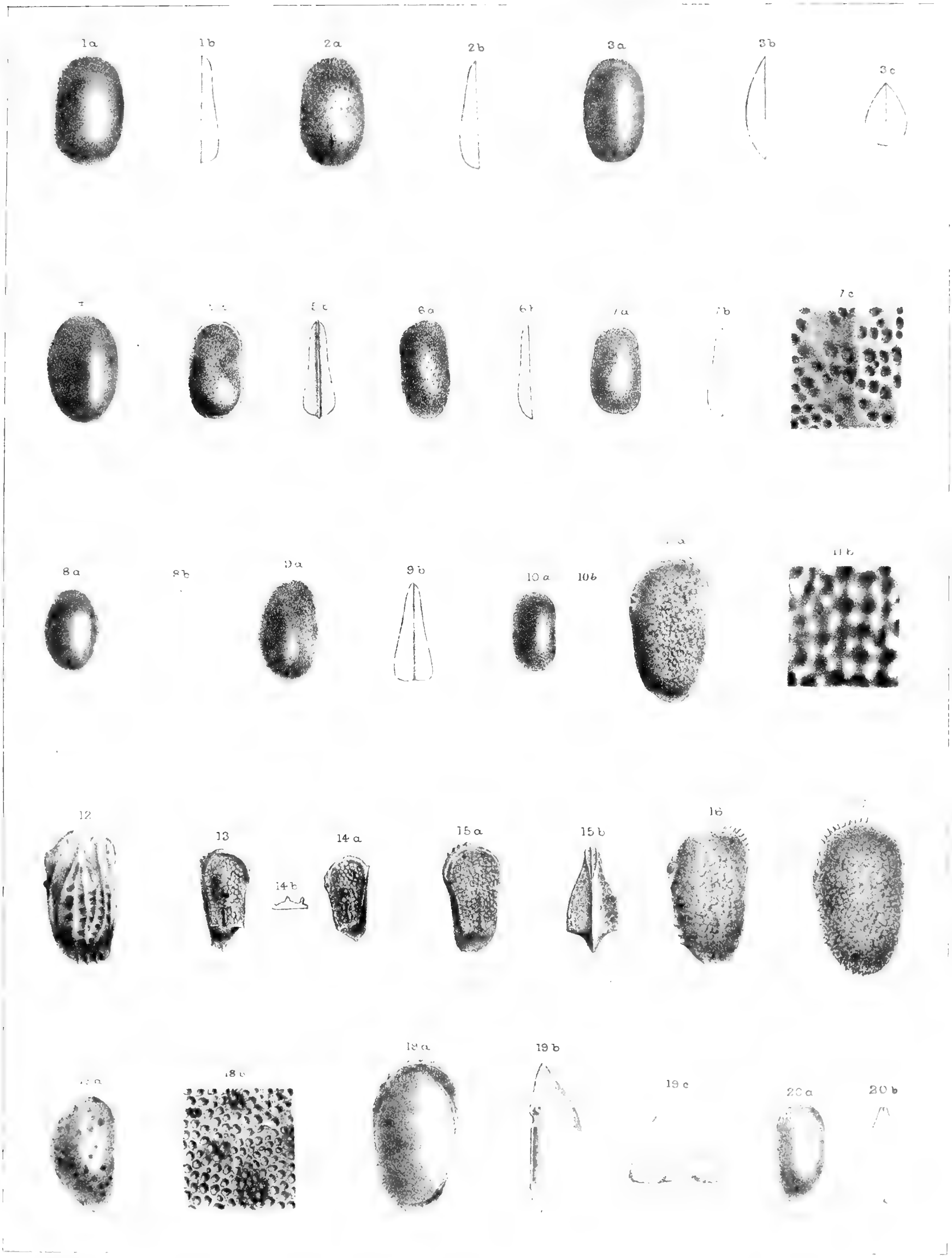
TERTIARY ENTOMOSTRACA. (Supplement.)

PLATE II.

All the figures are magnified 25 diameters, except 7 *c*, 11 *b*, and 18 *b*, × 75 diameters.

FIG.

1. *Cytherella Beyrichi*, Reuss. Var. *lævis*, Jones & Sherborn. (Page 48.)
   a, Right valve; *b*, edge view.
2. *Cytherella Beyrichi*. Var. 2. (Page 48.)
   a, Right valve; *b*, edge view.
3. *Cytherella Roemeri*, Jones & Sherborn. (Page 47.)
   a, Right valve; *b*, edge view; *c*, end view of a carapace.
4. *Cytherella Reussii*, Jones & Sherborn. Right valve. (Page 47.)
5. *Cytherella Beyrichi* (Reuss). Var. 3. (Page 48.)
   a, Carapace, with left valve outwards; *b*, edge view of carapace.
6. *Cytherella Beyrichi* (Reuss). Var. 4. (Page 48.)
   a, Left valve; *b*, edge view.
7. *Cytherella Beyrichi* (Reuss). Var. 5. (Page 48.)
   a, Right (larger) valve; *b*, edge view; *c*, portion magnified.
8. *Cytherella Reussii*, Jones & Sherborn. (Page 47.)
   a, Right valve; *b*, edge view.
9. *Cytherella Beyrichi* (Reuss). Var. 6. (Page 48.)
   a, Right valve; *b*, edge view of carapace.
10. *Cytherella Muensteri* (Roemer). (Page 47.)
    a, Left (small) valve; *b*, edge view.
11. *Cythere arenosa*, Bosquet. Var. (Page 27.)
    a, Right valve; *b*, portion magnified.
12. *Cythere transenna*, Jones & Sherborn. Right valve. (Page 31.)
13. *Cythereis Prestwichiana*, Jones & Sherborn. Left valve. (Page 33.)
14. *Cythereis Prestwichiana*, Jones & Sherborn. (Page 33.)
    a, Right valve; *b*, sectional view across the middle.
15. *Cythereis aranea*, Jones & Sherborn. (Page 33.)
    a, Left valve; *b*, ventral aspect of the carapace.
16. *Cythere scabropapulosa*, Jones. Right valve. (Page 28.)
17. *Cythere scabropapulosa*, Jones. Var. *aculeata*, J. & S. Right valve. (Page 28.)
18. *Bairdia Londinensis*, Jones & Sherborn. (Page 17.)
    a, Right valve; *b*, portion magnified.
19. *Cytheropteron triangulare* (Reuss). (Page 44.)
    a, Right valve; *b*, dorsal aspect of right valve; *c*, end view of carapace.
20. *Krithe Londinensis*, Jones & Sherborn. (Page 41.)
    a, Left valve; *b*, ventral aspect of carapace.



C D S & E C K del
E C Knight lith

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TERTIARY ENTOMOSTRACA (Supplement)

PLATE III.

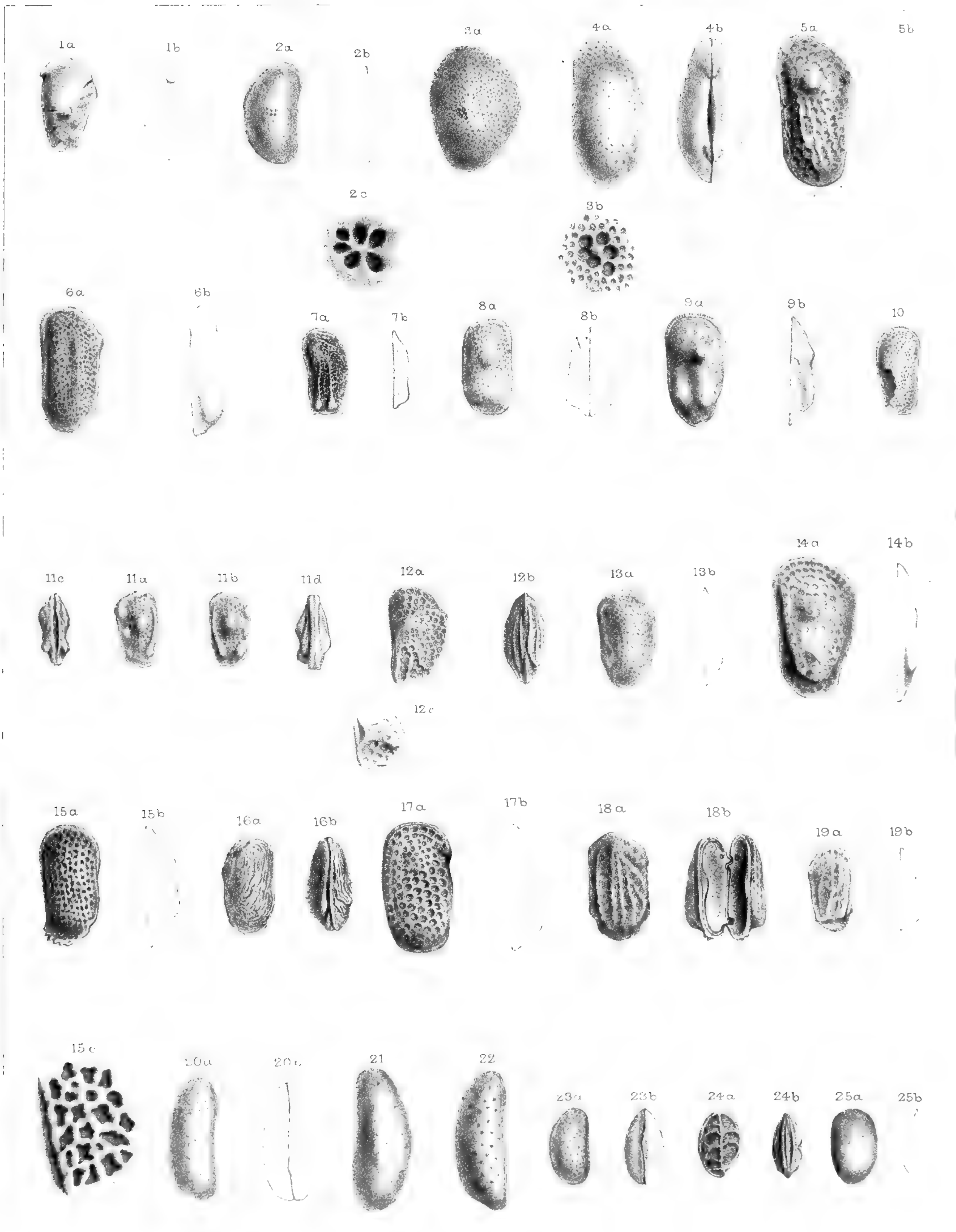
All the figures are magnified 25 diameters, except 2 *c*, 3 *b*, and 15 *c*, × 75.

Fig.

1. *Cypridea spinigera* (Sowerby). (Page 14.)
   a, Left valve of a young individual; *b*, ventral aspect of a perfect carapace from the Weald Clay of Punfield, Dorset.
2. *Aglaia ? cypridoides*, Jones & Sherborn. (Page 12.)
   a, Right valve; *b*, edge view; *c*, muscle spot, magnified.
3. *Bairdia ovoidea*, Jones & Sherborn. (Page 18.)
   a, Left valve; *b*, muscle spot magnified.
4. *Cythere consobrina*, Jones. (Page 20.)
   a, Left valve; *b*, dorsal aspect of carapace.
5. *Cythere Reidii*, Jones & Sherborn. (Page 23.)
   a, Left valve; *b*, ventral aspect.
6. *Cythere retifastigiata*, Jones. Var. *æquior*, Jones & Sherborn. (Page 23.)
   a, Left valve; *b*, ventral aspect.
7. *Cythere lachrymalis*, Jones & Sherborn. (Page 26.)
   a, Left valve; *b*, ventral aspect.
8. *Cythere dictyosigma*, Jones. (Page 24.)
   a, Right valve; *b*, ventral aspect of carapace.
9. *Cythere trachypora*, Jones. (Page 24.)
   a, Left valve; *b*, ventral aspect.
10. *Cythere Charlesworthiana*, Jones & Sherborn. Right valve (damaged). (Page 21.)
11. *Cythere baccata*, Jones & Sherborn. (Page 26.)
    a, Right valve; *b*, left valve; *c*, dorsal aspect of carapace; *d*, ventral aspect of carapace. (The same individual.)
12. *Cythere villosa*, G. O. Sars. (Page 25.) See also Plate I, figs. 4 *a*, *b*.
    a, Left valve; *b*, ventral aspect of carapace; *c*, hinder portion of a left valve of another individual.
13. *Cythere læsa*, Jones & Sherborn. (Page 25.)
    a, Left valve; *b*, ventral aspect.
14. *Cythere Woodwardiana*, Jones & Sherborn. (Page 23.)
    a, Left valve; *b*, ventral aspect.
15. *Cythere angulatopora* (Reuss). (Page 22.)
    a, Left valve; *b*, ventral aspect; *c*, left valve, portion magnified.
16. *Cythere delirata*, Jones & Sherborn. (Page 28.)
    a, Right valve; *b*, ventral aspect of carapace.
17. *Cythere Bosquetiana*, Jones & Sherborn. (Page 22.)
    a, Left valve; *b*, ventral aspect.
18. *Cythere Forbesii*, Jones & Sherborn. (Page 31.)
    a, Left valve; *b*, carapace open to show interior and ligament.
19. *Cythereis corrugata* (Reuss). Var., Jones & Sherborn. (Page 32.)
    a, Right valve; *b*, ventral aspect.

20, 21, 22. *Cytheridea elongata*, Brady. (Page 38.)
   a. Right valve; *b*, dorsal aspect of carapace; 21. Left valve; 22. Right valve.

23. *Xestoleberis aurantia* (Baird). Var., Jones & Sherborn. (Page 42.)
    a, Carapace showing the right valve; *b*, dorsal aspect of carapace.
24. *Cytherura clathrata*, G. O. Sars. (Page 44.)
    a, Left valve; *b*, dorsal aspect of carapace.
25. *Cytherella*, sp. (Page 48.)
    a, Right valve; *b*, edge view.



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TERTIARY ENTOMOSTRACA (Supplement)

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

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A MONOGRAPH

OF THE

BRITISH JURASSIC GASTEROPODA.

BY

WILFRID H. HUDLESTON, M.A., F.R.S., Sec.G.S.

PART I, No. 3.

GASTEROPODA OF THE INFERIOR OOLITE.

Pages 137—192; Plates VII—XI.

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practically re-describes D'Archiac's species, and, doubtless, the points of resemblance with the Ponton fossil are tolerably close. In *Al. pupæformis* the shell is still more depressed, and the position of the spines is very different from that of the Ponton fossil. For all this we must hold that our var. *spinifera* closely approximates to *Al. pupæformis*, D'Arch., as defined by Piette. On the other hand, the smooth or non-spinous variety of *Al. pontonis* is further removed from it.

This species is rather characteristic of the Lincolnshire Limestone of Great Ponton, but I have not met with it elsewhere in the Inferior Oolite. On the other hand, it strongly resembles some of the Minchinhampton specimens of the *trifida*-group, and thus affords another link uniting the Gasteropod fauna of Great Ponton with that of the Great Oolite, both in the East of France and at Minchinhampton. (See 'Great-Oolite Moll.,' Pl. iii, fig. 11.)

56. Alaria primigenia, sp. nov. Plate VII, fig. 3.

Description :

Length	22 mm.
Width of body-whorl to height of shell . .	42 : 100.
Spiral angle about	34°

Shell fusiform, turrited. Opening of the spiral angle convex and obtuse. Number of whorls about eight; the apical and subapical whorls are without keel and apparently smooth; the last three whorls of the spire betray a very sudden increase, and are sharply carinated about the middle. There is no longitudinal ornamentation, and the spiral ornamentation, if ever it existed, is obliterated in the only available specimen. The keels of the spire-whorls develop pointed spinous swellings, which are very salient on the penult; these do not occur in axial order.

The body-whorl presents but a moderate increase; it is strongly bicarinate, and rather excavated; the base is very sharply marked off by the second carina. The wing is scarcely, if at all, palmate; the posterior keel produces a vigorous digitation, at first triangular in section, but becoming rounder, as it sweeps with a sharp upward curve considerably beyond the apex. The anterior digitation and canal-sheath are too much broken away for description. Other indications wanting.

Relations and Distribution.—This curious species, though founded on a unique specimen, presents characters which easily separate it from any others heretofore described. The uncompressed spire, and the unsymmetrical arrangement of the spinous nodes, exclude this species from *Spinigera*, to which it has a certain superficial resemblance. It is a didactyl *Alaria*, which probably belongs to the *trifida*-group (Hamicaudes). It differs from *Alaria Lorieri* in the excessive sharpness and salience of the keels, and in the numerous spinous processes on the keels of the spire-whorls; it further differs in the extreme recurvation of the posterior digitation, reminding one somewhat of the curve in the tusk of the mammoth.

Occurs in the *Parkinsoni*-zone (P_1) of Vitney Cross with *Alaria Lorieri* and *Spinigera recurva*.

With this species the list of didactyl *Alariæ* comes to an end. Some other Aporrhaïds remain to be described, which it will be convenient to classify under Section 3, as belonging to no group in particular, or whose position is somewhat doubtful.

Section 3.

57. Alaria spinigera, *Lycett*, 1853. Plate VII, fig. 4.

1853. Rostellaria spinigera, *Lycett*. Proc. Cotteswold Nat. Field Club, vol. i, p. 80.

Description by Author.—" Spire elevated, acute; whorls few, each with seven prominent spines or spinous ribs; body-whorl spined above, grooved beneath, wing not digitated and but moderately expanded; caudal extremity straight and moderately long."

The specimen (fig. 4) forms part of the Lycett collection in the Jermyn Street Museum, but, as Lycett gives no figure, strictly speaking there can be no type-specimen. The specimen now figured is marked " *R. spinigera*, Nailsworth," apparently in Lycett's handwriting.

The length is 15 mm. and the spiral angle about 45°. The shell is sub-elongate, thick, and rugose, body-whorl and spire about the same height, apex somewhat acute. There is one prominent and highly-spinous keel on the body-whorl, which gives rise to a sharp, stumpy, upcurved digitation after the manner of the Monodactyls (hence, if we may judge from this specimen, it is not quite correct to say that the wing is not digitated).

The aperture is wide-triangular to trapezoidal, and forms a sort of angle posteriorly in connection with the short process which represents the digitation. The columella is very straight, and probably the canal also. There is an indication in the figured specimen of an anterior digitation. This would relegate the species to the section of didactyls. It is quite contrary to the original diagnosis of Lycett. Whether this really is an anterior digitation, or merely an accident in the development of the fossil, is a question awaiting further evidence.

Relations and Distribution.—The excessively rugose and spinous character of this shell, and the comparatively depressed spire, clearly separate this from all other *Alariæ* previously described in this Memoir. Hence there seems to be little danger of its being confounded with any one of them. But since a doubt yet remains as to whether the species is didactyl or monodactyl, and having regard also to the apparent scarcity of specimens, *Alaria spinigera* cannot be regarded as fully diagnosed at present.

Al. spinigera, Lycett, is quoted in Witchell's 'Geology of Stroud,' from the Oolite-Marl.

58. Alaria solida, *Lycett*, 1853. Plate IV, fig. 5.

1853. Alaria solida, *Lyc.* Proc. Cotteswold Nat. Field Club, vol. i, p. ? 80.

Description by Author.—"Spire turrited; whorls few, angulated by a circle of elevated, longitudinal, spinous ribs crossed by lines; body-whorl with a single *carina*, beneath which are several encircling grooves; wing simple, small, proceeding from the carina, caudal extremity short."

The specimen from which, apparently, the above description was taken, is in the Lycett collection at Jermyn Street, and has the word "*solida*" still legible upon the reverse. The spiral angle is about 38°. Certain variciform swellings may be traced across the whorls, presenting a feature not often observed, but the specimen is too imperfectly preserved for further description.

Relations and Distribution.—Though the character of the spire is somewhat similar to that of the last-named species, the ornamentation is less spiny, and what appear to be the variciform lines or swellings seem still further to distinguish it; the spiral angle, also, is considerably less. On the other hand, the short, upturned digitation greatly resembles that which appears to be the posterior digitation of *Al. spinigera*. The fossil also reminds us somewhat of the form of *Alaria* (*Diartema*) *hamulus* of the Great Oolite and appears to have been derived from the Inferior Oolite of the Cotteswolds.

Alaria solida is not quoted in Witchell's 'Geology of Stroud.'

59. Alaria solida, *Lycett*, var. Plate VII, fig. 6.

Description :

Length	. 17 mm.
Width of body-whorl to height of shell .	. 40 : 100.
Spiral angle	. 36°.

The apical whorls, conjectured to be about three in number, are wanting; the four remaining whorls of the spire are angular, the keel being rather above the middle; a series of nodular costæ, wide apart, originate upon the keels and extend for some distance below: in the penult these assume considerable proportions, and are seen to decussate with strong spiral lines. The body-whorl is rather shorter than the spire, moderately ventricose, and carries one very prominent and spinous posterior keel, from which a short upturned digitation emanates; beneath the posterior keel is a strong system of spirals (the several "encircling grooves" of Lycett), one of which functions as an anterior keel. From this proceeds an imperfect anterior digitation. The whole of the body-whorl and short upturned canal-sheath are richly chased with fine spiral ornament. Other indications wanting.

Relations and Distribution.—A single specimen from Crickley—most probably from the Oolite-Marl—is all I have seen. This belongs to Mr. Brodie, and is marked "*Rostellaria solida*, n. sp.," in Lycett's handwriting. It is less rugose and less variciform than the Jermyn Street specimen, which I assume to be the type, and it possesses, moreover, an incipient anterior digitation, like that of *Alaria Doublieri*. This, however, may have existed in the Jermyn Street specimen, but destroyed or obliterated subsequently.

N.B.—It is to be regretted that the interesting forms described as *Alaria spinigera*, *Al. solida*, and *Al. solida*, var. are so scarce that we are very much in the dark as to their true nature. Whilst exhibiting important differences, they possess several features in common, such as a comparatively short spire, spinous or rugose ornamentation, and a short, upturned principal digitation.

60. Alaria hamoides, sp. nov. Plate VII, figs. 7 *a*, 7 *b*.

Description :

Length	. 24 mm.
Width of body-whorl to length of shell .	. 42 : 100
Spiral angle	. 26°.

Shell turrited, fusiform. Probable number of whorls ten to eleven (apical ones unknown); these are very angular, with the keel slightly above the middle; anterior portion of each whorl marked by straight regular longitudinal costæ, close set, not less than a dozen in number, with a marked slope from right to left. The spiral lines are fine and numerous in the posterior areas, which are entirely devoid of longitudinal ornament, the spirals in the anterior areas are coarser and wider apart, decussating visibly with the longitudinals. Spiral lines may also be detected on the body-whorl, but no costæ. There is one prominent median keel, armed with a short spur, rather more than a quarter of a turn above the base of the wing, which is short. The nature of the digitation, if any, is unknown.

Aperture apparently trapezoidal, the outer lip enveloping the anterior half of the penult. Other indications wanting.

Relations and Distribution.—The character of the spire is not unlike that of *Al. hamus*, the turriting being distinctly mural. It somewhat resembles a figure given by Piette (op. cit., p. 44, pl. v, fig. 6) of a variety of *Al. hamus* from the Fuller's Earth of Les Clappes, which that author considered might be a distinct species; but his description does not tally quite so well, since he indicates only eight or nine costæ on the whorls of the spire. Only one specimen of *Al. hamoides* has yet been found with the body-whorl preserved, and the indications are not altogether reliable. At present it is only known to occur in the Lincolnshire Limestone at Great Ponton, where portions of the spire have been found from time to time.

61. Alaria (? Diartema[1]) varicifera, sp. nov. Plate II, figs. 10 *a*, 10 *b*; Plate VII, figs. 8 *a*, 8 *b*; figs. 8′ *a*, 8′ *b*.

Description.—The specimens found in the Lincolnshire Limestone at Great Ponton (fig. 8 *a*, and fig. 8 *b*) differ to a certain extent from those occurring at Weldon (figs. 8′ *a*, 8′ *b*), and these again present some differences between themselves. Amongst the specimens figured we recognise three different forms, which have certain features in common, but which differ in the final development. These forms may represent varieties or different stages of the same species. Describing the common features—

The shell is turrited and fusiform, apical portion of the spire blunt, with a convex angle and smooth whorls. The whorls of the remainder of the spire are angular and carinated, the carina being nearly median. The longitudinal orna-

[1] Piette, 1864. The forms now under consideration differ so widely from *Alaria* that they are only placed under that genus provisionally. They do not correspond exactly with *Diartema*. Beyond the obvious fact that they belong to the Aporrhäidæ it is not very clear to what genus we should refer them.

ments consist of stout costæ distributed at wide intervals in the form of varices, not usually in alignment, chiefly on the posterior area of each whorl, and very nodose in passing over the keels. Below the keels one, and sometimes two strong spiral bands may be noted, almost giving the appearance of bicarination; the lesser spirals are fine and numerous throughout the shell.

The Ponton variety presents the most interest, since here alone have I been able to find a specimen with the wing developed (or preserved), fig. 8 *b*.

Length	. 22 mm.
Width of body-whorl to height of shell .	. 45 : 100.
Spiral angle about . . .	. 30°.

Probable number of whorls seven or eight. Ornamentation of the spire-whorls as already described. Body-whorl tumid, sub-bicarinate, with two or three coarse nodular varices, and traces of numerous diverging spiral lines. Wing wide and short, and enveloping nearly half of the penult, apparently without digitation. Aperture wide and subquadrate, with an expanding lip, anterior margin slightly excavated; columella curved and but slightly encrusted; canal apparently almost as short as in *Brachytrema.*

The Weldon variety, which is presumed to be an immature form, and which might almost be regarded as a distinct species, is most characteristically represented by fig. 8′ *a*, a well-preserved specimen of the more usual form. See also Pl. II, figs. 10 *a*, 10 *b*.

Length	. 10—12 mm.
Width of body-whorl to height of shell .	. 55 : 100.
Spiral angle about . . .	. 40°.

A wide-angled, stumpy little shell of about six whorls. Body-whorl tumid, sub-bicarinate, spirally striated, and carrying three or four varices. There is no wing. Aperture wide, with a simple lip, and very short anterior canal, almost like *Brachytrema.*

A sub-variety of the Weldon fossil is shown in fig. 8′ *b*.

Probable length . . .	. 14 mm
Width of body whorl to height of shell .	. 42 : 100.
Spiral angle about . . .	. 30°.

Probable number of whorls six or seven; ornamentation similar to the last upon a narrower and more turrited spire. Body-whorl keeled and spirally ornamented, but entirely without varices. Other indications wanting. This is rare.

Relations and Distribution.—Accepting the adult specimen from Great Ponton (fig. 8 *b*), for the moment, as the type of the group, there is nothing like this known from the Inferior Oolite of the other districts. The form of the wing and the character of the aperture remind us of certain specimens of *Alaria* (*Diartema*) *paradoxa*, M. & L., a well-known fossil of the Great Oolite, but the spire is very different. If the diagnosis of *Diartema* were somewhat altered, it might be made to include the species here described as *varicifera*.

This is another instance where the Aporrhaïdæ of the Lincolnshire Limestone at Great Ponton show their affinity with Bathonian forms.

Family—CERITHIIDÆ.

"*Shell spiral, elongated, many-whorled, frequently varicose; aperture channeled in front, with a less distinct posterior canal; lip generally expanded in the adult.*"—S. P. Woodward.

The above diagnosis was no doubt formed so as to include both *Nerinæa* and *Aporrhais*, both of which are now excluded. Fischer observes that the shell is very variable; the canal, generally short, becomes rudimentary and even disappears completely, as though to show in some sort the impossibility of separating the Siphonostomes and the Holostomes. He observes that the same modifications of the canal are observed in the Melaniidæ. I would here remark on the possibility of the more recent Melaniidæ having originated from some of the old Jurassic Cerithiidæ, or at least from molluscs of that age, which we group with the Cerithiidæ. Most freshwater Gasteropoda are probably descended from genera which were once marine.

In the Inferior Oolite the Cerithiidæ are well represented, though some genera are placed here with a query—*Brachytrema*, already described, is thus classified by many. The following genera are referred to this family. *Cerithium*, Adanson, *Fibula*, Piette, *Ceritella*, Morris and Lycett, *Exelissa*, Piette, *Cryptaulax*, Tate, and *Cerithinella*, Gemmellaro. Of these *Cerithinella*, and possibly even *Cryptaulax*, might almost claim relationship with the Turritellidæ.

Genus—Cerithium, *Adanson*, 1757.

"*Shell imperforate, turrited; whorls numerous, narrow; the last always shorter than those of the spire; aperture oblong, semioval; anterior canal short, oblique, well-marked; lip more or less thickened.*"—Abridged from Fischer.

The Jurassic *Cerithia* cannot be judged by the same strict diagnosis as may be applied to existing species. A considerable group of fossil shells, many of them small, occur in our Liassic and Oolitic strata, to which the generic name *Cerithium* is applied. Some of these fossils are, perhaps, more like *Bittium*, where the anterior canal is short, indistinct, and scarcely reflexed. M. Cossmann observes that out of forty-one species of *Cerithia* recorded from Bathonian beds in France, probably not more than half really present the characters of *Cerithium*. We might almost say the same of many species in our Inferior Oolite. But if we were to remove them from that genus it would be necessary to make a number of allied genera in order to receive each species. In the case of forms now existing where the shell is well preserved and the animal can be put in evidence, such multiplication of genera is justifiable, and is even necessitated by the enforcement of the binomial system of nomenclature. To adopt this method where imperfectly preserved shells are alone obtainable is scarcely to be recommended. The result is that *Cerithium*, as a Jurassic genus, is not exactly the same thing as the recent genus, especially as now restricted. The Jurassic *Cerithia* have not the anterior canal so well developed or so strongly reflexed, and in some cases the canal is very poorly developed indeed, a defect which is aggravated by imperfect preservation.

It thus happens that species have been ranged under "*Chemnitzia*" which ought to be classified under *Cerithium*. This leads to the consideration of a question which is best discussed at the present stage, viz. what is to become of "*Chemnitzia*." It is scarcely necessary to point out that D'Orbigny's "*Chemnitzia*" of 1850 and his "*Chemnitzia*" of 1839 refer to distinct groups of shells. The "*Chemnitzia*" of 1850 is now very generally referred to *Pseudomelania*, Pictet and Campiche, a genus well represented in the Inferior Oolite, which will be dealt with subsequently. D'Orbigny's original "*Chemnitzia*" is now held to be a synonym of *Turbonilla*, Leach (*vide* Fischer, p. 789), a name applied to a group of shells which are elongate, narrow, and many-whorled, the whorls being slightly convex and usually costulated; the aperture is simple, and oval or subquadrangular. This genus is said to extend no farther back than the Tertiaries. In the Bathonian of France, Cossmann refers no species to "*Chemnitzia*." On the other hand, Gemmellaro, and after him Tryon, accept *Chemnitzia*, D'Orb., as a genus of fossil shells, divisible into the sub-genera *Chemnitzia*, *Rhabdoconcha*, *Pseudomelania*, *Oonia*, and *Microschiza*. The four last sub-genera evidently belong to the Pseudomelaniadæ, and need not be discussed here. There remains, then, *Chemnitzia*, D'Orb., as restricted, of which one of the types is *Chemnitzia* (*Turritella*) *undulata*, Benz. The following is Gemmellaro's diagnosis: "Shell elongate, composed of a great number of whorls transversely (axially) plicated. Mouth oval, rounded or angular in front, confined posteriorly. Columella straight or sometimes curved, and slightly incrusted. Lip thin and sharp." I do not think that there are any species in our Inferior Oolite which come within the above diagnosis. There are one or two cases where *Cerithia*, of the section originally grouped by Deslongchamps under *Melania*, have the anterior canal almost effete, a feature always accentuated by wear. But the connection of these forms with others, where the anterior canal is fairly well developed, is so obvious that we cannot fail to place them under *Cerithium.*

It must be borne in mind that mineralization has, in many cases, so affected the ornaments of *Cerithia*, especially of those preserved in calcareous rocks, as to produce more confusion than in any other class of shells. When to this is added the sporting or variation of an abundant group, the difficulties of nomenclature become very serious. For these reasons the common or demoid forms have given rise to more names than may be absolutely necessary. There are two of these demoid groups of *Cerithium* which more or less pervade the Oolites, at least as high as the Corallian-rocks. These are the *muricatum*-group, including the quondam "*Chemnitzia*" *vetusta* and its allies, and the *limæforme*-group. An attempt has been made to arrange the several species in something like the order of their apparent relationship. The last group included under *Cerithium* comprises four species, which might almost be constituted into a subgenus, if indeed they are not allied to one already constituted. Externally the species of this group have considerable resemblance to *Nerinæa,* but their internal structure is quite different.

As regards the possible origin of the Cerithia of the Inferior Oolite, we may suppose that some of them are the modified descendants of species occurring in the Lias. The intermediate sands, whether belonging to the *opalinus*-zone or to the *jurensis*-zone, seem to oppose a barrier, usually not very fossiliferous, between the abundant fauna of the *bifrons*-beds, and the more calcareous beds of the Inferior Oolite. Some small Liassic species, such as *Cerithium armatum, C. quadrilineatum*, and *Cryptaulax scobina,* still linger in the lower part of these sands. Somewhere in the *opalinus*-zone, as is well exemplified in the Yorkshire Dogger, *Cerithia* became both larger and more plentiful, whilst the fauna of the Inferior Oolite now presents itself to the collector in abundance.

62. Cerithium quadrilineatum, *Römer*, 1836. Plate VIII, fig. 1.

1836.	Turritella quadrilineata, *Römer.*	Ool. Geb., p. 154.
1850.	Cerithium quadrilineatum, *D'Orb.*	Prod., i, 250, Étage Toarcien.
1869.	— — *Römer.*	Brauns, Mittl. Jura, p. 171, pl. ii, figs. 7 and 8.
1876	— — —	Tate and Blake, York. Lias, p. 351.

Description of a Dogger Specimen.—Length 6 mm., width 2 mm. Shell elongate, subturrited. The spiral angle is regular; whorls seven or eight, nearly flat, well-divided by the suture. The ornaments consist of from four to five spirals, which reticulate with slightly arcuate longitudinals of about equal strength, producing a perfectly reticulate pattern. The longitudinal ornament becomes slightly weaker in the body-whorl. The upper row of spirals is rather more nodular and salient than the others. Other indications wanting.

Relations and Distribution.—This little shell seems to contain the germ of the *muricatum*-group. It is met with sparingly in the Blue-Wyke Sand-rock, which may be regarded as mainly in the *opalinus*-zone.[1] It is also quoted from the *jurensis*-zone by Tate and Blake.

The *Muricatum*-Group.

63. CERITHIUM MURICATUM, *Sowerby*, 1825 (Dogger variety). Plate VIII, figs. 2 *a*, 2 *b*.

1825. TURRITELLA MURICATA, *Sowerby*. Min. Conch., vol. v, p. 159, pl. 499, figs. 1 and 2.
1829. — — — Phillips, Geol. Yorkshire, 1st ed., vol. i, p. 135, pl. iv, fig. 8.
1844. CERITHIUM GRANULATO-COSTATUM, *Münst.* (pars). Goldf., Petrefact. Germ., vol. iii, p. 32, pl. clxxiii, fig. 10.
1884. — MURICATUM, *Sow.* Hudleston Geol. Mag., dec. iii, vol. i, p. 51, pl. iii, figs. 1 and 2.

Bibliography, &c.—Speaking in general terms *C. muricatum*, Sow., represents a group rather than a species, nevertheless fig. 2 *a* is taken from one of Sowerby's types. I have discussed this question at considerable length in the "Palæontology of the Yorkshire Oolites" and will merely repeat my conclusions, viz. that in the Yorkshire Dogger there are many varieties of *Cerithia*, such as those now figured and others not figured, which are so plainly connected that they cannot be separated specifically. Some of these, especially Sowerby's type, cannot be separated from certain varieties in the Coralline Oolite of Pickering.

Description.—Length 18—25 mm., spiral angle about 18°. Shell elongate, strongly turrited; whorls numerous, very slightly convex and rather constricted anteriorly. Width of whorl to height as 5 : 3·5. Suture distinct; ornaments conspicuous, consisting of granulated spiral bands usually four and sometimes five in number,[2] which decussate with more or less numerous longitudinal ribs, which latter usually have a slight inclination from left to right, and are sometimes slightly arcuate. The nodes or spinous granulations at the points of intersection are drawn out spirally, the upper band being somewhat the strongest. The body-whorl is short relatively to the spire and similarly ornamented, but the spiral

[1] Ammonites of the section, *Oxynoticeras*, are most characteristic of the Blue-Wyke beds.

[2] The variety "*sex-lineatum*" probably belongs to another species.

lines in the base, though very strong, are not granulated. Specimens showing the full character of the aperture are not available.

Relations and Distribution.—Differs from *C. vetustum* and its varieties in a less marked tendency to longitudinal ornament, *i. e.* that costæ, as a rule, do not predominate over the spiral ornamentation. Nevertheless I am scarcely prepared to say that these forms do not inosculate. The Yorkshire beds contain *C. muricatum*, more especially the lower portions of the Dogger proper. The variety named *trilineatum* is almost worthy of being regarded as a distinct species (fig. 3). This is a unique specimen from the Scarborough Limestone.

64. Cerithium gemmatum, *Morris and Lycett*, 1853. Plate VIII, fig. 4.

1853. Cerithium gemmatum, *Morris and Lycett.* Great Ool. Moll., p. 11 pl. xv, fig. 6.
1884. — — — Hudleston, Geol. Mag., dec. iii, vol. i, p. 58, pl. iii, fig. 9.

Bibliography, &c.—The type was from the Scarborough Limestone. The specimen now figured is from the Bean collection.

Description.—Length 15 mm., width 4·5 mm., spiral angle 20°. Shell turrited; whorls about ten, rather convex, encircled with five rows of nodules; nodules ovate, twenty-four in a whorl; the rows of nodules are slightly curved; they are oval, their longer diameter being in the axis of the shell, and they are distant from each other about their own diameter. The body-whorl shows five rows of nodules on the side; the base is ornamented with spiral bands, the granules of which are drawn out spirally, and less deeply cut. Other indications wanting.

Relations and Distribution.—Differs from *C. muricatum* in the fact that the granules are drawn out axially rather than spirally. The beaded character of the granulations may be partly the result of mineralization. It occurs in the grey marly Oolite of White Nab (Scarborough Limestone Series), and appears to be a local form. It may have some relationship to *Cerithium vetustum*, inasmuch as there is a tendency to axial rather than to spiral ornamentation.

The *Vetustum*-Subgroup, *partly included under* Chemnitzia *by some authors.*

This group may to a certain extent be said to inosculate with the *muricatum*-group, but its ramifications in the Inferior Oolite are much more extensive.

The numerous varieties and species which I refer to the *vetustum*-group have a tendency to longitudinal ornament, and even when their ornaments are markedly granular, the granules are usually drawn out axially rather than spirally. *Cerithium flexuosum*, Münst., as it seems to me, represents the immature condition of some varieties, where arcuate longitudinal costæ prevail before any turriting has commenced, whilst *C. muricato-costatum* represents robust varieties, where the granules have been more or less fused into continuous longitudinal costæ. This tendency to longitudinal ornamentation, so conspicuous in corroded specimens, has caused the original *Terebra vetusta* of Phillips to be classed under "*Chemnitzia*" even by D'Orbigny, although the representative species in the Bajocian of Normandy (Nos. 172 and 188 of the 10th stage) are classed under *Cerithium* in the 'Prodrome.'

As regards nomenclature, the difficulties which beset all demoid forms are aggravated in this case. Firstly, the prior name was given to a corroded specimen of the stunted species which occurs in the Millepore- and Scarborough-Limestone. Secondly, the whole group is peculiarly liable to have its ornaments affected by variations in conditions of mineralization, and this is particularly the case in the beds whence the type was derived. Münster's names, though very useful, and no doubt applicable to the German beds, represent conditions of mineralization, and in the case of *C. flexuosum* (only 10 mm. in length) even a stage of growth in all probability. Without in any way asserting, that the method adopted in this Monograph for dealing with such an extensive group is the best, it possesses the merit of exhibiting the facts of the case as they occur in the Inferior Oolite of this country. Some dubious forms, presumably belonging to this group, have not been noticed, but Münster's names would cover the majority of them.

65. Cerithium vetustum, Phillips, 1829. Plate VIII, figs. 5 *a*, 5 *b*, 5 *c*, 5 *d*.

1829. Terebra vetusta, *Phil.* Geol. York., Pt. I, vol. i, p. 152, pl. ix, fig. 27.
1844. Cerithium muricato-costatum, *Münst.* Goldfuss, t. 173, fig. 12.
1844. — granulato-costatum, *Münst.* Goldfuss, t. 173, fig. 10.
1844. — ? flexuosum, *Münst.* Goldfuss, t. 173, fig. 15.
1850. Chemnitzia vetusta, *D'Orb.* (*Phil.*). Prod., vol. i, p. 263.
1851. — ? — *Phil.* Morris and Lycett, p. 114, pl. xv, fig. 7.
1869. Cerithium vetustum, *Williamson.* Brauns, Mittl. Jura, p. 172.
1882. "Chemnitzia" vetusta, *Phil.* Hudleston, Geol. Mag., dec. ii, vol. ix, p. 247, pl. vi, figs. 9—11.

Bibliography, *&c.*—Brauns, in sweeping up the muricato- and granulato-costate *Cerithia* of North-west Germany into this net, included *Cerithium armatum*, Goldfuss, and *Cerithium* (*Cryptaulax*) *tortile,* Héb. and Desl., which was clearly a mistake, as these two are totally different species. He was not so far wrong in including *Melania undulata*, Deslong., as this is certainly in part a representative species. The same author also regarded *Chemnitzia? vetusta*, Morris and Lycett, as a species distinct from that of Phillips, and already included under *C. flexuosum*, Münster.

Description.—Size variable; 15 mm. is the length of a fair-sized specimen. The spiral angle is about 18°. Shell elongate to elongate-ovate. Spiral angle regular; whorls ten to twelve, flat to subconvex, anterior whorls turrited, suture close. The posterior whorls are very flat, with longitudinal costæ, which are straight and extend from suture to suture, almost without spiral decussation. By degrees the whorls become more convex, the costæ becoming arcuate, and in very well-preserved specimens decussated by fine spiral lines, which cause the costæ to be granular.

In full-sized specimens the body-whorl is slightly ventricose, and, if well preserved, the spiral decussations are shown; in this case the uppermost row of spirals assumes a slightly muricated character. Base full and spirally striated, with sometimes a slight prolongation of the axial costæ. Aperture broadly ovate, with a sharp angle at the posterior extremity; inner lip somewhat expanded on the columella; anterior canal fairly developed (in all available specimens the end of the canal has been broken off).

Varieties.—The original figure of *Terebra vetusta*, Phil., represents a specimen, either from the Millepore or Grey Limestone, which is in that condition where all the fine spiral lines are obliterated. This is perhaps the most usual condition for specimens. It is partly on account of this appearance that *Terebra vetusta* has been so often referred to "*Chemnitzia.*"

Chemnitzia? vetusta, Phil., of Morris and Lycett, represents a more perfect specimen from one or other of the same beds. The spiral ornaments are faintly distinguishable, more especially in the anterior whorls, and the longitudinals are somewhat more arcuate. Hence Braun's reference to *Cerith. flexuosum.* In the Dogger this stage of *C. vetustum* is not uncommon.

So much as regards Yorkshire varieties. Elsewhere in the Inferior Oolite of England there are specimens, some with granular, some with continuous costæ, straight or flexed, which may be referred to *C. vetustum.* I have several such from the *Parkinsoni*-zone of the Cotteswolds. When in bad condition *C. vetustum* is the most suitable name.

Relations and Distribution.—Under the head of relations little more need be said. As regards distribution, *C. vetustum* occurs in the Dogger, where it probably represents an incomplete stage of the next species. The best specimens, as regards condition, are obtained from the Lower Division of the Scarborough

Limestone series (Pickering Cliff, &c). It is doubtfully quoted from the Lincolnshire Limestone in Judd's 'Geology of Rutland.' Specimens from the Cotteswolds may be referred to *C. vetustum* or to *C. granulato-costatum* according to condition.

66. CERITHIUM VETUSTUM-MAJUS, *Hudleston*, 1882. Plate VIII, figs. 6 *a*, 6 *b*.

1882. "CHEMNITZIA" VETUSTA-MAJOR, *Hudl.* Geol. Mag., dec. ii, vol. ix, p. 248, pl. vi, fig. 12.

Description:

Length (large size)	43 mm.
Width	10 mm.
Spiral angle	18°.

Shell elongate, turrited; whorls flat to subconvex, and only turrited anteriorly; about twelve in number; suture distinct. Strong longitudinal ribs, having a crescentic curve, characterise the spine. The precise apical conditions are unknown. The anterior whorls have the longitudinal ribbing decussated by about six spirals, producing nodes at the points of intersection. In the larger specimens the last two whorls have the longitudinal ribbing less strongly marked, whilst the spiral ribbing towards the posterior margin becomes more pronounced, presenting somewhat the appearance of a nodular varix, which much increases the turrited aspect of the shell.

The base is strongly ribbed spirally. The aperture is somewhat widely ovate; and some specimens give evidence of a tolerably long anterior canal, but slightly reflexed.

Relations and Distribution.—It is by no means improbable that *Cerithium flexuosum*, Münst., represents the apical conditions of this species. It is closely allied to the larger varieties of *Melania undulata*, Deslong., whilst the typical *Cerithium vetustum* of the Scarborough Limestone, &c., is its attenuated representative on a higher horizon.

In Yorkshire the larger shells are confined for the most part to the principal shell-bed of the Dogger, but it is seldom that the ornaments are in a good state of preservation. In some of the other parts of the Dogger these are better preserved, but on the whole smaller.

67. Cerithium vetustum, var. *seminuda*, Hudl. Plate VIII, fig. 7.

1882. "Chemnitzia" vetusta, var. seminuda, *Hudl.* Geol. Mag., dec. ii, vol. ix, p. 249, pl. vi, fig. 13.

Description.—This is a subulate variety, about 23 mm. in length, and with a spiral angle of 14°. The spire is composed of about a dozen whorls, which are flat to subconvex, increasing with perfect regularity. The subapical whorls are ornamented with numerous delicate longitudinal ribs, very slightly curved. Lower down this ornament becomes very faint, and expires in the body-whorl or is merely represented by obscure sinuous lines.

Base rounded and smooth; aperture ovate: other indications wanting.

Relations and Distribution.—Differs from *C. vetustum* in being more slender and in the failure of ornamentation on the anterior whorls. Rare in the Yorkshire Dogger.

68. Cerithium subscalariforme, D'Orb., var. *spinicostata*, Wright, MS. Plate VIII, figs. 8 *a*, 8 *b*, 8 *c*, 8 *d*, 8 *e*, 8 *f*.

1850. Cerithium subscalariforme, *D'Orb.* Prod., vol. i, p. 271.
Compare also
1842. Melania scalariformis, var. a, *Desl.* Mém. Soc. Linn. Norm., vol. vii, p. 218, pl. xi, fig. 63.
1842. — undulata, var. b, *Desl.* Vol. cit., p. 217, pl. xi, figs. 59—62.

Bibliography, &c.—This species may be regarded as the principal representative of the *vetustum*-group in Dorsetshire. There are, it would seem, objections to both Deslongchamps' names, hence collectors usually fall back upon *Cerithium subscalariforme,* D'Orb., for a set of fossils which are well known in the Bayeux-beds. Although we cannot use Deslongchamps' names, we can at least apply his generalizations as follows:

"*Melania undulata*, var. b. Testâ longiori, costis striisque frequentioribus. *Lias supérieur.*" His Upper Lias I take to comprehend the Mâlière (see Introduction to the present Monograph), which is included in our Lower Division of the Inferior Oolite.

"*Melania undulata*, var. a. Testâ breviori, costis et striis crassioribus varioribusque. *Oolite ferrugineuse*," *i. e.* our Upper Division.

Deslongchamps' generalisation, as above stated, holds good throughout the Dorsetshire-beds, the varieties of *C. subscalariforme* having a tendency to become shorter, and to be more coarsely ornamented in the zones of *Am. Humphriesianus* and *Parkinsoni.*

Description of var. spinicostata :

Length of a fair-sized specimen . .	35 mm.
Width	7·5 mm.
Ratio of body-whorl to entire length . .	31 : 100.
Spiral angle	15°.

Shell elongate, strongly turrited. Spiral angle nearly regular; whorls about fifteen in number, subconvex in the apical region, but becoming flatter and somewhat pinched anteriorly so as to increase the turriting of the shells. The ornaments consist of about eight fine spiral lines, which in the latter whorls assume the character of spiral belts, with a considerable interspace; subordinate spiral lines may be detected, especially in the more mature whorls. The uppermost one is strongly tuberculate at the points of intersection with the costæ, which are numerous. The costæ are rather fine, and extend from suture to suture, decussating with the spirals so as to present a somewhat granular appearance at the points of intersection.

The body-whorl is less than one third the entire length of the shell, the shape and ornamentation are similar in character to the whorls of the spire, with, however, a tendency for the costæ to become more arcuate. The base is tolerably full and marked with strong spiral striæ, which are partially decussated by a faint continuation of the costæ. The aperture is ovate-elongate; the outer lip thin (always broken away). There exists a kind of rudimentary posterior canal. Columella excavated and but slightly encrusted. Anterior canal considerably produced, but slightly reflexed.

The following sub-varieties may be noted. Fig. 8 *b* is less subulate, and shorter. The specimen figured has suffered slightly from wear or solvents, so that the spiral lines are less distinct. The costæ are scarcely decussated in consequence. This is a medium-sized specimen and greatly resembles some of the larger forms of *C. subscalariforme* from the Bayeux-beds. Fig. 8 *c* represents a very elongate form, with fine ornamentation. In Fig. 8 *d* the proportions are as usual, but that which constitutes some difference is the twist in the costæ, and their marked inclination from right to left. In this specimen the spiral lines on the costæ are entirely obliterated. In Fig. 8 *e* the costæ are stouter and less numerous than usual, with great salience of the spinous row of nodules on the shoulder of each whorl. The traces of spiral ornamentation are still more difficult to find. This sub-variety leads up to *Cerithium subglabrum.*

Relations and Distribution.—The most typical forms of *C. spinicostatum* are to be met with in the *Sowerbyi*-bed of Bradford Abbas, where it is one of the most abundant fossils, though not always in the best state of preservation. It is related to *Cerithium costellatum,* Münst. (non Deslong.), as that fossil occurs in the Upper Lias of Compton, and some of the Bradford-Abbas specimens are scarcely to be distinguished from the Lias species, where, however, the costæ are somewhat straighter—a very unimportant difference. Taken as a whole, with all its varieties, this species is eminently characteristic of the Lower Division of the Inferior Oolite, but seldom so well preserved or of such large size as in Dorsetshire. Though the ornaments are considerably modified by conditions of preservation, it may be recognised in a granulato-costate condition in other places, as, for instance, in B of Mr. Walford's Hook Norton section. *Cerithium vetustum-majus* of the Dogger is probably its local representative in the Yorkshire-beds.

69. Cerithium subscalariforme, D'Orb., variety in the *Humphriesianus*-zone. Plate VIII, fig. 9.

This form is very near to *C. subscalariforme* as it occurs in the beds of Bayeux; it is somewhat smaller, and in the figured specimen the body-whorl appears unusually short. The costæ also happen to be somewhat more granular as in *granulato-costatum*, Münst. Occurs in the *Sauzei*-bed at Oborne.

70. Cerithium subscalariforme, D'Orb., variety in the *Parkinsoni*-zone. Plate VIII, figs. 10 *a*, 10 *b*.

Cf. Melania undulata, var. a, *Deslongchamps*, vol. cit., p. 217, pl. xi, fig. 58.

Description.—As compared with the previous variety, or varietal group, there can be no better description than "testâ breviori; costis et striis crassioribus rarioribusque." This is a much shorter form, it is more widely angled, and when in the granulato-costate condition the spirals are not usually more than four or sometimes, in well-developed specimens, five. Corresponding to the greater width of the shell the aperture is widely ovate, and it so happens that in the majority of the available specimens the anterior canal is by no means distinct (probably the result of wear).

Relations and Distribution.—This variety possibly represents rather than resembles the *C. vetustum* of the Yorkshire-beds. It is essentially a fossil of the Upper Division, and is moderately common. The specimen from Grove (fig. 10 *a*) greatly resembles the figure in Deslongchamps' work (xi, 58), and is exceptionally fine. Away from the Dorset-beds the specimens become poorer, worse preserved, and may be variously described as *C. granulato-costatum*, *C. muricato-costatum*, and even *C. vetustum* according to local circumstances.

71. CERITHIUM SUBABBREVIATUM, D'Orb., 1850. Plate VIII, fig. 11.

1850. CERITHIUM SUBABBREVIATUM, *D'Orb.* Prod., vol. i, p. 271.
1842. MELANIA ABBREVIATA, *Desl.* Mém. Soc. Linn. Norm., p. 219, pl. xi, fig. 67.

Bibliography, &c.—The most natural course, in this case, would be to retain the specific name given by Deslongchamps, by whom the species was originally described. But the specific term *abbreviatum* has already been bespoken by Mr. Leckenby for a *Cerithium* described by him.

Description :

Length	16 mm.
Width	6 mm.
Ratio of body-whorl to entire shell . .	35 : 100.
Spiral angle	28°.

Shell ovate, turrited. Spiral angle scarcely if at all convex. Number of whorls about twelve; these are narrow and subtumid; suture close and but little inclined. The spiral lines are very fine and numerous, and extend over the entire shell (in the figured specimen the faintness of this ornament is in part due to wear). The longitudinals are extremely numerous, extending with regularity, in the form of slightly arcuate costæ, from suture to suture.

Body-whorl subventricose. Aperture ovate with a considerable callus on the columella; canal short, small, and slightly reflexed.

Relations and Distribution.—Deslongchamps pointed out the relationship of this rare shell to "*Melania scalariformis.*" The shortness of the whorls of the spire and the ventricose character of the body-whorl constitute its principal difference.

A single specimen from P_1, Burton Bradstock.

72. (?) CERITHIUM OBESUM, sp. nov. Plate VIII, fig. 12.

Description :

Length	8 mm.
Width	5 mm.
Ratio of body-whorl to entire shell, about .	50 : 100.
Spiral angle, about . . .	50°.

Shell short, ovate, turrited. Number of whorls about six, convex, and increasing very rapidly. The ornaments consist of three or four spirals which decussate with a straight longitudinal system, thus producing straight granular costæ, the nodes of which are drawn out axially.

The body-whorl is ventricose and with similar ornamentation; base full and ornamented with granular spiral lines. Aperture ovate with some traces of an anterior canal. Other indications wanting.

Relations and Distribution.—The generic position of this curious shell is open to doubt, but it seems to be fulfilling the dictum of Deslongchamps with regard to the "Melaniæ" of the Inferior Oolite, viz. that they become shorter and stouter in the higher beds. The sudden increase in the body-whorl, however, carries it far beyond even *Cerithium subabbreviatum*, or the remarkable variety of *C. subscalariforme* from Grove (see fig. 10 *a*).

A single specimen from P_1, Vitney Cross.

73. Cerithium subglabrum, sp. nov. Plate VIII, fig. 13.

Description.—Shell elongate, turrited; spiral angle nearly regular. Whorls about eighteen in number, short, slightly curved to nearly flat; sutures rather close. But little trace of spiral ornamentation beyond a faint line on each whorl at a short distance from the posterior margin. The longitudinals are well-developed in the apical and subapical regions, but with a tendency to become wide apart. These gradually fail in the last two whorls, though the terminal tubercles are retained. The lines of growth between the costæ are visible.

Body-whorl short, and with but little trace of ornament; base spirally striated. Aperture ovate. Other indications wanting.

Relations and Distribution.—Evidently related to *C. subscalariforme*, but the differences are so marked as to almost exceed the limits of a mere variety. Rare in the *Sowerbyi*-bed of Bradford Abbas.

This terminates the list of species referred with more or less certainty to the *Vetustum*-Subgroup.

74. Cerithium (species or variety). Plate VIII, fig. 14.

Description.—Probable length 35 mm., spiral angle about 14°. Shell elongate, subulate, whorls numerous, convex, and well separated by the suture. The spiral lines are fine and numerous, upwards of twelve on the anterior whorls; one, slightly broader than the others, occupies the shoulder of each whorl, forming a slight belt near the posterior margin. The longitudinal costæ are numerous, regular, and slightly arcuate on all the posterior whorls, but become faint and almost effete on the anterior whorls. Other indications wanting.

Relations and Distribution.—This rare form has a certain resemblance to the finer varieties of *C. spinicostatum*, and at one time I was disposed to regard it as, possibly, a worn example of that rather abundant species; but further examination induces me to believe that the differences are not so brought about, since the whorls are more tumid in addition to the great difference in the ornamentation. The anterior portion of the shell is not unlike *C. costellatum*, Desl. (p. 202, pl. xi, 19). As regards the failure of the longitudinal ornaments anteriorly we have similar instances in *C. vetustum*, var. *seminuda* of the Dogger.

A single specimen in the *Sowerbyi*-bed of Bradford Abbas.

75. Cerithium (species or variety). Plate VIII, fig. 15.

An incomplete specimen. Length of fragment 21 mm., spiral angle about 11°. Shell elongate, subulate. Number of whorls remaining thirteen, short, subconvex, well separated by the suture. The spiral lines on each whorl are about eight in number; longitudinal costæ numerous, slightly arcuate, extending from suture to suture, and slightly decussating with the spirals. Upper row of spirals slightly nodular. Other indications wanting.

This may be an extremely subulate variety of *C. spinicostatum*, of which the apical portions alone are preserved. A single specimen in Mr. Whidborne's collection, apparently from the *Sowerbyi*-bed of Bradford Abbas.

76. Cerithium armatum, *Münster*, 1844. Plate IX, fig. 1.

1844. Cerithium armatum, *Münst.* Goldfuss, Petref., t. 173, fig. 7.

A single specimen from the Sands below the Cephalopoda-bed at North Nibley, though somewhat larger than typical specimens from the *Torulosus-schichten* of Uhrweiler, answers the description of this species very well. It may be distinguished from *Cryptaulax scobina* by having only two extremely spiny spiral belts. The specimen under consideration does not show an aperture, but Mr. Wilson informs me that specimens from the Lias show that this species is a true *Cerithium.*

77. Cerithium leckhamptonense, sp. nov. Plate IX, fig. 2.

Description :

Length (about)	27 mm.
Width	9 mm.
Length of body-whorl to entire shell about .	33 : 100.
Spiral angle	20°.

Shell elongate, scarcely turrited ; number of whorls probably twelve, apical conditions unknown. Whorls short, slightly convex in the middle stage, but becoming flat anteriorly, sutures close. The ornaments consist of about ten spiral lines of somewhat unequal strength, which are decussated by numerous thick, though not prominent costæ, which are slightly arcuate, and slope considerably from left to right. The costæ become faint in the penult.

The body-whorl is about one-third the total length of the shell. Fine spiral lines are the only ornaments, the costæ having entirely disappeared. Base tolerably full and spirally striated. Aperture (?) ovate, with a considerable callus on the columella. Other indications wanting.

Relations and Distribution.—As far as I know, this form seems to stand pretty much by itself. The failure of axial costæ on the anterior whorls might suggest some degree of relationship to certain varieties of the *vetustum*-group, but otherwise there is no resemblance.

A single specimen from the Inferior Oolite of Leckhampton Hill.

78. Cerithium (species or variety). Plate IX, fig. 3.

Description :

Length (about)	20 mm.
Width	4 mm.
Spiral angle (about) . . .	10°.

Shell very subulate, turrited ; spiral angle nearly regular. Whorls about sixteen, short and very flat; suture close. The extreme apical whorls are apparently devoid of ornament. The subapicals have three well-cut spirals, which decussate with numerous longitudinals of about equal strength, inclining from left to right. Four, and ultimately five, spirals are developed in the anterior whorls. A very fine mesh results from the decussation of such equal spiral and longitudinal lines, the enclosed space being rectangular and spirally elongated; the nodes at the intersections are very slight.

The body-whorl is relatively small, base rather flat. Aperture subquadrate, with a straight columella. Canal apparently short, other indications wanting.

Relations and Distribution.—This form appears to have relationship to the several species described by Deslongchamps from the Inferior Oolite of Normandy, as *Cerithium triseriatum*, *quadriseriatum*, &c. With these, unfortunately, I am unacquainted. It is noticeable, however, that in this species we lose the comparatively strong longitudinal ornamentation of the *vetustum*-group.

Single specimen from the Inferior Oolite (*? Murchisonæ*-zone) of Coker.

The *Limæforme*-Group.

This group is intended to include *Cerithia* which are usually rather small, often pupoid, and with fine ornaments, where the spiral lines are more conspicuous than the longitudinals. The aperture has rather a tendency to be subquadrate, columella short, with a short but well-developed anterior canal, slightly reflexed. Judged by the character of the aperture these little shells are perhaps more nearly allied to the existing genus *Cerithium* (including *Bittium*) than the group last described. In the Lower Oolites of this country *Cerithium Beanii*, and *C. limæforme* are the two species round which the less common forms may be grouped. But these also vary so obviously that it is almost impossible to draw a very distinct line. In order to realise how hopeless it is to make "hard-and-fast species" out of this group, let anyone study a well-stocked collection of small *Cerithia* from the Lincolnshire Limestone. And yet it is equally impossible to avoid the temptation of making a certain amount of nominal differentiation.

79. Cerithium Leckenbyi, *Hudleston*, 1884. Plate IX, fig. 4.

1884. Cerithium Leckenbyi, *Hudl.* Geol. Mag., dec. iii, vol. i, p. 61, pl. iii, fig. 12.

Description:

Length (restored)	? 17 mm.
Width	4 mm.
Height of whorl to width . . .	2 : 3·75.
Spiral angle	14°.

Shell elongate, subturrited; whorls (?) thirteen, flat, short in comparison with their width; sutures close. The ornaments consist of finely granulated or tuberculated spirals, of which the first is strongest and the fifth the faintest. The longitudinals are irregular as in *C. Beanii*, frequently not reaching to the anterior portions of the whorls. Spirals on the base of the body-whorl scarcely granulated. Other indications wanting.

Relations and Distribution.—*C. Leckenbyi* may, perhaps, be regarded as an unusually fine development of *C. Beanii*, from which, however, it differs in its greater size, more marked turriting, and in the details of its ornaments. Rare in the Dogger.

80. CERITHIUM BEANII, *Morris and Lycett*, 1851. Plate IX, figs. 5 *a*, 5 *b*.

1851. CERITHIUM BEANII, *M. and L.* Great Ool. Moll., p. 112, pl. xv, fig. 5.
1884. — — — Hudleston, Geol. Mag., dec. iii, vol. i, p. 59, pl. iii, figs. 10 and 11.
Compare also for varieties
CERITHIUM PUPÆFORME, *Koch and Dunker.* Beitr., p. 33, pl. ii, fig. 10.

Bibliography, &c.—Although described by the authors of the 'Great Oolite Mollusca' as occurring near Scarborough, their type, I have very little doubt, came from the Dogger at Blue Wyke.

Description of the Dogger or type-form:

Length varying from . . .	9—12 mm.
Width	3—3·5.
Spiral angle of apex . . .	25°.
Do., anterior portion of spire . .	15°.

The above dimensions are only approximate, regard being had to the numerous varieties.

Shell small, more or less pupoid, turrited; whorls from ten to twelve, narrow, and rather flattened. The anterior whorls are ornamented by five tuberculated spirals, of which the third and fifth are least prominent. Sometimes the tubercles become slightly confluent, in which case there is a tendency to the formation of axial costæ, especially in the upper part of each whorl. The upper row of spirals is strongly tuberculated, though this feature is subject to some variety.

Body-whorl slightly compressed, and not exceeding one-third the total length of the shell; ornaments as in the anterior whorls of the spire. Base spirally striated. Aperture subquadrate; columella short, and terminated by a short but rather deeply cut anterior canal.

Relations and Distribution.—The Yorkshire specimens are to a certain extent *sui generis.* Those from the Lincolnshire Limestone, and the very rare specimens from the Inferior Oolite of the Cotteswolds, vary considerably from these types.

81. CERITHIUM BEANII, var. WELDONIS, sp. nov. Plate IX, figs. 6 *a*, 6 *b*, 6 *c*; 6′ *a*, 6′ *b*, 6′ *c*, 6′ *d*.

Description.—Sub-variety A with five spirals. Three specimens are figured figs. 6 *a*, 6 *b*, 6 *c*), each showing some difference of ornament or condition. The usual form is decidedly pupoid, and the ornaments are rather coarser and more open than in the Dogger specimens. It often happens that in the sub-apical whorls the tubercles are so fused together axially as to produce a costate appearance. The uppermost row of spirals is very strongly tuberculated, and the distinctions as to the fineness of the third and fifth spirals not so strong as in Dogger specimens. Specimens of *C. Beanii* from the Inferior Oolite of Cleeve much resemble these forms, though slightly larger. These are in Mr. Brodie's collection.

Sub-variety B with four spirals (figs. 6′ *a*, 6′ *b*, 6′ *c*, 6′ *d*). The ornamentation is, on the whole, similar to the preceding, but the general form of the shell is more stumpy. This, for the sake of distinction, we might term *C. Beanii-quadricinctum.*

There are also other forms with four spirals approaching *C. limæforme.*

Relations and Distribution.—The fossils described under the above heading, as *C. Weldonis*, afford an excellent example of the proneness to change of form and ornament in these small pupoid *Cerithia.* They are very abundant in the Lincolnshire Limestone of Weldon, and less so at other fossil-localities in that Limestone, where for the most part their place is taken by *C. limæforme* and its relatives.

82. CERITHIUM QUADRICINCTUM, *Münster*, 1844. Not figured.

1842—1844. CERITHIUM QUADRICINCTUM, *Münst.* Goldfuss, Petr. Germ., t. 173, fig. 11.

The sub-varieties of *C. Beanii* with four spirals are passing into the form figured by Goldfuss, but their ornaments are less regular and the shell more pupoid. Very rarely, however, specimens occur in the Lincolnshire Limestone, where the granulations are small and regular, and the shell less pupoid. These we seem justified in referring to *C. quadricinctum.*

83. Cerithium limæforme, *Römer,* 1836, var. *Pontonis*, sp. nov. Plate IX, fig. 7.

1836. Cerithium limæforme, *Röm.* Ool. Geb., tab. xi, fig. 19, p. 142.

Bibliography, &c.—Römer's species was originally described and figured from the Coral Rag of Hoheneggelsen. Morris and Lycett referred to *C. limæforme* and to *C. quadricinctum*, Münst., a similar group of shells occurring in the Great Oolite of Minchinhampton. Subsequently Lycett (' Suppl.,' p. 122) observed that what the authors of the ' Great Oolite Mollusca ' had regarded as two separate forms must be united into one species, and to this he assigned the name of *C. quadricinctum,* Münst. The figure in Goldfuss is not very like either the Ponton or the Minchinhamptom fossils. On the other hand, there cannot be any doubt that the Ponton shells are closely related to *C. limæforme*, Röm., a name which in a certain sense is applicable to the entire group now under consideration.

Description :

Length	10 mm.
Width	3 mm.
Length of body-whorl to entire shell, about .	33 : 100.

Shell small, subelongate, scarcely turrited; spiral angle very convex. The apex is blunt; number of whorls about ten, flattish; suture rather open. The subapical whorls exhibit two to three tuberculated spirals, and the tubercles on the two upper rows have a tendency to coalesce axially so as to produce costæ. In the anterior whorls the two upper spirals are strongly tuberculate, and have the effect of producing a kind of zone. The number of spirals varies, but is three or four. In some cases where there are four the third is faint, as in *C. Beanii.*

The body-whorl is about one-third the length of the entire shell, and similarly ornamented with spiral lines on the base. Aperture sub-oblong, with a broad, short anterior canal.

Relations and Distribution.—This particular variety of the *limæforme*-group is distinguished by its slender shape and somewhat more delicate ornamentation both from *C. Beanii* on the one hand, and from C. *Wansfordiæ* on the other. It is the prevailing form at Ponton, but met with sparingly elsewhere in the Lincolnshire Limestone. The Minchinhampton forms, referred by Lycett to *C. quadricinatum*, Münst., are on the whole more slender, less markedly pupoid, and finer in their ornamentation. Although the bulk of the specimens of *C. Pontonis* are more irregular in ornamentation, and have a slight tendency to the cingulate arrangement, there are specimens from Ponton which can in no way be distinguished from specimens of *C. limæforme* occurring in the type locality of Hoheneggelsen.

84. Cerithium (species or variety). Plate IX, fig. 8.

A single specimen from the shelly freestones of the Cotteswolds presents the zonal arrangement of *C. Pontonis* in a more complex form; the zone in the upper part of each whorl being made up of three granulated spirals instead of two. As a means of distinction merely I would propose to call this *Cerithium* "*cingula*."

85. Cerithium Wansfordiæ, sp. nov. Plate IX, figs. 9 *a*, 9 *b*, 9 *c*.

Description :

Length	6 mm.
Width	2·75 mm.
Spiral angle	30°—35°

Shell short, subconical, turrited; apex obtuse, but angle of increase nearly regular in the majority of specimens. Number of whorls about nine, flat, very narrow, and richly ornamented. Suture well marked. The subapical whorls are ornamented with from two to three spirals, whose tuberculations are fused axially. In the anterior whorls the richly cut spirals are three in number, the two upper ones being strongly tuberculate and generally fused axially.

The body-whorl is rather more than one-third the entire length of the shell, and similarly ornamented; the spiral lines on the base are finer than those on the flank. The aperture is subquadrate and contracted with a relatively large anterior canal, which is reflexed.

Relations and Distribution.—Although evidently related to *C. limæforme*, this species is, in the majority of cases, conical rather than pupoid, with a rather wide base for a *Cerithium*. Nevertheless, there are many connecting links. Indeed, the whole of the small *Cerithia* of the Lincolnshire Limestone are so linked by connecting forms that, under some aspects of the case, they might be regarded as one and the same species, represented by local varieties. *C. Wansfordiæ* is the prevailing form about Wansford and Barnack, though met with occasionally, but in a modified form, at the other localities.

86. Cerithium Georgii, sp. nov. Plate IX, fig. 10.

Description :

Length	12 mm.
Width	3 mm.
Spiral angle	Very convex.

Shell slender, pupoid, turrited. The spiral angle ranges from about 20° at the opening to 13° in the anterior portions of the spire. Whorls numerous, narrow and flattened. Sutures distinct. The subapical whorls are ornamented by three granulated spirals, which in the anterior whorls are increased to the number of five or six. The spirals undulate and decussate, with short and not prominent costæ at regular intervals, producing a very pretty basket-shaped pattern. There is some irregularity in the development of these spirals, the nodulations of the upper row being always the strongest.

The body-whorl is about one-third the length of the shell, compressed, and with ornaments similar to those of the spiral whorls (in the figured specimen these have suffered from wear). Aperture subquadrate, with a short, stout anterior canal.

Relations and Distribution.—Closely related to the *limæforme* section of the group. Specimens somewhat resembling *C. Georgii* occur in the Corallian of England and possibly also in the Great Oolite. We may regard such either as distinct species, or as megalomorphs of the prevailing form. Named after Mr. George, curator of the Northampton Museum. Rare in the Lincolnshire Limestone.

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87. Cerithium subcostigerum, sp. nov. Plate IX, fig. 11.

Description :

Length	8 mm.
Width	2·75 mm.

Shell short, subpupæform, slightly turrited; number of whorls about seven, subconvex, and separated by a wide and shallow suture. Apex obtuse. The ornaments consist of numerous fine spiral lines, so fine as to be scarcely visible in the upper part of the whorls. These are decussated by robust costæ, which extend from suture to suture, being, however, strongest towards the posterior margin of each whorl. These costæ have a kind of twist from left to right, and do not follow in true sequence.

The body-whorl somewhat exceeds one-third the total length of the shell, and its flanks are similarly ornamented. Base full, spirally striated, but without any axial lines. Aperture subquadrate; other indications wanting.

Relations and Distribution.—This species has some resemblance to *Exelissa* (*Kilvertia*). On the other hand, it also has relations to some varieties of the *limæforme*-group, where the tuberculations have a tendency to fuse throughout into axial costæ. Only found, to my knowledge, in the Lincolnshire Limestone.

88. Cerithium latisulcatum, sp. nov. Plate IX, fig. 12.

Description :

Length	11 mm.
Width	3·75 mm.
Length of body-whorl to entire shell .	28 : 100.
Spiral angle about . . .	20°.

Shell elongate, subconical, turrited; spiral angle moderately convex. Number of whorls ten to twelve, flat, subangular, and separated by a wide suture. In the subapical whorls the tubercles coalesce so as to produce short axial costæ, which preponderate over the obscure spiral lines. In the anterior whorls four spirals are distinguished, of which the two uppermost are the most strongly tuberculated, the third is faint, and the fourth spiral is so prominent as to impart an angular shape to the whorls of the spire.

The body-whorl is barely one-third the entire length of the shell, and in shape and ornament similar to the whorls of the spire. Base rather full and finely striated. Aperture nearly quadrate, with a deep anterior canal.

Relations and Distribution.—Distinguished from *C. Beanii*, *C. limæforme*, and their numerous varieties by the less curved spiral angle, by the great width of suture, by the angular shape of the whorls, and by the relative shortness of the body-whorl. In the matter of ornamentation, however, there is a certain general resemblance to the shells of the *limæforme*-group, though we can scarcely regard *C. latisulcatum* as belonging to that group.

Rare in the Lincolnshire Limestone at Weldon and Wackerly.

89. Cerithium pisoliticum, sp. nov. Plate IX, figs. 13 *a*, 13 *b*.

Description :

Length	8 mm.
Width	1·75 mm.
Spiral angle (about) . . .	10°.

Shell small, slender, turrited; spiral angle nearly regular, apex but slightly obtuse. Number of whorls about twelve; apical whorls smooth; third whorl slightly costated; subapical whorls flat, not very closely defined by the suture, and ornamented by three granular spirals. The anterior whorls are turrited, and the spirals are four or five in number, and each row is studded with a series of circular tubercles, which are largest on the upper row. A slight failure in the third spiral may sometimes be noticed. There is no trace of axial (longitudinal) ornamentation.

Body-whorl rather less than one-third the entire length of the shell, and ornamented similarly to the whorls of the spire, base spirally striated but not granulated. Aperture restricted, subquadrate, with a relatively large and deeply notched canal, moderately reflexed.

Relations and Distribution.—The typical specimens are found in the Peagrit of the Cheltenham district, where they occur in two stages, viz. an apical portion without the turrited whorls, and the complete shell as above described. Lately I have received additional specimens, which serve to connect this species with *C. Beanii.*

A variety (or possibly another species) with a less acute spiral angle, but with very similar ornamentation, occurs in the Cephalopoda-bed at Frocester and also in the "Lower Limestone" of the Nailsworth district. Specimens of the latter, like nearly all fossils from the "Lower Limestone," are too much worn for figuring. Hence such fossils are only doubtfully referred to *C. pisoliticum.*

90. Cerithium (species). Plate IX, fig. 14.

Description :

Length	15 mm.
Width	5 mm.
Spiral angle	22°.

Shell subelongate, strongly turrited; spiral angle somewhat convex. Whorls nine to ten in number, flat, short, and increasing by gradations. The sculpture is very prominent, consisting of five spirals. The upper row is strongly tuberculated at frequent intervals, thus imparting to the shell a spinose appearance; the second and third rows are less strongly tuberculate, but the fourth is almost as strong as the first row; the fifth is feeble, like the second and third. The longitudinal ornaments are coarse and somewhat irregular on account of the unequal tuberculation of the spiral rows, the general effect of their decussating with the spirals being a coarse reticulation.

The body-whorl is barely one-third the entire height of the shell, and similarly ornamented; base somewhat depressed and spirally striated. Aperture ? subquadrate, with a well-marked anterior canal. Other indications wanting.

Relations and Distribution.—Resembles *C. Chapuiseum*, Piette ('Bull. Soc. Géol. France,' 2^{me} sér., vol. xiv, pl. v, fig. 40), from the Upper Bathonian of Rumigny. Also not unlike *C. Beanii*, but more rugose, and less pupæform. Very rare in the *Parkinsoni*-zone of the Castle Cary neighbourhood.

91. Cerithium turris, *Hudleston,* 1884. Plate IX, fig. 15.

1884. Cerithium turris, *Hudl.* Geol. Mag., dec. iii, vol. i, p. 61, pl. iii, fig. 13.

Description :

Length	13 mm.
Width	4·75 mm.
Spiral angle (mean)	20°.

Shell rather short, strongly turrited ; spiral angle somewhat convex Whorls about twelve in number, flat and short, suture close. The ornaments are conspicuous. Seven spirals are counted on the penultimate, consisting of wavy lines drawn out spirally, at considerable intervals, producing a sort of basket-like pattern. The longitudinals are strong, and close together, especially in the upper part of each whorl, but are on the whole irregular.

Aperture subquadrate to oval, with a well-developed anterior canal.

Relations and Distribution.—This is more widely angled and less pupoid than average specimens of *C. Beanii,* has a more complex system of ornamentation, and is more strongly turrited. Very rare in the Yorkshire Dogger.

92. Cerithium (species). Plate X, fig. 1.

Description.—Probable length 28 mm., width about one-fourth ; spiral angle about 18°, and tolerably regular. The shell is scarcely turrited. The upper half of the specimen is not sufficiently preserved for description. Whorls subtumid with very close sutures, the sutural angle being but little inclined. The ornaments consist of numerous fine spiral lines which are decussated at wide intervals by irregular nodular costæ, with a tendency to curve and incline from left to right. These costæ are usually the most developed anteriorly, and this causes the preceding whorl to project somewhat over the succeeding one—a feature the reverse of turriting. The number of the nodular longitudinals is about seven. Aperture ovate with indications of an anterior canal.

The specimen under consideration comes from the Inferior Oolite of Rodborough Hill, and was regarded by Lycett as a *Cerithium.* It has some resemblance to *C. variculosum,* Desl. (vol. cit., p. 210, pl. xi, fig. 46), a fossil of the Upper Lias of Fontaine-Ètoupefour.

The *Comma*-Group.

This name is applicable to a group of shells which are rare in the Inferior Oolite of this country, but not so unfrequent in the Bajocian of Normandy. There can be very little doubt that they are included by Deslongchamps (op. cit., pl. xi, figs. 64—66) as forming part of his var. *a*, "*Melania scalariformis,* Deshayes." The other part of var. *a*, viz. fig. 63, is the basis of *Cerithium subscalariforme*, D'Orb. As this name, then, has been used for quite a different species of *Cerithium*, we must fall back upon Münster's name. The forms described below as distinct species are probably little more than varieties; but as, owing to their rarity in England, the missing links are not forthcoming, I propose to describe some two or three different forms for which more or less appropriate foreign names may be found.

93. Cerithium comma, *Münst.*, 1844. Plate X, fig. 2.

1842. Melania scalariformis, *Desl.* (pars). Deslongchamps, Mém. Soc. Linn. Norm., vol. vii, pl. xi, fig. 64.
1844. Cerithium comma, *Münst.* Goldfuss, Petr., t. 173, fig. 14.
1850. Synonym Cerithium opis, *D'Orb.* Prod., vol. i, p. 271.

Bibliography, &c.—The following is the original description by Goldfuss: "Turrited, with twelve to fourteen whorls, quadrangular, subquadrate, beset in the upper part with numerous wrinkles. These wrinkles form at the suture elongated knots, and run off into feeble, somewhat crooked ribs, which split up, and terminate at the lower margin in a row of very fine knots. At one place are observed obscure traces of faint spiral lines." The length of this specimen was about 20 mm.

Description of an English specimen: Length 30 mm., width 9·5 mm. Spiral angle about 20°. Shell sharply turrited. Spiral angle regular, whorls numerous, about sixteen, flat or slightly concave, rather narrow, and increasing by steps. The spiral striæ are very fine and numerous; longitudinals bold and prominent on the posterior half of each whorl, having a spinous projection upon the upper border. About half way across the whorls the longitudinals become attenuated, usually bifurcating and curving from right to left, so as to give the appearance of a comma.

The body-whorl is less than one-third the total length of the shell; the ornaments are similar to those on the whorls of the spine; base finely striated; other indications wanting.

Relations and Distribution.—D'Orbigny relied upon the presence of the row of fine spiral knots at the anterior margins in the type *C. comma* to separate it from *C. opis.* If this be a valid difference, then our specimen should be called *C. opis.* But I regard the difference as more a question of preservation than anything else. This variety occurs in the upper part of the *Humphriesianus*-zone at Sherborne, where it is very scarce.

94. Cerithium comma, variety near to *C. unitorquatum*, Héb. and Desl. Plate X, fig. 3.

The step-like character is fully maintained in this variety. The chief differences are in the ornamentation. The longitudinal costæ are more nodular on the upper margin of each whorl, and bifurcate much higher up. The closeness of the tubercles gives the aspect of a narrow band on the upper margin of the whorls, which answers to the "cordon transversal étroit" of Hébert and Deslongchamps ('Foss. Montreuil-Bellay,' p. 41, plate vi, fig. 3).

This variety occurs in the *Parkinsoni*-zone of South Dorset—Bridport Harbour, Burton Bradstock, Vitney Cross, and Loders, but it is somewhat rare, and extremely difficult to extract in good condition.

95. Cerithium circe, *D'Orbigny*, 1850. Plate X, fig. 4.

1842. Melania scalariformis, *Desl.* (pars). Desl., vol. cit., pl. xi, fig. 66.
1850. Cerithium circe, *D'Orb.* Prod., vol. i, p. 271.

Bibliography, &c.—D'Orbigny's species is described as much elongated, and the whorls, which are step-like, as costulated transversely by arched ribs. This is the name applied usually in Calvados to the whole *comma*-group without any distinction. They are much more plentiful there than with us.

Description.—Length 32 mm., width 8·5 mm., spiral angle about 15°, and regular; whorls slightly concave, and increasing by steps, though slightly. The longitudinal ornament is conspicuous, consisting of close-set semilunar costæ, which extend entirely across the whorls. These are irregularly flexuous at times, but as a rule do not bifurcate; each terminates posteriorly in a tubercular thickening, which adds to the tabulate character of the whorls.

Body-whorl small relatively to the spire; aperture ? subovate, with a good-sized anterior canal.

Relations and Distribution.—The more slender spire, its less strongly tabulate character, and the continuity of the costæ without bifurcation, separate this species from other members of the *comma*-group. French specimens of *C. circe* are certainly more tabulate than the one figured, which is from the Inferior Oolite of Dorsetshire, and is the only one of the kind known to me as British.

The above constitute the *comma*-group as far as it is known to occur for certain in our Inferior Oolite. Thus restricted, it would be seen to be confined to the Upper Division.

96. Cerithium (species or variety). Plate X, fig. 5.

A *Cerithium*, apparently belonging to the *comma*-group, occurs very rarely in the Lincolnshire Limestone at Weldon. It is about 15 mm. long, extremely tabulate, and with concave whorls. The costæ are numerous, short, and confined to the posterior margin. But these conditions are not altogether reliable, owing to peculiarities of mineralization.

The body-whorl is angular, concave, and bicarinate; base rather depressed; aperture subquadrate, with a well-developed anterior canal.

The whorls are more concave than in *C. comma*, and the bicarination of the body-whorl is another marked feature of difference. As a temporary name we may distinguish this as *Cerithium commaoïdes.*

In some respects also this form leads up to a group of *Cerithia* with tabulate whorls and no axial ornamentation.

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97. Cerithium pergradatum, sp. nov. Plate X, fig. 6.

Description :

Length	20 mm.
Width	6·25 mm.
Spiral angle	18°.

Shell subelongate, conical, strongly turrited; apical conditions unknown. Whorls about twelve in number, flat or slightly excavated anteriorly, and increasing by steps so as to overlap the suture, which is channeled. A raised rim marks the posterior margin, which is spirally striated; plain spiral lines succeed, which are about six in number in the anterior whorls.

The body-whorl is about one-third the height of the entire shell, with ornaments similar to those of the spire; there is a faint rim at the base, which causes it to be very slightly carinate at either extremity. Base depressed and ornamented with numerous fine spiral striæ. Aperture almost quadrate. Columella short, with a considerable callus; anterior canal apparently small.

Relations and Distribution.—This form, or something very like it, occurs in several countries, and on more than one horizon of the Jurassic system. The nearest approach, so far as I am aware, is *Cerithium aptyxoides*, Gemmellaro, which has nearly the same spiral angle and general proportions, though not quite so "gradate." Moreover, Gemmellaro states that *C. aptyxoides* has a smooth surface ('Gemm. Faun. Giur.,' &c., p. 290, plate 23, figs. 10—12). *Cerithium gradatum*,[1] Hudl., from the Yorkshire Corallian, is also very similar ('Geol. Mag.,' dec. ii, vol. vii, pl. xvi, fig. 5), but this also is without ornament, though possibly the circumstance may have been due to conditions of mineralization.

Cerithium pergradatum occurs at Haselbury, possibly in the *Opalinus*-zone, and is extremely rare.

98. Cerithium (? species). Plate X, figs. 7 *a*, 7 *b*.

Description.—The length of specimens about 5 mm., spiral angle about 16°; shell subulate, spiral angle nearly regular. Whorls about ten in number, smooth and belted posteriorly, so as to form steps.

Body-whorl scarcely one-third of the total height of the shell, concave and slightly bicarinate. Aperture restricted, subquadrate, with a fairly well-developed anterior canal. The whorls in section are seen to be subcircular to ovate.

Relations and Distribution.—These little shells occur sparingly in the Lincolnshire Limestone. Being so small, it is possible that they represent the immature conditions of some other species, described or unknown. Simply as a name of convenience, and awaiting further evidence, I would call this "species" *C. "annulatum."*

99. Cerithium clypeus, sp. nov. Plate X, figs. 8 *a*, 8 *b*, 8′.

Description.—Length of an average specimen 24 mm., greatest breadth rather more than one-fourth of the length; spiral angle 16°. Shell elongate, turrited. Spiral angle nearly regular, sutures close. Whorls about fourteen, raised posteriorly by a belt which occupies the upper margin, nearly flat; the increase is by steps,

[1] This name will not stand, since it had been previously applied by Moore to a species of *Cerithium* in the Lias, which belongs to a different section of the genus.

though not very strongly marked. Fine spiral lines, somewhat wide apart, may be traced in well-preserved specimens.

Body-whorl scarcely one-third the entire length of the shell, almost smooth; aperture subovate? Whorls ovate in section. Other indications wanting.

Relations and Distribution.—This is a modified form of the "gradate" *Cerithia;* but how far these modifications are due to mineralization it is not easy to tell. Until we can gauge the measure of this element of uncertainty close comparisons are out of the question. Rare in the *Clypeus*-grit of Rodborough and in the *Parkinsoni*-zone of Aston.

The *Abbas*-Group.

One other group, provisionally referred to *Cerithium*, yet remains, consisting of elongate shells of considerable size, with closely fitting whorls spirally ornamented (or smooth), and ovate in section. The aperture is ovate-elongate, with a long anterior canal, more or less reflexed. The type of the group is *Cerithium abbas.* It is possible that some shells heretofore referred to *Fibula* may belong here. It may be regarded as a Nerinæoid group.

100. Cerithium attritum, sp. nov. Plate X, figs. 9 *a*, 9 *b*.

Description:

Length of a full-sized specimen . .	48 mm.
Width of same	12 mm.
Length of body-whorl to entire shell[1] . .	28° : 100.
Spiral angle	16°.

Shell elongate, scarcely turrited; spiral angle regular. Whorls about sixteen, flat in the posterior part of the spire, subtumid in the anterior portion. The width of a whorl is equal to its height *plus* the height of the preceding whorl. Slight traces of spiral lines or belts are noticeable in the earlier whorls, but not so in the later ones, which are smooth and subconvex.

Body-whorl relatively short, smooth, and subtumid. Aperture ? ovate, with a long anterior canal considerably reflexed. Whorls in section squarishly ovate.

Relations and Distribution.—The evidently rolled condition of all available specimens makes me rather cautious about instituting comparisons based on the external appearance of the shell. It clearly belongs to what I have ventured to call the Nerinæoid group of *Cerithia.* *Cerithium multivolutum*, Piette ('Bull. Soc.

[1] The canal is included in this measurement.

Géol. France, 2[me] sér., vol. 14 (1857), pl. v, fig. 16, &c., p. 547), has a certain resemblance. This species, according to Cossmann, has many synonyms ('L'Étage Bathonien,' p. 94), and is far from being uncommon in the Bathonian of North-East France. *C. attritum* is tolerably abundant at Weldon, but it is rare to find a specimen of the size figured.

101. CERITHIUM ABBAS, sp. nov. Plate X, figs. 10 *a*, 10 *b*, 10 *c*.

Description:

Length of a good-sized specimen . .	60 mm.
Width of same	14 mm.
Spiral angle	16°—18°.

Shell elongate, turrited; spiral angle regular. Whorls sixteen to twenty, flat, about twice as wide as high, suture close. The posterior whorls are not turrited, and increase as an elongated cone; lower down a shoulder is developed on the upper part of each whorl, which gives this part of the shell a turrited aspect. The ornaments consist of numerous spiral lines of unequal strength, thick or thin lines frequently alternating; towards the shoulder one or two lines are stronger than the rest, giving a slight appearance of a zone or girdle.

The body-whorl is sub-cylindrical, and with ornaments similar to those of the spire, except that in some specimens the rugosities due to increase are very strongly marked. The base is full, rounded, and finely striated spirally. Aperture ovate-elongate, with a considerable callus on the columella. Anterior canal well developed, elongate, and slightly reflexed. In section the whorls are ovate-elongate, both outer and inner walls being rather thick.

Varieties.—In some specimens the whorls, instead of being flat, are subconvex, and almost without any shoulder; in this variety the body-whorl is not so cylindrical (B). Not figured.

In another variety, which occurs at Beaminster, the conical outline of the earlier whorls is maintained throughout, so that there is no turriting whatever, the sutures lying in a sulcus or groove; there is also a slight belt at the anterior margin of each whorl (C). Almost a distinct species. Not figured.

Relations and Distribution.—Hitherto I have failed to find any species in the Inferior Oolite of Normandy which appears to possess any relationship to the shells above described. *Cerithium abbas* has been at times taken for a *Nerinæa*, and I believe that it has been so marked in collections. However, the longitudinal section shows that the resemblance to *Nerinæa* is external rather than internal. It is placed provisionally under *Cerithium* until a suitable genus is provided for it and similar shells. *Cerithium abbas* is tolerably abundant in the

Sowerbyi-bed at Bradford Abbas, and the variety C occurs on what is nearly the same horizon at Beaminster. It has occurred to me that possibly *Cerithium Lorieri*, D'Orb. (Prod., i, 271), from the Bajocian of the Sarthe might in some sense represent this species.

102. Cerithium polystrophum, sp. nov. Plate X, figs. 12, 13.

Description:

Length (estimated) . . .	55 mm.
Width	10·5 mm.
Spiral angle	14°.

This species so nearly approaches *Cerithium abbas*, var. B, that it is best described by comparison with that form. The shell is more uniformly subulate, having a narrower spiral angle; the whorls are all convex, the principal convexity being rather below the middle; there is no trace of a shoulder in any of them. The spiral striæ are very close, regular, and equal. In the earlier whorls (fig. 13) the ornaments consist of about half-a-dozen such striæ, those adjoining the sutures being slightly crenulate; in the mature whorls these lines increase in numbers till they are not far short of twenty.

The body-whorl is rather short in comparison with the entire shell; aperture ovate-elongate, with a well-developed anterior canal.

Relations and Distribution.—This fossil is rare in the Lincolnshire Limestone of Weldon. The condition of the few specimens is by no means satisfactory, so that its actual relations to *C. abbas* cannot be fully made out.

103. Cerithium obornense, sp. nov. Plate X, fig. 11.

Description:

Length (restored) . . .	60 mm.
Width	12 mm.
Spiral angle	15°.

Shell elongate, somewhat turrited; spiral angle regular. Whorls numerous, flat, and sub-concave, much broader than high, and slightly rising towards the sutures, which are bounded on either side by a raised rim, of which that on the lower side is the strongest. The ornaments consist of numerous fine spiral lines of somewhat unequal thickness, and they diminish somewhat in strength anteriorly.

The body-whorl is similarly ornamented, and is slightly angular; base full and striated spirally with a very fine pattern, which slightly decussates with axial lines. Aperture ovate-elongate; columella straight and but little encrusted; anterior canal produced.

Relations and Distribution.—Related to *Cerithium abbas*, var. C, this species is still more like a *Nerinæa*. A single specimen from the *Sauzei*-bed at Oborne.

Genus—FIBULA, *Piette*, 1857. 'Bull. Soc. Géol. France,' 2me sér., vol. xiv, p. 556.

The characters of this genus are not particularly well defined. Piette regarded it as something between a *Turritella* and a *Cerithium*. Lycett ('Suppl.,' p. 16) gives the following modified diagnosis: "A rounded, straight columella, with a rudimentary umbilical groove near the base, is combined with an arcuated outer lip, slightly notched posteriorly at the suture; the base of the aperture forms a slight canal at its junction with the anterior extremity of the columella, or in other instances there is no canal. . . . . The surface of the volutions is plain or slightly ornamented with oblique costæ." Piette's types were *Fibula undulosa* and *F. nudiformis*, to which Lycett added *Fibula variata*, Lyc., *F. eulimoides*, Whiteaves, and *F. phasianoides*, M. and L. All five are Great-Oolite species.

M. Cossmann ('L'Étage Bathonien,' p. 108, *et seq.*) more or less does away with *Fibula* by merging it in *Ceritella*, so that, according to this arrangement, *F. undulosa*, P., and *F. nudiformis*, P., become *Ceritellæ*.[1] Fischer regards *Fibula* as a subgenus of *Ceritella*. Whether *Fibula* is worth preserving as a genus or not it is eminently a Bathonian group; so also is *Ceritella*. Both are extremely rare in the Inferior Oolite of England. The two species which I now propose to classify under *Fibula* might possibly be allowed a place under *Cerithium*. The species in the Inferior Oolite which I regard as belonging to *Ceritella* have the body-whorl relatively longer and more approaching the cylindrical form.

104. FIBULA ANGUSTIVOLUTA, sp. nov. Plate XI, fig. 1.

Description:

Length	12 mm.
Width	4 mm.
Ratio of body-whorl to entire shell . .	30 : 100.
Spiral angle	25°.

[1] *Fibula Royssii*, d'Arch., comes under another category.

Shell elongate, conical, spiral angle regular; whorls ten to twelve, flat to subconvex, narrow, smooth; a slightly raised belt in the upper part of each whorl gives a faint appearance of turriting; suture close.

Body-whorl rather short, subtumid, rounded, and smooth. In some specimens there is a slight indication of an umbilicus; columella short and straight. Aperture subquadrate, with a thin rounded outer lip and a square base strongly notched at its junction with the columella.

Relations and Distribution.—The small size of all specimens hitherto found may be deceptive, since Gasteropoda in the Lincolnshire Limestone are usually small. The narrowness of the whorls seems to distinguish it from any other species hitherto referred to *Fibula*. Somewhat rare in the Lincolnshire Limestone at Weldon.

105. Fibula canina, *Hudleston*, 1884. Plate XI, figs. 2 *a*, 2 *b*.

1884. Cerithium (?) caninum, *Hudl.* Geol. Mag., dec. iii, vol. i, p. 107, pl. iv, figs. 1 and 2.

Description:

Length of a large specimen . . .	51 mm.
Width	21 mm.
Ratio of body-whorl to entire shell . .	35 : 100.
Spiral angle	32°.

Shell subelongate, conical, with perhaps a rudimentary umbilicus; spiral angle regular. Whorls about ten, smooth, somewhat tumid towards the centre, and separated by a suture of moderate depth. Wavy longitudinal lines, apparently lines of growth, are seen in some specimens.

Body-whorl rather more than one-third the total height of the shell, rounded, and smooth; aperture quadrate, with some traces of an anterior notch. Other indications wanting.

Relations and Distribution.—When one has to deal with a doubtful species it is as well to place it in a doubtful genus. The nature of the matrix may have somewhat modified the available specimens. The number of whorls seems to be few for such large shells. *F. canina* has some resemblance to *Fibula* (*Chemnitzia*) *phasianoides*, M. and L. (pl. ix, fig. 5), whilst it has less resemblance to the types of Piette. We are also reminded of *Fibula Gastaldi*, Gemm., ('Faune Giuresi,' p. 281, pl. 22, fig. 55). Rare in the Yorkshire Dogger.

Genus—Ceritella, *Morris and Lycett*, 1851.

"*Shell turrited, spire acute, subulate, volutions flattened, their margins usually sulcated; the last whorl large, aperture lengthened and oblique, canal very short; columella smooth, rounded, and slightly reflected at the base; outer lip thin.*"—'Gt. Ool. Moll.,' p. 37.

This is so essentially a Bathonian genus that it is hardly necessary to say much regarding it in this Memoir. It is well known that Piette in 1856–57 ('Bull. Soc. Géol. France,' 2me sér., t. 13, p. 592, and t. 14, p. 558) constituted the genus *Tubifer* to receive a group of shells from the Bathonian of the Ardennes, which are, on the whole, very similar to the *Ceritellæ* of Morris and Lycett. Fischer ('Manual,' p. 684) regards *Tubifer* as a subgenus of *Ceritella*, having the form of an *Actæon*, the last whorl cylindrical and strongly developed. Cossmann (op. cit., p. 108) does not regard *Tubifer* as being even a subgenus.

In the Great Oolite of Minchinhampton, where alone *Ceritellæ* can be regarded as at all abundant, two very distinct sections may be noted, viz. species which have the shell perfectly smooth, such as *C. unilineata* and *C. Sowerbyi*, and those which are sculptured longitudinally as in *C. conica*. An impressed line on the shoulder of the whorls is a frequent characteristic of the smooth species, but appears to be absent in *Ceritella acuta*.

In the Inferior Oolite of this country *Ceritella* is extremely rare, and none of the forms attain even to the size of the little shells from Bathonian beds. Lycett ('Proc. Cottes. Nat. Club,' vol. i, p. 80, pub. 1853) describes *Ceritella sculpta* and *Ceritella tumidula* from the Inferior Oolite of Gloucestershire. These I have not seen, nor are they mentioned in the lists of the 'Handbook to the Cotteswold Hills' published in 1857. As far as my present opportunities extend I have not been able to determine any species of *Ceritella* from the Inferior Oolite of the Cotteswolds, though there are some small forms in the "Lower Limestone" of the Stroud-Nailsworth district which rather suggest this genus, but these are too imperfect for description. However, since the physical resemblance of these beds to the Minchinhampton beds is considerable, we may expect to find *Ceritella* in them. The Lincolnshire Limestone seems to be the only part of the Inferior Oolite which has hitherto yielded *Ceritella*. A few specimens have been found at Weldon and at Ponton. These most resemble the smooth species with sulcated margins, such as *C. Sowerbyi*. The body-whorl is cylindrical, and the general aspect of the shells so much like that of certain forms of *Nerinæa* that it has been found necessary to cut sections for the purpose of ascertaining the internal structure. With considerable variety as to width there seems too much general resemblance to constitute more than one species.

106. Ceritella Lindonensis, sp. nov. Plate XI, figs. 3 *a*, 3 *b*, 4.

Description.—Length from 8—10 mm., with an average width of about three-eighths of the height, but varying considerably; mean of spiral angle about 30°. Shell turrited, apex acute; whorls about eight, flat, smooth, and increasing suddenly by steps; shoulder somewhat sloping, marked with a spiral line below the suture, producing a sort of zoned appearance in some specimens.

Body-whorl large, fully equal to half the entire length of the shell, smooth, cylindrical, slightly constricted in the centre, and rounded at the base. Columella long, slightly arcuate, and reflexed; aperture elongate, and anteriorly oblique, terminating in a sort of tube which has very much the appearance of a canal. In section the outer wall of the whorls is perfectly smooth, but a slight tendency to a fold may be noticed on the columellar side.

Relations and Distribution.—The impressed line on the shoulder, the large relative size and cylindrical shape of the body-whorl, clearly distinguish this species from *C. acuta*, M. and L. It is much more nearly allied to *C. Sowerbyi*, M. and L. Indeed, there are specimens in the Great Oolite of Minchinhampton which can hardly be said to differ from some of those in the Lincolnshire Limestone. But *C. Sowerbyi*, as figured and described, has not the body-whorl quite so cylindrical or so large. In fact *C. Sowerbyi* is not quite so like a *Nerinæa*.

The varieties of *C. Lindonensis* are considerable. Figs. 3 *a*, 3 *b*, represent a front view and a section of a short stout form, which might lead to a different species. It is rare. Fig. 4 represents an unusually large specimen of the more prevailing form, which occurs sparingly at Weldon. The small, slender forms from Ponton are almost identical with *C. Sowerbyi*. Indeed, the less completely developed specimens, whether from Ponton or from Weldon, are not to be distinguished from ordinary forms of the Great-Oolite species.

Genus—Exelissa, *Piette*, 1861, 'Bull. Soc. Géol. France, 2^{me} sér., t. 18, p. 15; = Kilvertia, *Lycett*, 'Supplement,' pp. 15 and 93.

"*Shell small, narrow, subcylindrical, somewhat pupæform; whorls numerous, ornamented with longitudinal ribs, tuberculated or spinous; last whorl contracted at the base, with a tendency to detach itself from the axis; aperture orbicular, entire, with lips elevated, prominent, slightly thickened; columella solid.*"—Fischer.

With few exceptions, the above is the original diagnosis of *Kilvertia*, which was so well formulated by Lycett, although Piette's name appears to have the priority. Fischer places this genus with a query under the Cerithiidæ.

These curious little shells are by no means abundant. *Exelissa numismalis* is described by Tate from the Lower Lias. The ornaments of this species are not very characteristic, and, as usual with Lias specimens, the character of the aperture is not well-defined. Four species were recognised by Lycett in the Great Oolite, one of which, *Ex. strangulata*, D'Arch., is regarded as the type of the genus. All four are recorded by Cossmann as occurring in the Bathonian of France.

In the Inferior Oolite of this country there are three if not four species of *Exelissa*, two of which are closely allied to, and possibly in one case identical with, Bathonian species.

107. Exelissa strangulata, *D'Archiac*, 1843, Inf.-Ool. Varieties. Plate XI, figs. 5 *a*, 5 *b*, 6.

1843. Cerithium strangulatum, *D'Arch.* Mém. Soc. Géol. France, t. v, p. 382, pl. xxxi, figs. 1 *a*, *b*.
1851. — — — Morris and Lycett, Great Ool. Moll., p. 31, pl. ix, fig. 18.
1863. Cerithium ? (Kilvertia) strangulatum, *D'Arch.* Lycett, Suppl., pp. 8 and 94, pl. xliv, fig. 2.

Bibliography, &c.—Lycett's figure in the 'Supplement' is good, showing the straight, thick ribs characteristic of this species. He says (p. 8): "The present specimen, which agrees more nearly with the example figured by D'Archiac, has *seven* longitudinal costæ, which are conspicuous even to the base."

Var. Pisolitica (figs. 5 *a*, 5 *b*).

Length about same as in specimens of *Ex. strangulata* from Eparcy (8 or 9 mm.), figure rather more slender, and apex less obtuse. The ornamentation differs considerably. In the var. *pisolitica* the longitudinal costæ are not quite so regular, and straight; moreover the granulations of which the costæ are built up are larger and about half as numerous; they correspond in fact to four or five spiral lines on each whorl instead of at least eight as in *Ex. strangulata*. The contracted, pupæform aperture, with its prominent lips, is alike in both; but this, of course, is a generic feature.

This variety occurs rarely in the lower part of the Inferior Oolite of the Cotteswold, and chiefly in the Pea-grit.

Var. Ovalis (fig. 6).

About 8 mm. in length, this variety is broader than typical specimens from

Eparcy; the apex also is somewhat more obtuse. The ribs are wider apart, the last whorl somewhat less constricted, and the aperture less filled up, and not quite so circular. There are eight costæ, which are decussated by about as many fine spiral lines. This variety differs from the type exactly in the opposite direction to *Ex. pisolitica*, but is, on the whole, nearer to the Great-Oolite forms.

Rare in the Lincolnshire Limestone of Weldon, where poorly preserved specimens are difficult to distinguish from bad specimens of *Cerithium subcostigerum.*

108. Exelissa pulchra, *Lycett*, 1863. Plate XI, fig. 7.

1863. Kilvertia pulchra, *Lycett.* Suppl., pp. 10 and 94, pl. xliv, fig. 4.

The following is Lycett's description: "Shell small, thick, elongately turrited (?); volutions eight, convex, the sutures deeply impressed; transverse (*i. e.* axial) costæ about twelve in each volution, oblique, large, decussated, and rendered nodulous by six narrow encircling lines; . . . . the figure of the aperture in shells of the same size presents some variability, the typical suborbicular figure becomes subquadrate, and in other instances is somewhat pointed at the two extremities, but in the young condition apparently the aperture is always orbicular."

As I have not had an opportunity of seeing specimens of *Ex. pulchra* either from the Great Oolite of Minchinhampton or from the Forest Marble of Laycock, there may be room for doubting the present identification. But certain shells from the Lincolnshire Limestone at Ponton answer very well to Lycett's figure and description. This case affords another instance of the resemblance in Ponton fossils to Bathonian forms.

109. Exelissa Weldonis, *Hudleston*—Correction of name. Plate XI, figs. 8 *a*, 8 *b*.

1884. Cerithium (Kilvertia) Comptonense, *Hudl.* Geol. Mag., dec. iii, vol. i, p. 62, pl. iii, fig. 14.

Bibliography, &c.—By inadvertence this species, so characteristic of the Lincolnshire Limestone of Weldon, received the specific name of "*Comptonense.*"

Description.—Length about 6 mm., width less than one-third of the length. Shell pupæform; whorls six to eight, sutures not very distinct in the spire. The ornaments are more conspicuous spirally than longitudinally. In the majority of specimens are three spirals, the upper and lower of which, but sometimes all three, are distinguished by large oval granulations, drawn out spirally, but arranged so as to form the axial costæ of the spire. In the body-whorl the oval granulations are sometimes lost. Body-whorl much constricted anteriorly, and not unfrequently showing a tendency to detach itself. Aperture small, thickened, and orbicular.

Relations and Distribution.—This species was originally described from a specimen obtained from the Millepore Rock of the Yorkshire coast, which differs in some details from Weldon specimens. It is more slender than *Ex. strangulata*, besides differing very much in ornamentation. The large oval granulations and general coarseness of the spiral lines completely distinguish this species from *Ex. pulchra* and *Ex. formosa*.

110. Exelissa Normanniana, *D'Orb.*, 1850. Plate XI, fig. 9.

1850. Cerithium Normannianum, *D'Orb.* Prod., i, p. 271.

Bibliography, &c.—D'Orbigny describes his species as near to *C. contortum*, but shorter and provided with seven longitudinal rows of costæ. It occurs at Bayeux. By the kindness of Prof. Eugene Deslongchamps I possess a specimen from the "Oolite ferrugineuse," thus identified. It is barely 12 mm. in length, and is pupæform, so that its resemblance to *C. contortum* is very slight indeed. It has seven longitudinal rows of costæ, as stated by D'Orbigny. Whether it should be referred to *Exelissa* or to *Cryptaulax* is not quite clear. The small size and pupoid shape are in favour of the former view, whilst the ornaments are more those of *Cryptaulax*. No perfect aperture has been seen by me.

Description.—Length about 10 mm., width two-fifths of the length. Shell pupæform. Number of whorls about eight, polygonal, and well separated by the suture, the last whorl narrowing towards the base. Ornaments rugose; regarded longitudinally, *i. e.* in the direction of the axis, there are eight rows of costæ, the spirals in each whorl being three in number, and grossly tuberculated for so small a shell, especially as regards the first and third spirals. Columella short and encrusted by the peristome, which is subcircular and situated in the base of the shell. Other indications wanting.

Relations and Distribution.—In size, shape, and details of ornamentation, English specimens agree fairly well with those from Bayeux, the chief difference being that there are eight rows of costæ instead of seven.

It may be that this rugose little species serves to form a connecting link between *Exelissa* and *Cryptaulax*. Before deciding we await better specimens; both *Exelissa* and *Cryptaulax* are very tender in the mouth.

Occurs at Stoford, Burton Bradstock, and Grove—in the *Parkinsoni*-zone.

Genus—Cryptaulax, *Tate,* 1869, 'Ann. and Mag. Nat. Hist.,' ser. 4, vol. iv, p. 418; = Pseudocerithium, *Cossmann* (at least in part), 1884, 'L'Étage Bath.,' p. 124.

Shell elongate, pointed, with a more or less polygonal spire, ornamented with longitudinal ribs, which succeed each other with a twist from left to right—a feature more conspicuous in some species than in others. Suture wide, columella short, aperture suborbicular to ovate, with little or no anterior canal. Peristone entire, and broadly reflexed on the inner side—a shallow, oblique, posterior canal in the angle formed by the body-whorl and outer lip. (Tate's diagnosis somewhat modified.) *Type*, C. tortilis, *H. and D.*

Cossmann (op. cit.) gives a somewhat similar diagnosis as regards the shell, but does not mention the concealed posterior canal as one of the features of his genus, *Pseudocerithium*, the type of which he takes to be *Cerithium undulatum*, Quenst.

It may be that *Cryptaulax* and *Pseudocerithium* are not exactly synonyms, though M. Cossmann is now disposed to regard them as such. If we allow that they are synonyms, the genus *Cryptaulax* certainly will cover shells which present considerable differences.

Cryptaulax occurs most abundantly in the *Parkinsoni*-zone, and is mainly confined to No. 1 District. No species, either from the Lincolnshire Limestone or from Yorkshire, has hitherto come under my notice.

111. Cryptaulax scobina, *Deslongchamps,* 1842. Plate XI, fig. 10.

1842. Cerithium scobina, *Desl.* Mém. Soc. Linn. Norm., vol. vii, p. 196, pl. x, fig. 49.
1867. — varicosum, *Desl.* Moore, Middle and Upper Lias, p. 83, pl. iv, fig. 15.
1869. Cryptaulax scobina, *Desl.* Tate, Ann. Mag. N. H., ser. 4, vol. iv, p. 418.

Bibliography, &c.—Originally described from a single specimen in the Upper Lias of Fontaine-Étoupefour. Moore obtained four examples from the highest horizon of the Ilminster Upper Lias; these he referred inadvertently to *Cerithium varicosum*, Desl. Tate pointed out the mistake.

Description:

Length	17 mm.
Width	5 mm.
Spiral angle	18°.

Shell elongate, but slightly turrited; spiral angle nearly regular. Whorls about twelve, flattish, sutures wide but varying. Each whorl is ornamented by three strong nodular spirals, of which the two posterior are somewhat removed from the third, the centre one being usually the weakest, an indistinct fourth spiral line may sometimes be noticed. The longitudinals are prominent, and extend throughout the shell in an almost continuous series with a twist from left to right.

Base depressed and marked with three spiral lines. Aperture confined, and suborbicular, with a considerable callous deposit on the columella, which is extremely short. Other indications wanting.

Relations and Distribution.—The above description is sufficiently near to the original diagnosis of Deslongchamps to leave little doubt that this is at least a variety of *C. scobina*. It occurs very rarely in the Inferior-Oolite Sands, the figured specimen being described by the late Mr. Witchell as from "the base of the Sands, Nailsworth." Tate, on the authority of Lycett, speaks of *C. scobina* from the "Upper-Lias Sands, Upper zone, Nailsworth." It is related to *Cryptaulax tortilis*, H. and D., which may be regarded as the generalised representative of the group on several horizons. *Cryptaulax scobina* also occurs towards the base of the Yeovil Sands at East Cliff, near Bridport Harbour.

112. CRYPTAULAX TORTILIS, *Hébert and Deslongchamps*, 1860. Plate XI, figs. 12 *a—c*.

1860. CERITHIUM TORTILE, *H. and D.* Foss. Montreuil-Bellay, p. 39, pl. vi, figs. 1, *a—e*.

1884. Cf. also EXELISSA TORTILIS, *H. and D.* Cossmann, Étage Bathonien, p. 123, pl. xiv, fig. 46.

Non CERITHIUM TORTILE, *Eudes Deslongchamps.* Mém. Soc. Linn. Norm., vol. vii, p. 200, pl. xi, fig. 15.

Bibliography, &c.—The authors observe that this species might almost be ranked with the Turritellas. They make the diagnosis very comprehensive so as to include a number of varieties. It is thus that *Cryptaulax tortilis* comes to have a wide range both in time and space. Originally described from the Callovian of Montreuil-Bellay, where it attains a length of about 14 or 15 mm., a variety of it about 10 mm. in length, with only three spirals, occurs at Hutka[1] in Poland, on what is stated to be the same horizon. The subjoined description refers more especially to varieties occurring in the Inferior Oolite of England.

Description:

Length	15 mm.
Width	$4\frac{1}{2}$ mm.
Spiral angle	15°—17°.

[1] Specimens from this locality are in the Museum of the Geological Society of London.

Shell elongate, turrited, apex sharp; spiral angle regular; sutural sulcus wide. Whorls eight to ten, short, subpolygonal; apical whorls more turrited in some specimens than the anterior ones. The ornaments consist of from three to four spinous or tuberculated spiral belts, of which the two outer ones are always the strongest. The costæ are from ten to twelve in number, and only moderately twisted, in some varieties scarcely at all; usually the costæ are not very prominent.

Body-whorl about one-fourth of the total height of the shell, in some specimens slightly constricted anteriorly; base depressed and spirally striated. Aperture suborbicular, columella short and strongly encrusted. In some specimens there are indications of the groove at the posterior angle.

Varieties.—Fig. 12 *a* represents a specimen, from the *Parkinsoni*-zone of Aston, with four closely set spirals, and costæ nearly straight and numerous. Fig. 12 *b* is a specimen from the same horizon and locality with three spirals. This might be almost called "*triarmatum.*" Fig. 12 *c* is a specimen from the highest part of the *Humphriesianus*-zone at Oborne. This is longer than usual, possesses four spirals; and the costæ are not quite so close; they are also more twisted. Fig. 11 represents a form apparently intermediate between *C. tortilis* and *C. scobina.*

Relations and Distribution.—If we accept all the varieties above enumerated as belonging to one species then it is somewhat difficult to see why *Crypt. scobina* should not be included. The longitudinal costæ in the latter species are less numerous, and the ornaments less close.

As regards distribution, *Cryptaulax tortilis* in this country is principally confined to the higher zones of the Inferior Oolite. Besides the localities already mentioned it is met with in the *Parkinsoni*-zone at Grove. Aston and Notgrove are the points farthest north where any of its varieties have come under my notice.

113. Cryptaulax papillosa, *Deslongchamps*, 1842. Plate XI, fig. 13.

1842. Cerithium papillosum, *Desl.* Mém. Soc. Linn. Norm., vol. vii, p. 209, pl. xi, figs. 42—44.

Bibliography, &c.—Described from a single specimen of the "Oolite ferrugineuse," Bayeux; considerably smaller than the specimen described below.

Description:

Length	14 mm.
Width	5 mm.
Spiral angle	20°.

Shell subelongate, rugose; spiral angle nearly regular. Whorls about ten, short, and separated by a wide sutural sulcus. The ornaments consist of two very strong spiral bands, which are grossly nodular (papillæ) at the intersection with the longitudinal costæ. These latter are seven or eight in number, and but slightly interrupted; the amount of inclination or twist is very slight.

Body-whorl small; base depressed and marked with strong spiral lines. Aperture suborbicular, with a short and thickly encrusted columella; indications of the groove or furrow at the posterior angle.

Relations and Distribution.—Distinguished by its very coarse tuberculation, and by having only two spiral bands. A single specimen from the *Parkinsoni*-zone of Grove.

114. Cryptaulax, cf. undulata, *Quenst.*, 1858. Plate XI, fig. 14.

1858. Cerithium undulatum, *Quenst.* Der Jura, p. 488, t. 65, fig. 24.
1860. Turritella undulata, *Quenst.* Héb. and Desl., Foss. Mont.-Bellay, p. 49, pl. vii, figs. 13, *a—c*.
Cf. also Cerithium hystrix, *Desl.* Mém. Soc. Linn. Norm., vol. vii, p. 195, pl. x, fig. 47.

Bibliography, &c.—*T. undulata* was very doubtfully described as a *Turritella* by Hébert and Deslongchamps, who remark that it has some resemblance to *Cerithium hystrix*, Desl. In the latter, they say, the whorls are more concave, the spiny tubercles of the anterior and posterior spiral belts (cordons) are more numerous, whilst the costæ do not form a regular longitudinal series, but suffer interruption.

Description.—Probable length 40 mm.; spiral angle about 12°. Whorls numerous, polygonal, widely separated by the sulcus of the suture. Each whorl possesses a pair of prominent spiral bands or keels near the sutures; numerous fine spiral lines occupy the intermediate area. The costæ are stout, wide apart, and extend nearly from suture to suture, but are irregular in sequence. They are about six in number. At the points where the costæ decussate with the two spiral bands are very spiny tubercles, which give a rough aspect to the shell. Other indications wanting in English specimens.

Relations and Distribution.—The species to which I now draw attention is very rarely found in the *Parkinsoni*-zone of South Dorset, and hitherto only in fragments. It is probably intermediate between *C. hystrix* and *C. undulata*. The former occurs somewhat rarely in the Bajocian of Normandy.

115. Cryptaulax contorta, *Deslongchamps*, 1842. Plate XI, figs. 15 *a*, 15 *b*, 15 *c*.

1842. Cerithium contortum, *Desl.* Mém. Soc. Linn. Norm., vol. vii, p. 194, pl. x, fig. 44.

Bibliography, &c.—A fossil of the "Oolite ferrugineuse" of Les Moutiers and Bayeux, where it is by no means rare.

Description :

Length of a fair-sized specimen . .	40 mm.
Width	$7\frac{1}{4}$ mm.
Length of body-whorl to entire shell .	22 : 100.
Spiral angle	11°.

Shell subulate, turrited, apex very sharp; spiral angle regular. Whorls numerous, pentagonal, subconcave, and separated by a broad sutural sulcus. The ornaments consist of two stout spiral bands at each extremity, enclosing one or two which are less prominent; between these bands are fine spiral lines or striæ. There are five prominent longitudinal costæ twisted from left to right, and producing at the points of intersection blunt tubercles drawn out spirally. In the posterior whorls the costæ are for the most part in sequence, but anteriorly this line becomes irregular and dislocated.

Body-whorl relatively short, base very flat, and spirally striated. Aperture suboblong, columella short; inner lip circular, outer lip angular, especially at the junction with the body-whorl, where indications of the furrow may be noticed. Whorls in section ovate-oblong.

Relations and Distribution.—The strongly pentagonal outline of the spire, besides minor differences of ornamentation, serve to distinguish *Cryptaulax contorta* from the species last described. Both of them belong to what I may term the Turritelloid section of *Cryptaulax*. They also more especially answer to Cossmann's genus "*Pseudocerithium*," which is represented in the Bathonian of France by *Pseudocerithium densistriatum*, Cossmann. Both sections of *Cryptaulax* are unrepresented in the Great Oolite of this country. On the whole, it would seem that *Cryptaulax contorta* and its allies might just as well be placed under the Turritellidæ as under the Cerithiidæ.

Cryptaulax contorta, in this country, seems confined to the *Parkinsoni*-zone, or to the very highest beds of the *Humphriesianus*-zone, such as the *Cadomensis*-bed at Oborne. It is especially abundant in P_1 at Burton Bradstock, Vitney Cross, &c., and occurs on the same horizon at Stoford and at Grove, all in No. 1 district.

It has been traced in the Cotteswolds (No. 2 district) as far as Horton Hill (Sodbury), where it occurs in the equivalents of the Upper *Trigonia*-grit. North of this point it has not hitherto been obtained.

Genus—CERITHINELLA, *Gemmellaro*, 1878. 'Faune Giuresi,' &c., p. 282.

Shell subulate, conical-elongate, subcylindrical; whorls numerous, nearly flat, the surface puckered and ornamented with spiral lines. Aperture quadrangular, with a very short anterior canal.

The shells described by Gemmellaro under *Cerithinella* are extremely elegant in form, being externally not unlike some of the more cylindrical Nerinæas, though internally the arrangement is quite different. The spiral system of ornamentation predominates. He describes and figures eight species from the crystalline Limestone of Montagne del Casale in Sicily, which appears to be of Liassic or Lower Oolite age.

We have in the Lower Division of our Inferior Oolite a few extremely elegant Nerinæoid fossils, which display considerable resemblance to the Cerithinellæ of Gemmellaro. The chief difference consists in the sutural sulcus being more open in the majority of our specimens. The group also occurs in the Lias, where it is represented by such forms as *Cerithium confusum*, Tate ('Geol. Mag.,' 1875, p. 205), described from the *Spinatus*-zone of the neighbourhood of Banbury. Probably also some of the so-called *Turritellæ* of the Lias might be referred here. If I am right in classifying our fossils under *Cerithinella*, the genus is perhaps more nearly allied to the Turritellidæ than to the Cerithiidæ. Placed by Fischer provisionally in the latter family.

116. CERITHINELLA BAJOCENSIS, sp. nov. Plate XII, figs. 1 *a*, 1 *b*, 2, 3.

Description:

Length (estimated) . . .	35 mm.
Width	7 mm.
Spiral angle	10°—12°.

Shell subcylindrical, somewhat turrited; spiral angle slightly convex at first, afterwards regular. Number of whorls eighteen to twenty, constricted rather below the middle, rising slightly towards the sutural sulcus. The subapicals have two nodular spiral belts, the posterior being the most prominent, and exhibiting short, thick costæ. Beyond this point the ornaments vary considerably within certain limits. The upper spiral belt becomes a complex zone made up of several spiral lines more or less undulating, which decussate with a system of numerous short nodular costæ; about three spiral lines without any decussation occupy the lower and more constricted portion of the whorl, which is terminated by a nodular spiral belt, representing the lower of the two belts in the earlier whorls. The above description only applies to very fully developed specimens.

Body-whorl short, concave, and similarly ornamented; base depressed and somewhat excavated, marked with strong spiral lines. Aperture small, sub-oblong, and somewhat constricted anteriorly. Anterior angle strongly marked, but with scarcely any canal. A slight incrustation of the inner lip.

Varieties.—With the above I associate provisionally two varieties, one of which (fig. 2) occurs in the "Dew-bed" of Bradford Abbas. The proportions are nearly the same, except that the body-whorl is somewhat shorter relatively. The shell itself is more turrited and the whorls rather more angular; the ornaments also are less rich, the number of spirals especially being fewer. Altogether it is a less well-developed variety. I propose to distinguish this as var. *drosera*. The specimen is unique.

The other variety (fig. 3) is from the neighbourhood of Beaminster, and occurs, no doubt, on one of the lower horizons. The whorls are not angular, and are separated by a very wide and shallow sutural sulcus. There is no turriting in the sense of the succeeding whorls projecting beyond the preceding ones. The ornaments are less elaborate; the short costæ in the posterior part of each whorl are simpler, and have a decided twist from left to right. The specimen, which is unique, exhibits an almost imperceptible fold in the outer lip, as in *Nerinæa*. This I propose to distinguish as var. *melitta*.

Relations and Distribution.—But little more can be said at present on the score of affinities. These beautiful shells are very scarce and never perfect. Excluding the two varieties already named, the *Sowerbyi*-bed of North Dorset alone has yielded these fossils.

117. Cerithinella Brodiei, sp. nov. Plate XII, figs. 4 *a*, 4 *b*.

Description :

Length about	30 mm.
Width	6 mm.
Spiral angle about	10°.

Shell subcylindrical; whorls numerous, angular, varying from subconvex to subconcave, sutural sulcus wide. The ornaments undergo considerable modification. Apical whorls unknown. Towards the middle of the spire the posterior margin of each whorl carries a single row of roundish tubercles, below which is a slight constriction, and then a convex zone made up of undulating spirals decussating with short costæ. In the anterior whorls a considerable change takes place; the whorls become concave, and instead of costæ a single row of tubercles occurs at each extremity, the spiral ornaments remaining the same.

The body-whorl is relatively small, angular, and with a base which is depressed and slightly excavated towards the centre. Aperture restricted anteriorly, sub-oblong, columella short, outer lip slightly constricted.

Relations and Distribution.—This is the most cylindrical of the several forms described from the Inferior Oolite. It also differs considerably in the details of ornamentation from *C. Bajocensis.* In other respects it must be regarded as closely approximating to that species. When comparing it with species from the Lias of Sicily it seems to resemble *Cerithinella elegans*, Gemm. (op. cit., p. 285, pl. 23, fig. 34). Fig. 4 *a* represents the type-specimen obtained by Mr. Brodie from the Leckhampton Freestones. Fig. 4 *b* represents either a variety, or the earlier stage before the whorls become concave; it was collected by Lycett from the Inferior Oolite of Nailsworth.

Fig. 5 represents the anterior whorls of a larger shell, somewhat modified by mineralization from the *Murchisonæ*-zone of Stoford. This last may represent the maturer condition of *C. Brodiei;* or, what is more probable, of *C. Bajocensis*, var. *drosera.*

PSEUDALARIA, genus novum.

Testâ subelongatâ, conicâ, acutâ. Anfractibus spiraliter striatis, in medio vel sub medio carinatis, carinis sæpe crenulatis; ultimo anfractu bicarinato. Aperturâ quadratâ, anticè et posticè subcanaliculatâ; labro dextro sinuato.

The above generic diagnosis is practically that given by Deslongchamps in describing *Turritella unicarinata* (vol. cit., p. 151, pl. xi, fig. 68), said to occur in the Oxford Clay of Dives. *Turritella Guerrei*, Héb. and Desl. (op. cit., p. 46, pl. vi, fig. 6), from the Callovian of Montreuil-Bellay, is a somewhat narrower form. Cossmann (op. cit., p. 229, pl. v, fig. 15) describes a still narrower variety of *T. Guerrei* from the Bathonian of Le Wast.

The latter author observes that *T. Guerrei* might almost as well be an *Alaria* as a *Turritella*, since the double keel reminds us so much of the former, though the form of the aperture removes it completely from *Alaria.* He suggests a change of genus. Undoubtedly the spire has a remarkable resemblance to some of the didactyl Alarias, such as those of the *trifida*-group. The form of the aperture is peculiar and suggestive of *Potamides*, as was justly observed by Hébert and Deslongchamps. But in the modern *Potamides* there really is a canal, whilst in *Pseudalaria* there is little more than the semblance of one. Bearing in mind that both M. Cossmann and the late Mr. Tawney have borne testimony to the resemblance of these shells to *Alaria*, the name selected for the genus is not altogether inappropriate. Whether it should be placed under the Cerithiidæ or the Turritellidæ is not quite clear. The existence of a sort of posterior canal is in favour of the former view.

118. Pseudalaria Etheridgii, *Tawney*, 1873. Plate XII, figs. 6 *a*, 6 *b*, 6 *c*, 7, 8.

1873. Alaria Etheridgii, *Tawney.* Dundry Gasteropoda, p. 14, pl. i, fig. 7.
Cf. also
1842. Turritella unicarinata, *Desl.* Mém. Soc. Linn. Norm., vol. vii, p. 151, pl. xi, fig. 68.
1844. Cerithium concavum, *Münst.* Goldf., Petrifacta, t. 173, fig. 16.

Bibliography, &c.—A single specimen from "Yeovil," *i. e.* from the Inferior Oolite of Bradford Abbas, was all the material available for Mr. Tawney, who was evidently unaware of the true nature of the aperture. *Cerithium concavum*, M., from the "Unter-Oolithe" of Rabenstein, has considerable resemblance. Moreover, Münster's species has crenulated carinæ, which is the case with *Pseudalaria Etheridgii*, though the fact was not noticed by Mr. Tawney.

Description :

Length	20 mm.
Width	8 mm.
Length of body-whorl to entire shell . .	37 : 100.
Spiral angle	24°.

Shell conical, sharp; whorls about ten, angular, spirally striated, and provided with a very large keel, which is nearly median, sharp, and crenulate. A rudimentary second keel is partly exposed in the penult. Just below the suture in each whorl is a beaded band.

The body-whorl is rather more than one-third the total height, and bicarinate, the anterior carina being quite equal to the other as it approaches the outer lip. Base flattish, and marked with spiral lines of considerable prominence. Aperture quadrate, outer lip sinuous and effuse, base very square, forming at its junction with the extremity of the columella an angular recess in imitation of a canal. There is also a short posterior canal. In section the earlier whorls are very similar to those of keeled *Alariæ*, having about the same spiral angle, but in the later whorls the section is more inclined to be quadrate, giving evidence of the absence of preparations for the anterior canal.

Varieties.—A variety from near Beaminster (fig. 7) is rather more squat in figure, has the keel somewhat lower down, and does not expose the rudimentary lower keel in the penult to such an extent. Another variety (fig. 8), from the irony-nodule bed of the *Murchisonæ*-zone in Burton Cliff, differs in an exactly opposite direction, being narrower, and displaying the lower keel at a still earlier stage than *Ps. Etheridgii.* Moreover, the crenulations on the keel, and the granular zone on the posterior margin, are much more pronounced. This I propose to call var. *granosa,* indeed it is almost worthy of being regarded as a distinct species.

Relations and Distribution.—*Pseudalaria Etheridgii* occurs somewhat sparingly in the *Sowerbyi*-bed of Bradford Abbas, and has been met with on or about the same horizon at Pitcombe. This species may be regarded as the type of a genus which has representatives on lower as well as on higher horizons. My attention has lately been called by Mr. Edward Wilson to a specimen obtained from the Lias, which he regards as identical with *Purpurina Patroclus,* D'Orb. This well-preserved fossil differs from *Ps. Etheridgii* chiefly in the more decided character of the anterior canal, which gives to this part of the aperture an appearance not unlike that of the Purpurines.

119. Pseudalaria jugosa, *Bean.* No date. Plate XII, fig. 9.

1885. "Trochus jugosus," *Bean* MS. Hudleston, Geol. Mag., dec. iii, vol. ii, p. 255, pl. v, fig. 11.

Bibliography.—It was mentioned (*loc. cit.*) that this could hardly be a *Trochus.* "It has more the look of an *Alaria* without the wing. On the other hand, it may represent a shell which never had a wing." Attention was at the same time directed to *Turritella unicarinata,* Desl.

Description.—Shell conical, turrited; whorls five or six; suture well marked, and situated in a hollow. The whorls of the spire are angular, and slope outwards to a very prominent carina situate about two-thirds down. Keels sharp and apparently plain. Faint traces of a lower keel may be noted in the whorls of the spire; body-whorl strongly bicarinate. The whole of the shell, including the base, is marked by fine spiral lines. Other indications wanting.

Relations and Distribution.—This species somewhat resembles the Beaminster variety of *Pseud. Etheridgii;* the deficiency of ornament may be due to conditions of mineralization. Very rare in the Yorkshire Dogger.

Family—NERINÆIDÆ.

"*Shell turrited, subcylindrical, conical or ovate-elongate, solid, thick; aperture slightly channeled in front. . . . Columella or walls of the aperture furnished with folds, which are continued into the whorls of the spire.*"—Fischer.

The author of the 'Manuel de Conchyliologie' is evidently disposed to agree with Blainville and Woodward in placing the Nerinæidæ in close relationship to the Cerithiidæ rather than to the Pyramidellidæ, in accordance with the views of Defrance and D'Orbigny. The family is almost entirely composed of one genus, *Nerinæa* (including sub-genera, such as *Ptygmatis*, &c.); but, as if to show that no family can be constituted without an exceptional member, there is just one limited genus which violates the rule as to the existence of internal folds.

Genus—Aptyxiella, *Fischer*, 1885, 'Manual,' p. 689; = Pachystylus, *Gemmellaro*, 1878; = Aptyxis, *Zittel*, 1873.

Shell conical-elongate, subcylindrical, not umbilicated; whorls numerous, not embracing. Aperture quadrangular, terminating anteriorly in an insignificant canal; no internal folds on the columella and walls.

The above diagnosis is a modification of those given by Gemmellaro and Fischer. The former regards *Pachystylus* as belonging to the Pyramidellidæ; three species are described by him from the white crystalline Limestone of Montagne del Casale. Fischer gives as an example of the genus *Aptyxiella sexcostata*, D'Orb., from the Corallian of La Rochelle.

120. Aptyxiella subconica, sp. nov. Plate XII, figs. 10, 11.

Description:

Probable length	55 mm.
Width about	$\frac{1}{5}$th.
Spiral angle about	10°.

Shell elongate, subcylindrical; whorls numerous, concave, the width of one whorl being nearly equal to its own height, *plus* that of the preceding whorl. The whorls are apparently smooth, but the available specimens are much worn.

Body-whorl short, angular, concave, with a raised rim on the anterior margin, and a wide, depressed base. Aperture quadrate, columella short. In section (fig. 11) the whorls are subrectangular, and nearly square; columella and walls equally without folds. Other indications wanting.

Relations and Distribution.—In comparison with *Pachystylus conicus*, Gemm., this species is of somewhat larger habit, and its whorls are not quite so narrow. Coming nearer home one would suspect its relationship to *Cerithium Defrancii*, Desl. (Mém. Soc. Linn. Norm., vol. vii, p. 193, pl. viii, fig. 36), a fossil occurring in the Bathonian of France.

Aptyxiella subconica has not hitherto been found out of the *Parkinsoni*-zone of Aston and Over Harford in the Eastern Cotteswolds.

Genus—Nerinæa, *Defrance*, 1825.

General definition—" *Shell perforate or not; whorls numerous; aperture subquadrangular, oval or elongate, with a short anterior canal or superficial notch; lip forming posteriorly a narrow sinus, which leaves in passing off a narrow sutural band; lines of growth strongly inflected near the suture; columella furnished with folds, which are internally persistent throughout its entire length; other folds appear sometimes on the lip and the columellar side.*"—Fischer, 'Manuel,' p. 687.

Before dealing with the question of the sections and subgenera of this most important genus a few remarks on its development in the Jurassics of this country may not be inappropriate. The following passage bearing on this point is quoted from 'Contributions to the Palæontology of the Yorkshire Oolites.'[1]

" A peculiar interest attaches to the Nerinæas of the Inferior Oolite, since they are the earliest of their kind. The genus, we are told by Sharpe, usually occurs in calcareous strata associated with shallow-water shells. Thus we do not find Nerinæas in the Lias nor in the *Striatulus*-beds, nor even in the Dogger Sands. Indeed, I am not aware that any remains of the genus have been detected in the lower portions of the Dogger itself, such as the nodule beds which occur at intervals immediately above the *Cynocephala*-zone (Yellow Sands). But when we come to what was once the more calcareous portion of the Dogger, the shell-bed towards the top is so full of them as to have received the name of *Nerinæa*-bed. In this bed, only eighteen inches thick, the first noteworthy accumulation of Nerinæas occurs, nor are they ever plentiful again throughout the Yorkshire Oolites until we reach the Corallian Rocks.

[1] 'Geol. Mag.,' decade iii, vol. i, p. 108.

PLATE VII.

Fig.

1 *a*. *Alaria Pontonis*, sp. nov. Lincolnshire Limestone, Great Ponton. My collection. (Page 135.)

1 *b*. The same. Another specimen, front view. Same locality and collection.

2. *Alaria Pontonis*, var. *spinifera*. Lincolnshire Limestone, Great Ponton. My collection. (Page 136.)

3. *Alaria primigenia*, sp. nov. P_1., Vitney Cross. My collection. (Page 137.)

4. *Alaria spinigera*, Lycett. I. O., Nailsworth. Jermyn Street Museum. (Page 138.)

5. *Alaria solida*, Lycett. I. O. Cotteswolds. Jermyn Street Museum. (Page 139.)

6. *Alaria solida*, Lycett, var. I. O. (? Oolite Marl), Crickley. Brodie collection. (Page 140.)

7 *a*. *Alaria hamoides*, sp. nov. Lincolnshire Limestone, Great Ponton. My collection. (Page 140.)

7 *b*. The same. Another specimen. Lincolnshire Limestone, ? Great Ponton. Sharp collection.

8 *a*. *Alaria (? Diartema) varicifera*, sp. nov. Lincolnshire Limestone, Great Ponton. Sharp collection. (Page 141.)

8 *b*. *Diartema varicifera*. L. L., Great Ponton. My collection. (Page 141.)

8′ *a*. ? The same. The usual form in the L. L. of Weldon. My collection. (Page 141.)

8′ *b*. ? The same. An exceptional form in the L. L. of Weldon. My collection. (Page 141.)

9. *Alaria hamus*, Deslongchamps. I. O., ? Dorsetshire. Whidborne collection. (Page 113.)

10. *Alaria Roubaleti*, Schumberger, var. *Dorsetensis*. I. O., Bradford Abbas. Buckman collection. *Specimen showing the character of the digitation and canal-sheath, but without the spines.* (Page 123.)

11. *Alaria pinguis*, sp. nov. *Parkinsoni*-zone, Vitney Cross. My collection. (Page 117.)

12. *Brachytrema binodosum*, sp. nov. Lincolnshire Limestone, Great Ponton. My collection. (Page 99.)

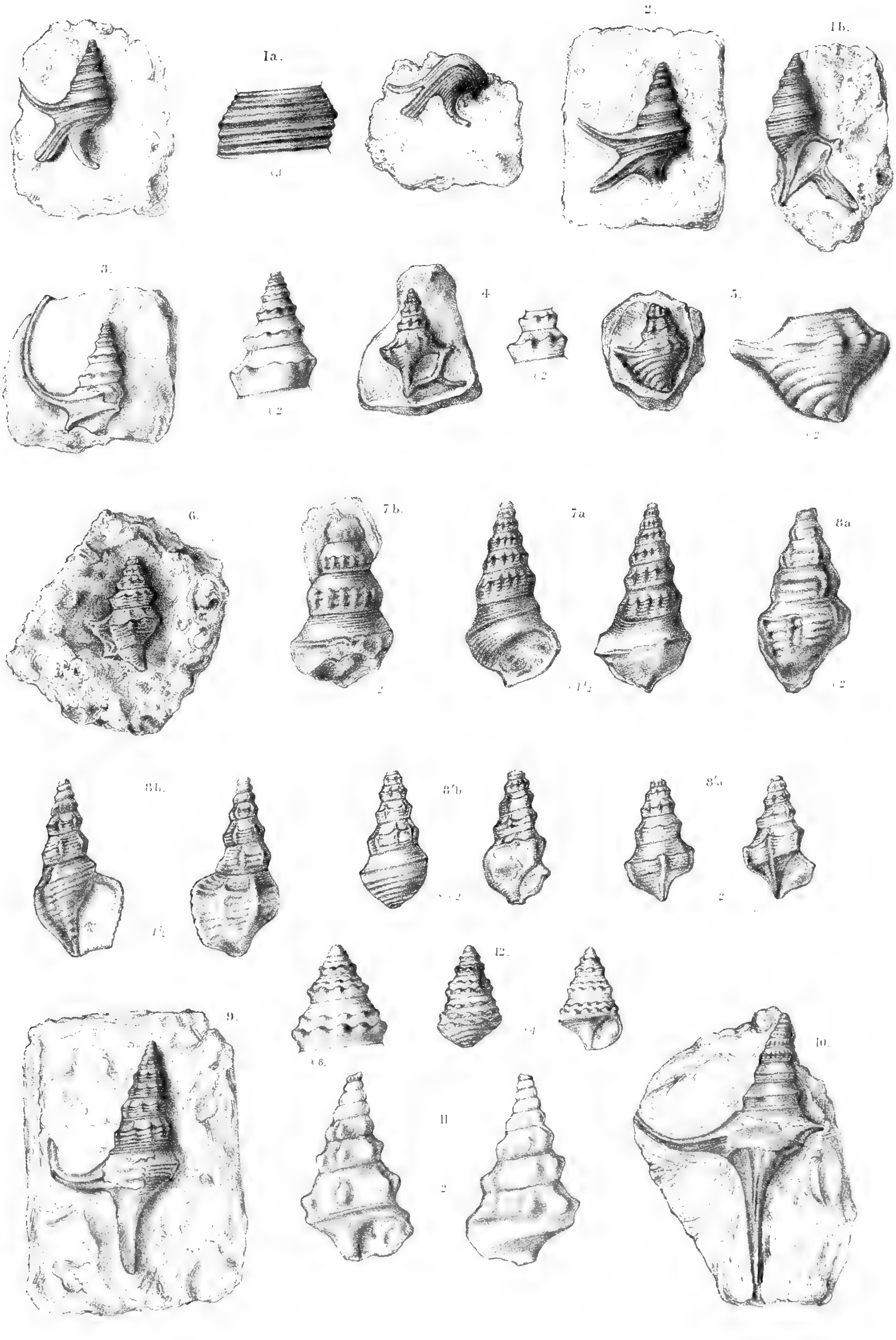
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PLATE VIII.

Fig.

1. *Cerithium quadrilineatum*, Röm. Blue Wyke Sands. My collection. (Page 145.)

2 *a*. *Cerithium muricatum*, Sow. Dogger, Blue Wyke. One of Sowerby's types, British Museum. (Page 146.)

2 *b*. The same. Group of shells in Dogger matrix. My collection.

3. *Cerithium muricatum* var. *trilineata*. Scarborough Limestone. York Museum. (Page 147.)

4. *Cerithium gemmatum*, Morris and Lycett. Scarborough Limestone. British Museum. (Page 147.)

5 *a*, 5 *b*, 5 *c*. *Cerithium vetustum*, Phil. Scarborough Limestone, Pickering Cliff. My collection. (Page 148.)

5 *d*. Variety. Leckenby collection.

6 *a*. *Cerithium vetustum-majus*, Hudl. Dogger, Blue Wyke. My collection. (Page 150.)

6 *b*. The same. Leckenby collection.

7. *Cerithium vetustum* var. *seminuda*, Hudl. Dogger, Blue Wyke. Leckenby collection. (Page 151.)

8 *a—f*. *Cerithium subscalariforme*, D'Orb. var. *spinicostata*, Wright, MS. *Sowerbyi*-bed, Bradford Abbas. My collection. (Page 151.)

9. *Cerithium subscalariforme*, D'Orb., var. in the *Humphriesianus*-zone, Oborne. My collection. (Page 153.)

10 *a*. *Cerithium subscalariforme*, D'Orb., var. in the *Parkinsoni*-zone (*? granulato-costatum*, Münst.). Grove near Castle Cary. (Page 153.)

10 *b*. The same from another locality. My collection.

11. *Cerithium subabbreviatum*, D'Orb. P_1, Burton Bradstock. My collection. (Page 154.)

12. *? Cerithium obesum*, sp. nov. P_1, Vitney Cross. My collection. (Page 154.)

13. *Cerithium subglabrum*, sp. nov. *Sowerbyi*-bed, Bradford Abbas. My collection. (Page 155.)

14. *Cerithium*, species or variety. *Sowerbyi*-bed, Bradford Abbas. My collection. (Page 155.)

15. *Cerithium*, species or variety. *Sowerbyi*-bed, Bradford Abbas. Whidborne collection. (Page 156.)

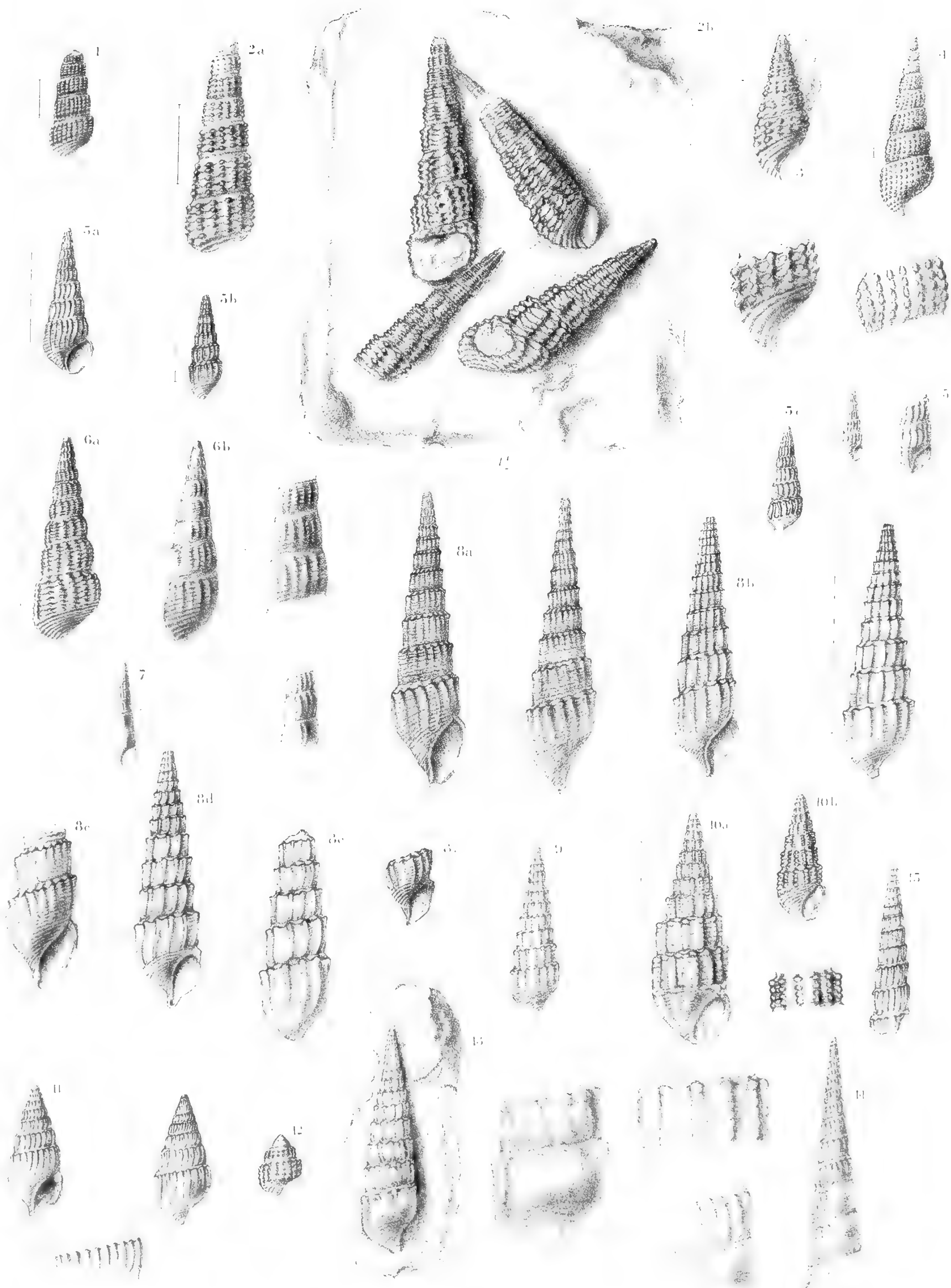

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PLATE IX.

FIG.

1. *Cerithium armatum*, Münst. Sands below Cephalopoda-bed, North Nibley. Buckman collection. (Page 156.)
2. *Cerithium Leckhamptonense*, sp. nov. I. O., Leckhampton Hill. Jermyn Street Museum. (Page 157.)
3. *Cerithium*, species or variety. ? *Murchisonæ*-zone, Coker. My collection. (Page 157.)
4. *Cerithium Leckenbyi*, Hudleston. Dogger, Blue Wyke. Woodwardian Museum. (Page 158.)

5 *a*, 5 *b*. *Cerithium Beanii*, Morris and Lycett. Dogger, Blue Wyke. York Museum. (Page 159.)

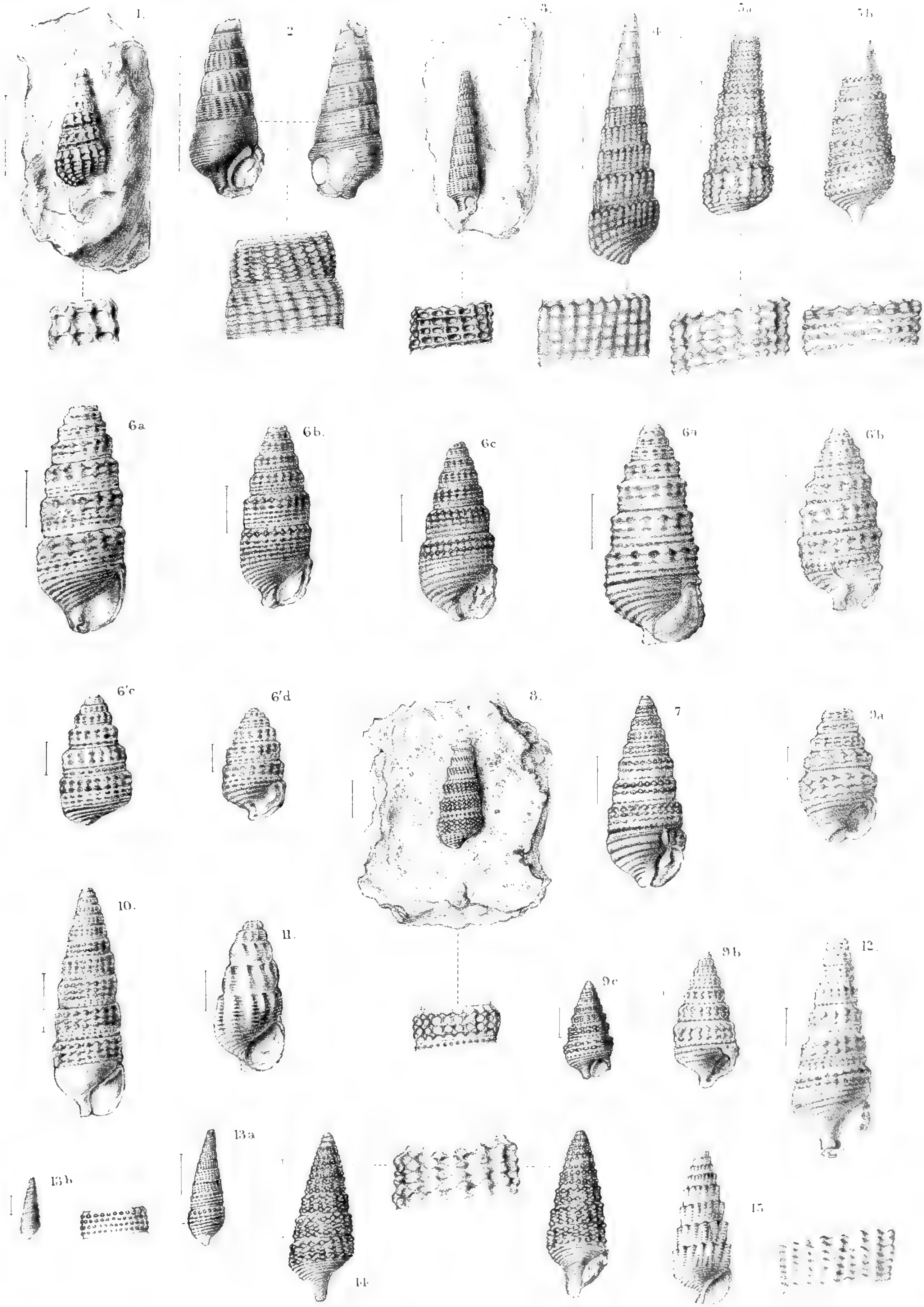
6. *Cerithium Beanii*, var. *Weldonis*. Lincolnshire Limestone. (*a*) Weldon. My collection. (*b*) No locality. Collection of Mr. George. (*c*) Rolled specimen, no locality. Sharp collection, B. M. (Page 160.)

6′. *Cerithium Beanii*, var. *Weldonis*, subvariety B (with four spirals). *a*, *b*, *c*, *d*, Weldon. My collection. (Page 160.)

7. *Cerithium limæforme*, Röm., var. *Pontonis*. Lincolnshire Limestone, Ponton. Sharp collection, B. M. (Page 161.)
8. *Cerithium* "*cingula*" (? var. of *C. limæforme*). Shelly freestones in I. O. of Cotteswolds. Jermyn Street Museum. (Page 162.)
9. *Cerithium Wansfordiæ*, sp. nov. Lincolnshire Limestone, Wansford or Barnack. *a*, *b*, Sharp collection, B. M. *c*, Collection of Mr. George. (Page 162.)
10. *Cerithium Georgii*, sp. nov. Lincolnshire Limestone. Collection of Mr. George. (Page 162.)
11. ? *Cerithium subcostigerum*, sp. nov. Lincolnshire Limestone, Weldon. Jermyn Street Museum. (Page 163.)
12. *Cerithium latisulcatum*, sp. nov. Lincolnshire Limestone, Weldon. My collection. (Page 164.)

13 *a*, 13 *b*. *Cerithium pisoliticum*, sp. nov. Peagrit, Cheltenham. My collection. (Page 164.)

14. *Cerithium*, species or variety. *Parkinsoni*-zone, near Castle Cary. My collection. (Page 165.)
15. *Cerithium turris*, Hudleston. Dogger, Blue Wyke. Jermyn Street Museum. (Page 166.)



S. Foord del et lith.

PLATE X.

FIGS.

1. *Cerithium* near to *variculosum*, Desl. I. O., Rodborough Hill. Jermyn Street Museum. (Page 166.)
2. *Cerithium comma*, Münst. *Cadomensis*-bed, Oborne. Woodwardian Museum. (Page 167.)
3. *Cerithium comma*, var. near to *C. unitorquatum*, H. & D. P_1, Bridport Harbour. Woodwardian Museum. (Page 168.)
4. *Cerithium circe*, D'Orb. I. O., Dorset. Woodwardian Museum. (Page 168.)
5. *Cerithium "commaoides."* Lincolnshire Limestone, Weldon. My collection. (Page 169.)
6. *Cerithium pergradatum*, sp. nov. Haselbury, ? from the *Opalinus*-zone. My collection. (Page 169.)

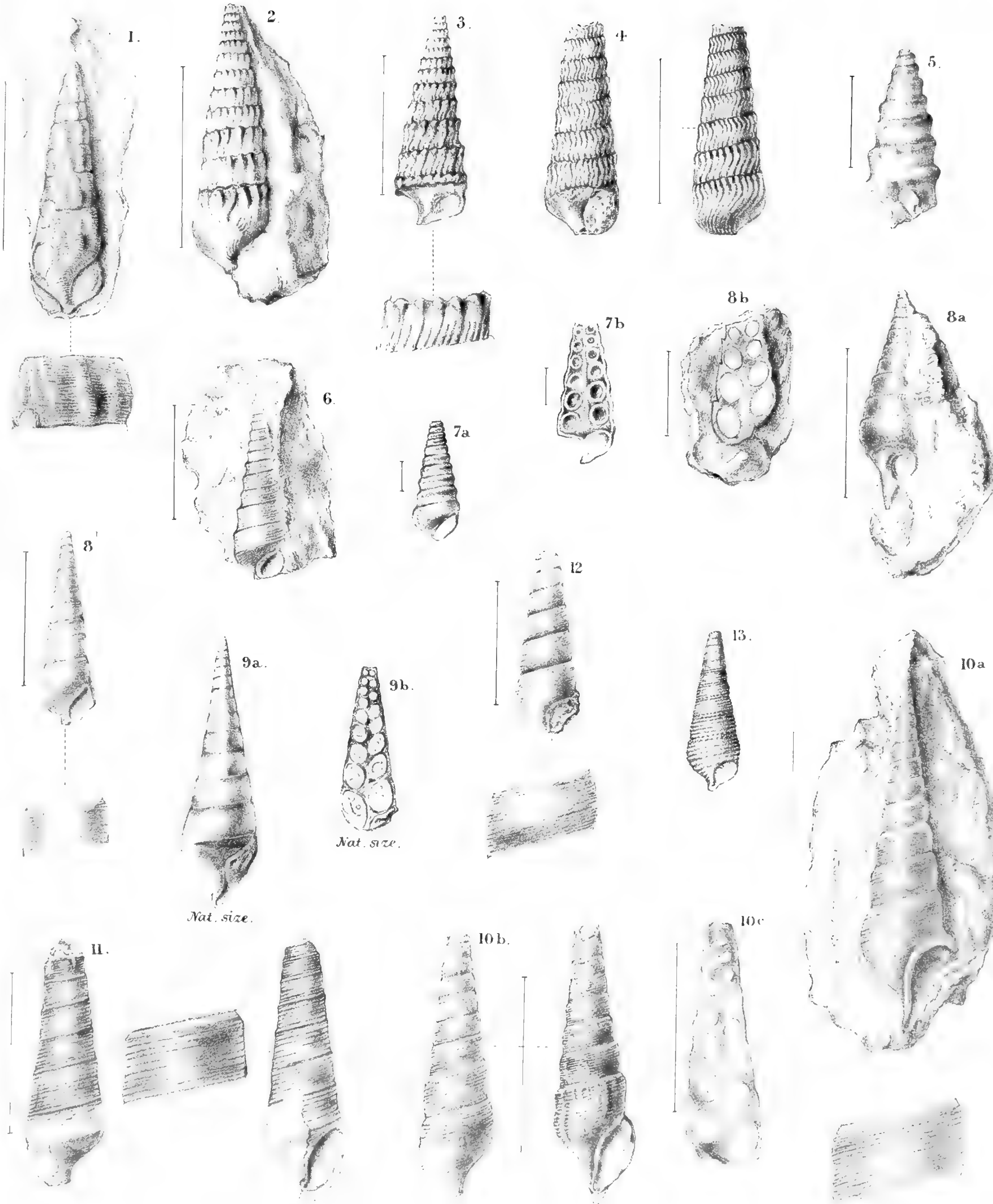
7 *a*. *Cerithium "annulatum."* Lincolnshire Limestone. Sharp collection, British Museum. 7 *b*. Section of another specimen, same collection.

8 *a*. *Cerithium clypeus*, sp. nov. *Clypeus*-grit of Rodborough. Witchell collection. 8 *b*. Section of another specimen. 8′. Variety from the *Parkinsoni*-zone of Aston. My collection. (Page 170.)

9 *a*. *Cerithium attritum*, sp. nov. Lincolnshire Limestone, Weldon. My collection. 9 *b*. Section of another specimen, same collection. (Page 171.)

10 *a*, 10 *b*. *Cerithium abbas*, sp. nov. *Sowerbyi*-bed, Bradford Abbas. My collection. 10 *c*. Section of another specimen, same collection. (Page 172.)

11. *Cerithium obornense*, sp. nov. *Sauzei*-bed, Oborne. My collection. (Page 173.)
12. *Cerithium polystrophum*, sp. nov. Lincolnshire Limestone, Weldon. My collection. (Page 173.)
13. *Cerithium* species or immature form. Lincolnshire Limestone, Weldon. My collection.



A.S. Foord del et lith.

PLATE XI.

Figs.

1. *Fibula angustivoluta*, sp. nov. Lincolnshire Limestone, Weldon. My collection. (Page 174.)

2 *a*. *Fibula canina*, Hudleston. Dogger, Blue Wyke. Bean collection, British Museum. 2 *b*. Another specimen from same locality. Leckenby collection. (Page 175.)

3 *a*. *Ceritella Lindonensis*, sp. nov., var. *pinguis*. Lincolnshire Limestone. Sharp collection, British Museum. 3 *b*. Section of do. (Page 177.)

4. *Ceritella Lindonensis*, usual form. Lincolnshire Limestone, Weldon. My collection.

5 *a*. *Exelissa strangulata*, D'Arch., var. *pisolitica*. Pea-grit, Crickley. My collection. 5 *b*. Another specimen showing the apical whorls in good preservation. (Page 178.)

6. *Exelissa strangulata*, D'Arch., var. *ovalis*. Lincolnshire Limestone, Weldon. My collection.

7. *Exelissa pulchra*, Lycett. Lincolnshire Limestone, Ponton. My collection. (Page 179.)

8 *a*. *Exelissa Weldonis*, Hudleston. Millepore Rock of Yorkshire coast. Leckenby collection. 8 *b*. Specimen from the Lincolnshire Limestone, Weldon. My collection. (Page 179.)

9. *Exelissa normanniana*, D'Orb. Stoford. My collection. (Page 180.)

10. *Cryptaulax scobina*, Desl. Base of I. O. sands, Nailsworth. Witchell collection. (Page 181.)

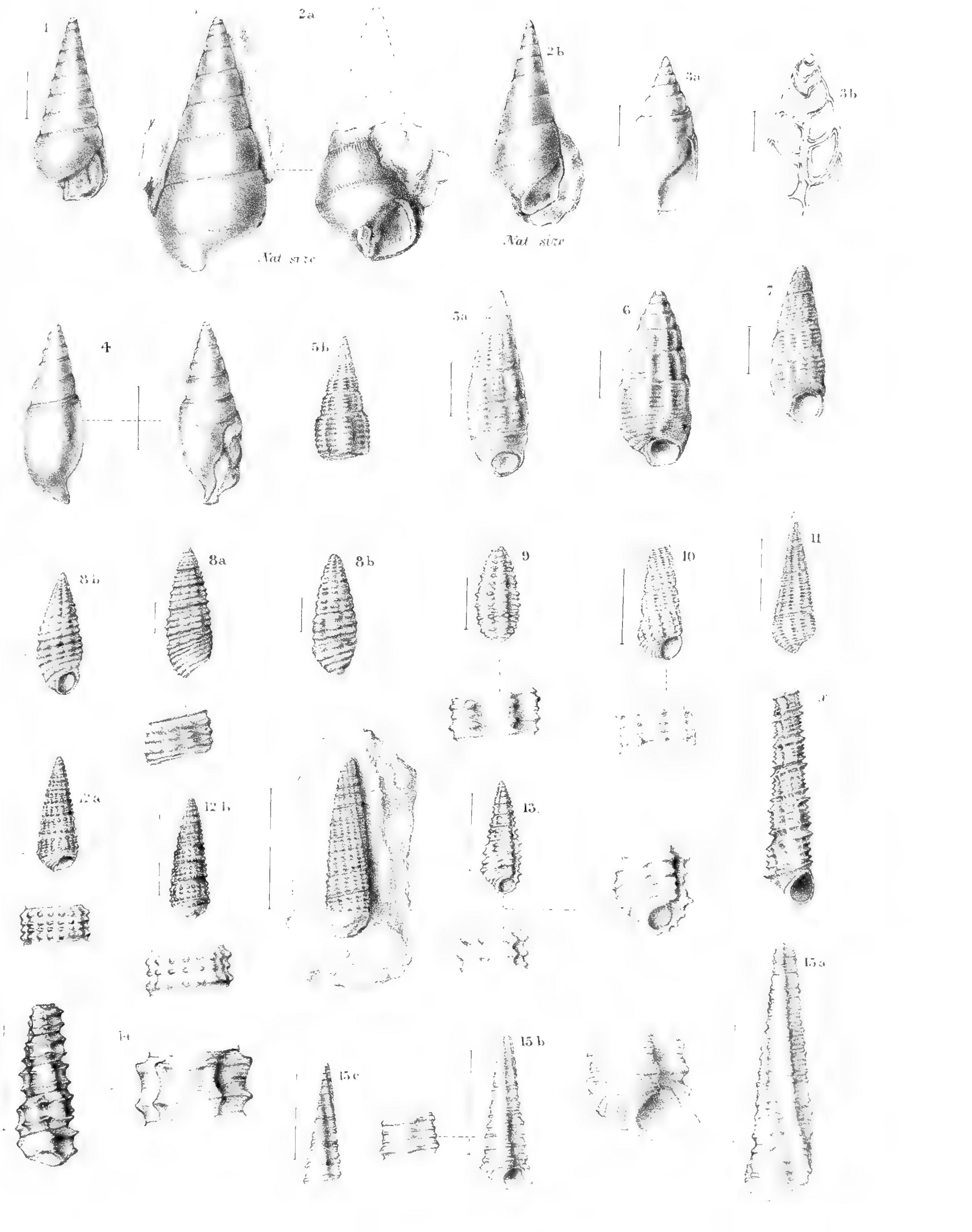
11. *Cryptaulax scobina*, Desl., var. approaching *C. tortilis*, H. & D. I. O. sands, Nailsworth. Jermyn Street Museum.

12 *a*. *Cryptaulax tortilis*, Hébert & Desl., var. with four spirals, *Parkinsoni*-zone, Aston. 12 *b*. Do. from same locality with three spirals. 12 *c*. Do. large specimen with four spirals from *Cadomensis*-bed, Oborne. My collection. (Page 182.)

13. *Cryptaulax papillosa*, Desl. *Parkinsoni*-zone, Grove. My collection. (Page 183.)

14. *Cryptaulax*, cf. *undulata*, Quenst. *Parkinsoni*-zone, Bridport Harbour. Woodwardian Museum. *x*. Copy figure of "*Turritella*" *undulata*, Quenst. Héb. and Desl., Foss. de Montreuil-Bellay, pl. vii, 13. (Page 184.)

15 *a*, 15 *b*, 15 *c*. *Cryptaulax contorta*, Desl. P_1, Burton Bradstock. My collection. (Page 185.)



A. S. Foord del. et l.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1888.

LONDON:

MDCCCLXXXIX.

A MONOGRAPH

ON THE

INFERIOR OOLITE AMMONITES

OF

THE BRITISH ISLANDS.

BY

S. S. BUCKMAN, F.G.S.

PART III.

PAGES 57—144. PLATES XV—XXIII AND PLATE A.

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1889.

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have had figured again so as to show its true characters accurately. Closely allied to the typical *Lioc. concavum*, and occurring in the same bed with it, we find a large number of different forms certainly capable of separation (pp. 72—76), although it requires careful and accurate observation to effect it For such a purpose Sowerby's figure in the 'Mineral Conchology' was not sufficient. These different forms of *Lioc. concavum* may be most conveniently classed in two groups as follows :—The varieties in the first group develop at a very early age sigmoidal radii, which are projected forwards on the ventral area; those in the second continue for a long time (even to attaining the size at which the former become nearly adult) to possess only the V-shaped radii. Such ribs or radii take the form of an expanded ⋖, with its apex pointing forward on the lateral area, while its outer end meets the ventral area and passes over it and over the carina[1] nearly at right angles. (Specimens with these ribs are particularly shown in Pl. IX, figs. 6, 7, and Pl. X, figs. 5, 7.) It is only at an advanced stage that the V-shaped radii give place to sigmoidal curves. The varieties composing the second class are also, generally speaking, coarser in their ornamentation, of larger growth, with less compression, and a smaller carina.

If we compare all the forms which I shall include under "*Lioceras concavum and varieties*," we observe that there is a very general similarity among them. The inner area devoid of ribs and made subconcave by the edge of the inner margin being raised, the nearly parallel sides, the sloping ventral area, and lastly the "*concave*" umbilicus with traces of ribs in its inmost whorls, are the most persistent characters. Although the whorls are not always occluded quite to the edge of the inner margin, yet the slope of this inner margin, together with the less occluded whorls of youth, always give to the umbilicus a definite character, namely, its peculiarly excavated appearance.

By breaking up a specimen to obtain the inner whorls, we are able to find out the manner in which the concave umbilicus has been formed. Until about the third whorl (diameter about 2 lines) the aperture is almost round—being about as broad as it is long—while the whorls are not at all compressed. This third whorl is occluded about one half by the next, which has its sides much flattened. The breadth of its aperture is one-and-a-half times that of the corresponding portion of the previous whorl; while its length has increased to two and a quarter times. This whorl is about three-fifths occluded by what is about the fifth whorl; and in this fifth whorl we meet with the commencement of the concave inner

[1] The radii on the ventral area are only striæ. The term "radii" seems to be convenient in describing that combination and alternation of ribs and striæ which make the ornamental curves on the shell from the inner to the outer margin. When thus understood the term obviates the necessity of an explanation each time a change (whether from ribs to striæ or *vice versâ*) takes place along one of the curves.

margin, which then causes the umbilicus to appear deeper. When once the inner margin is definitely formed, occlusion extends to its upper edge; and the superposition, in this manner, of the steep concave inner margins each time the whorls come round tends to form a small but deep umbilicus, instead of the open one which the first few whorls possessed. The total result is a '*concave*' umbilicus, which appears as if it had been taken out with a gouge, and which may very aptly be compared to the inside of a thimble.

The inner whorls of a specimen with falciform ribs show us that the ribbing commences at what is about the third or fourth whorl, that is, at about the time when the keel begins to be distinctly formed, and when the specimen assumes the flattened shape which it possesses from now onwards. The ribs do not seem to begin with any appearance of the V-shape, as we might perhaps expect; but they are fairly straight, though at the same time bent forwards on the ventral, and slightly curved on the lateral, area. Before the specimen attains the diameter of half an inch the ribs are distinctly formed, and do not show any trace of that strong reflexion which specimens of the second group exhibit; but they have something between a falciform and a sigmoidal shape. From this time onwards, the ribs or radii develop a rather greater angle on the lateral area; and, according as the inner portion may be rather straight or slightly flexed, so they either approach a falciform or else a sigmoidal shape. As a matter of fact, as the inner margin becomes distinctly formed, the ribs on the inner area degenerate into striæ. The smoothness of the inner area, due to this absence of ribs, is one of the generic characters.

Among the forms in the first class we find that a slight amount of obscure bifurcation of the ribs takes place about the middle of the lateral area—two ribs sometimes appearing to spring from one line of growth; but in reality this apparent bifurcation is caused by the unequal size of the striæ—the smaller being less noticed beside the larger,—or else by the very close approximation of the striæ in the more finely ribbed varieties. In the type form the striæ on the inner margin are fairly straight, and may be likened to the handle of a sickle; but the ribs can never be said to obtain the very strong sweep on the outer area which characterises the *Harp.-falciferum*-group. Nevertheless, the forward sweep on the ventral area distinguishes the typical forms from those of the second class, in which the ribs meet the ventral area at right angles—or sometimes even point slightly backwards—and, continued as striæ, cross the carina at about right angles. The V-shaped radii of this second class gradually change to sigmoidal or sub-falciform ribs; and this change takes place at a diameter varying from rather over one inch to four or five inches according to the variety.

Whether or not the typical forms possessed, in the young state, a pointed lateral process, as in *Lioc. v-scriptum*, I cannot say; but it is probable that they did, though the straighter flexures of the ribs would indicate that it was not very important.

We may notice the influence which the lateral process, whether pointed or rounded, has had upon the ribs; at first causing them to be more prominent in the middle of the lateral area, and at a later stage making them curve forwards, and sometimes in addition to thicken slightly; at other times it has raised small waves along the middle (a well-marked instance of this may be observed in Pl. X, fig. 9); while again at other times very small knobs are formed, as Pl. VIII, fig. 7. (These knobs, however, are inconspicuous, and specimens showing them are very rarely obtained.) A noticeable feature in the termination of this species is that, when the test is present, there is no indication of those constrictions which are otherwise visible; the test of the termination is, at the rim, as thin as paper; but is thickened internally just behind, causing a marked constriction of the aperture. The same thing may be noticed in *Lioc. v-scriptum* (Pl. IX, figs. 1 and 3).

The variability of this species in certain minute characters seems to be almost endless. The differences which the various forms present are small, but fairly persistent; and yet it requires a great amount of labour to separate all the different varieties, and to trace them from youth to adolescence. I have had depicted in the plates only the more striking forms, because it would have been well-nigh impossible to thoroughly bring out in any drawing the various differences which may be detected; but I shall devote a separate article to noticing, as far as possible, the many variations which the species exhibits. I believe it necessary to fully work out and separate all forms of this or other species which differ from the type; and I scarcely agree with the common practice of placing several various forms under one specific name, in collections or otherwise, without note or comment as to their differences. The reason for this opinion is that I think a thorough investigation of such forms is the one way to arrive at a true idea regarding the descent of certain species from others; because a very slight variation may give us the necessary clue, or the form may have developed in an unexpected manner. For such critical work as this the figures given by most of our older authors were not sufficiently exact; and therefore their specimens should, when possible, be redrawn. As regards this species, I have had the opportunity of thoroughly examining several hundred specimens; and in fact it is, or rather was, so plentiful at Bradford Abbas as to be frequently neglected by collectors. To this neglect, in all probability, the scarcity, in most collections, of certain varieties and similar-shaped species is partly due, because, as their differences could not be noticed when they were embedded in the matrix, the specimens would be left alone, under the impression that they were nothing more than the common *Lioc. concavum*.

When we consider the abundance in which specimens of this species occur, we can scarcely marvel at the variability which they exhibit; and it is on account of this variability no easy matter to point out all the differences between this and allied species. The variety *Lioc. formosum* closely resembles *Ludwigia cornu;* the adult of *Lioc. v-scriptum* is somewhat like *Lioc. fallax*, while the young approach *Lioc. apertum;* the variety *Lioc. pingue* and the young of *Lioc. giganteum* are somewhat similar. All these will be alluded to and explained under their respective headings.

As regards the type form, if the character of its ribbing, the great inclusion of its whorls, and the proportions shown by the figures,[1] be kept steadily in view, I do not think it should be confounded with any other species. From *Lioc. elegans*[2] (Young) and *Lioc. opalinum* (Reinecke) its coarser ribbing and very concave umbilicus separate it specifically; from any forms of *Ludwigia*, the mode of ribbing and the difference in the suture-line separate it generically. The more minute differences which distinguish it from its varieties will be best understood by reference to pp. 66, 67, 69.

It is singular that in spite of the frequency with which this species occurs, yet from the year 1815, the date which Sowerby's plate bears, until the year 1881, when my father figured a variety of it, no approach to any correctly identified specimens of Sowerby's species had been figured in England, nor, I believe, on the Continent. The regularly hollow umbilicus, which is mentioned by Sowerby, seems to have been either ignored or not noticed by those who have referred to this species; and, so far as my experience goes, the identification of this shell in both public and private collections leaves much to be desired. The name *Ammonites concavus* is given, for some reason, to a shell or a whole series of forms from the Upper Lias, and seldom to our species from the Inferior Oolite. Probably d'Orbigny and Dumortier are to a certain extent answerable for this. The form from the Upper Lias figured by d'Orbigny under the name *Am. concavus* ('Terr. Jurass. Ceph.,' pl. 116) is referred by Dr. Wright[3] to *Am. Lythensis*, Young and Bird; and by Dr. Haug, with a query, to *Am. compactilis*, Simpson. At any rate it differs totally from Sowerby's *Am. concavus* in suture-line and ribbing, also in having a straight or slightly convex inner margin, and an open umbilicus.[4] MM. Chapuis and Dewalque[5] also figure under the name *Am. concavus*, Sowerby, a species which appears very probably to belong to the genus *Pseudolioceras*. Its

[1] See p. 62 concerning an error in the drawing of the front view of the type.

[2] The figures of this species given by Dr. Wright ('Lias Amm.,' pl. lxiii, figs. 1—3, *Harpoceras elegans*) not being correctly drawn are likely to be misleading. The specimen is now in the British Museum (Natural History), numbered C 1859, and a comparison with the figure shows that the umbilicus is drawn too small the lower part of the outer whorl too broad, the centre of the umbilicus a trifle too high up, and the carina (in fig. 3 especially) too acute.

[3] 'Lias Ammonites,' p. 444

[4] See p. 86, *Pseudolioceras compactile.*

[5] "Fossiles de Luxembourg," 'Mém. Acad. Belgique,' Bruxelles, 1853, pl. viii, fig. 3.

suture-line agrees very fairly therewith; but its ribs seem much too straight on the lateral area. (This may be an error in drawing; the curvature of ribs is a feature which has received neither the notice which it deserves, nor the attention sufficient to ensure perfect accuracy.) The specimen is said to have come from the Upper Lias, and it has evidently nothing to do with the genus *Lioceras*.

Dumortier ('Études Paléont.,' vol. iv, pl. 13, figs. 1 to 3) depicts a shell, from the zone of *Am. bifrons*, which is very much nearer to our species, and belongs to the same genus. It possesses the same suture-line and concave inner margin, and fig. 1 has a very similar umbilicus; but it differs in having very fine striations, instead of the ribs characteristic of *Lioc. concavum*.[1] Prof. Blake[2] quotes *Harpoceras concavum* (Sowerby), from the zone of *Am. annulatus* at Whitby; but this must be an incorrect identification, for, from the synonyms which he gives, he is evidently referring to *Lioc. elegans* (Young).

The typical *Lioceras concavum* is not so common as some of its varieties. It occurs in the *Concavum*-beds of Bradford Abbas and near Halfway House, Dorset. With its varieties it forms the leading, and by far the most abundant, shell in what has been called "the Cephalopoda-bed of Bradford Abbas;" and it characterises the same horizon in a somewhat similar lithological bed at Halfway House and in neighbouring quarries. Some forms have also been obtained from near Sherborne, Dorset, and from Stoford, East Coker, and Corton Denham in Somerset: Sowerby's type came from near Ilminster in that county. All these places are situated either in North Dorset or South Somerset, and generally not far from the border-line which divides the two counties. I cannot remember to have collected it from any of the exposures in South Dorset, namely, near Broad Windsor,[3] Bridport, &c. From Dundry Hill, in North Somerset, I possess two specimens. This hill, which I have lately had an opportunity of visiting, is usually considered to be an outlier of the Cotteswolds; but palæontologically, and especially geologically, it strikingly recalls the Dorset strata, while it has little resemblance to those of the Cotteswolds. I was not fortunate enough to obtain any specimen of *Lioc. concavum* there, nor to detect its horizon; but several examples from this locality are preserved in the Bristol Museum, showing, like the Dorset specimens, considerable variation. From the Cotteswold Hills themselves, or from the Inferior Oolite of any other part of England, I have neither collected a specimen nor found one among those sent by

[1] See p. 39.

[2] 'Yorkshire Lias,' p. 303, 1876.

[3] This is not now correct. By recent work, done while this sheet was passing through the press, I have discovered many specimens of this species at Horn Park and Stoke Knap, near Beaminster. Both places are about one mile from Broad Windsor. At the former the *Concavum*-bed is not a foot thick; at the latter it is four feet thick, if not more; while it is absent at Coneygore just the other side of Broad Windsor.

friends for identification. Its occurrence in any of these places would be extremely interesting from a geological point of view; and my idea is that it should be sought for in the *Lower Trigonia*-grit of the Cotteswold area. Mr. Hudleston ('Gasteropoda,' Pal. Soc., pp. 27, 44, 1887) states that this species[1] is characteristic of the "Malière" of Normandy, and Dr. Haug (*loc. cit.*, p. 684) says that it occurs in the *Sowerbyi*-zone in the Jura of Berne.

Plate II, figs. 6, 7, represent the actual type of the species, since it is the specimen originally figured by Sowerby, now redrawn. It is in the British Museum (Natural History Branch). The artist has made the breadth of the aperture at the inner area too great, and has failed to delineate the characteristic concavity in the inner area, which, however, is to be noticed in fig. 6. The inner margin is also shown convex instead of concave.

Plate VIII. figs. 1, 2, show the typical form of this species, of a somewhat larger size, collected by my father at Bradford Abbas, Dorset.

Plate VIII, figs. 3, 4, illustrate a younger specimen, but with finer ribs than the above forms apparently possess; otherwise it is similar. This has one of the most perfect tests that I have seen. It came from Bradford Abbas, Dorset, and is in my collection.

The life-zone in the Bradford Abbas district, which *Lioc. concavum* and its varieties dominate in point of numbers, is the bed No. 5 of my section at page 5. It is here a yellowish-brown stone, with darker grains, or sometimes inclining to blue with similar grains. In the partings it weathers to a soft yellow paste, from which shells are very readily extracted; but the bed altogether generally yields specimens in an extremely good state of preservation, and the matrix can be chipped cleanly away from the tests, thus differing from the "Paving-bed" (*Murchisonæ*-zone) below, which sometimes very closely resembles it in colour and texture. It is seldom that specimens in the *Concavum*-bed are at all perished; but this condition is not unfrequent in the Paving-bed. At Halfway House the *Concavum*-bed is very similar; but at Louse Hill and at Wyke Quarry, in both of which it is the chief "fossil-bed," it is rather harder, of a bluish colour, with light yellow grains, often very few of them. It does not yield specimens in as good condition as at Bradford Abbas; and, when exposed to the weather, they deteriorate from decomposition very much sooner. At Corton Downs[2] the same horizon exhibits quite a different character, being a blue clayey marl with bands of stone. *Lioc. concavum* and Ammonites in general are scarce here, and are found without any test and frequently crushed. They partake of the blue character of the matrix. Brachiopoda are abundant and well preserved, and are

[1] As the species he refers to seems also to go by the name *Am. aalensis* it is possible it may be my *Lioceras ambiguum* (see p. 28), and if so has a peculiar bearing on my remarks, p. 64.

[2] Marked as Horethorne Down on the Ordnance Survey Map.

of the same species which occur in the *Concavum*-bed in Dorset. The most typical species are *Rhynchonella Forbesi*, Dav., *Rh. liostraca*, S. Buckm., *Terebratula Eudesi*, Oppel, and *T. cortonensis*, S. Buckm.

It was doubtless on account of the abundance of the various forms of *Lioceras concavum*, and the well-defined horizon of which they are characteristic, that Mr. Hudleston, when giving a very complete account of the Inferior Oolite of Dorset, in his Monograph on the Gasteropoda,[1] called these strata the *Concavum*-beds rather than the *Sowerbyi*-zone. The reasons which he gives for this are certainly most cogent; and I will now state why I adopted his suggestion.

I have lately had the opportunity to visit the sections at Dundry Hill, and to examine in the Bristol Museum Sowerby's figured specimen of *Am. Sowerbyi*, and the matrix, from which it was extracted, preserved with it.[2] This matrix is certainly not the same as that from which the Dundry specimens of *Lioceras concavum* in the Museum appear to have been obtained. I have always noticed the scarcity of *Am. Sowerbyi* in Dorset, and it seems to be equally scarce at Dundry Hill, for there were no other specimens in the Museum. During the short time at my disposal I was unable to determine the actual horizon at Dundry Hill occupied by either *Lioceras concavum* or *Am. Sowerbyi*, but, considering all the evidence, I had certainly some doubts whether they occurred together. It is possible that the true *Am. Sowerbyi* may really occupy a somewhat higher horizon than that of *Lioceras concavum*,[3] and yet be below the *Sauzei*-zone,[4] and that such

[1] Pal. Soc., vol. xl, for year 1886. See also "Excursion to Sherborne" by the same author, 'Proc. Geol. Assoc.,' vol. ix, p. 191, 1887, for much information concerning these beds generally.

[2] 'Mineral Conchology,' pl. 213, lower figure. The original *Am. Sowerbyi* evidently came from the Ironshot Oolite, which yields specimens of *Steph. Humphriesianum*.

[3] Since the above was written the advent of more specimens of Dundry Ammonites through the persevering energy of my kind friend Mr. E. Wilson, F.G.S., has enabled me to say that *Am. Sowerbyi* and *Lioceras concavum* occupy two different horizons, a fact which may be deduced from the matrix peculiar to each species. *Lioc. concavum* occurs in the lower position, viz. in the series of strata which underlie by some two feet the well-known "Ironshot Oolite" (*Humphriesianum*-zone?) of Dundry Hill. These strata are about six feet thick, and may be described as a most irregular series of bluish-grey, very slightly oolitic, nodular ragstone embedded in yellowish-brown marl. Sometimes the stone so preponderates that the marl appears merely as partings. The two feet lying between the ragstones and the "Ironshot" consist of whitish stone with a few iron grains, which are more plentiful than in the former, but less so and smaller than in the latter.

On trying to correlate the Dundry strata with those of Dorset, and the strata of both localities with those of the Continent, it appears to me that the *Concavum*-beds must occupy an horizon intermediate between the series of strata known on the Continent as, respectively, the *Murchisonæ*-zone and the *Sowerbyi*-zone, and that they (the *Concavum*-beds) are absent upon the Continent. In

[4] Where the *Sowerbyi*- and *Sauzei*-zones are well developed, as would appear to be the case in certain localities on the Continent, it may be possible to separate them distinctly; but at Dundry we find peculiar conditions, because it would appear that *Am. Sowerbyi*, *Am. Sauzei*, and *Am. Humphriesianus* occupy the same horizon. Perhaps the name *Sowerbyi*-zone will have to be dropped, there having been considerable misconception regarding the type-form of the species.

ascending order the full sequence of strata should be—1, *Murchisonæ*-zone; 2, *Concavum*-beds; 3, so-called *Sowerbyi*-zone. When we consider with what attention the Inferior Oolite has been studied upon the Continent we cannot fail to be surprised that so many new species of Ammonites should be met with in our English strata, most of which species occur in the *Concavum*-beds. Mr. Hudleston has noticed the same fact concerning the Gasteropoda. Not only so, but it seems to me that the species of Ammonites from these beds which are already named are practically absent from the *Murchisonæ*- or *Sowerbyi*-zones of the Continent. But this fits in exactly with a theory which supposes the *Concavum*-beds to be intermediate between the continental *Murchisonæ*- and *Sowerbyi*-zones, and to be absent on the Continent; and it seems to me that the number of new species can be explained in no other way. It might be suggested that the *Concavum*-beds form part of the *Murchisonæ*-zone; but the *Ammonite*- and *Brachiopod*-Fauna of the two horizons in Dorset are perfectly distinct and always characteristic, whilst of those Continental species which do occur in the *Concavum*-beds the majority belong to the so-called *Sowerbyi*- rather than the *Murchisonæ*-zone.

Dr. Vacek ('Oolithe Cap San Vigilio') has noticed that a great hiatus exists between the *Murchisonæ*- and *Sowerbyi*-zones of the Continent both geologically and palæontologically, and he has therefore proposed that this point was the most natural at which to draw the line of demarcation between the Lias and Inferior-Oolite formations. On account of the extraordinary and truly oolitic development of the former zone in the Cotteswold area—so different to what appears to be the case on the Continent—this proposition cannot fail to be most unmeaning to English geologists; yet it must not therefore be summarily dismissed. At present it appears to me that the strata, of which the Bradford-Abbas quarry is the type, supply, in the form of the *Concavum*-beds, that "missing link" whose absence M. Vacek has detected upon the Continent.

Between the Malière and the typical Bajocian of Normandy (I get my information from Mr. Hudleston, 'Gasteropoda,' p. 27, Pal. Soc., vol. xl) is an extremely well-marked break. Evidently this is the break to which Vacek refers, and which he finds to be persistent over a large area. The question whether the *Concavum*-beds are intermediate between and really connect the Malière and the Bajocian cannot be definitely decided until I have figured all the species which occur in them and comparisons can be made with the Continental Fauna. If the majority do not occur in either the *Murchisonæ*- or *Sowerbyi*-zones of the Continent, or if only certain recognisable mutations of these species occur, then it appears to me that this theory concerning the *Concavum*-beds will be tenable.

In the Stroud area the strata show a marked hiatus between the Upper Freestone and the Gryphite-grit—the Lower Trigonia-grit of the North Cotteswolds is absent. In the North Cotteswolds the hiatus occurs between the Gryphite-grit and Upper Trigonia-grit (*Parkinsoni*-zone)—the strata which were being deposited during this interval (*Humphriesianum*-zone, &c.) being found at Dundry and in Dorset. (This same hiatus occurs in the Stroud area, but not marked stratigraphically as in the North Cotteswolds.) At Bradford Abbas, I am unaware of any hiatus, although the strata between the *Concavum*-beds and the *Parkinsoni*-zone are much attenuated. Although the recommencement of deposition was different in the two cases, yet the hiatus in Normandy begins evidently on about the same horizon as the marked one in the Stroud area; but for that very reason is different to that of the North-Cotteswold hiatus. It is probable that the *Concavum*-beds were being deposited in Dorset during the interval thus represented; this must actually have occurred under similar circumstances in the Cotteswolds.

I have no wish to create a new zone. The *Concavum*-beds will, perhaps, have to be merged into the *Murchisonæ*- or so-called *Sowerbyi*-zone for convenience' sake even if their intermediate character, so far as the Continental zones are concerned, be recognised. At present it seems better—especially considering the doubtful position of *Am. Sowerbyi* as revealed to me by recent investigations (see next note)—to treat the *Concavum*-beds as a distinct horizon.

beds may be absent at Bradford Abbas. Judging, however, from certain Ammonite-species collected by my father, I should expect to find these beds well developed at Sherborne in the Sandford-Lane quarry; but unfortunately it has not been worked down to this level for many years. I have therefore thought it preferable, when treating of the chief fossil-bed of Bradford Abbas and its vicinity, to use Mr. Hudleston's term "*Concavum*-beds" for the horizon of which the species is characteristic. I much wish that we could see a good exposure at Sherborne down to the Yeovil Sands at any point where the *Humphriesianum*-zone is developed, because it would probably help us to thoroughly clear up some difficulties which still exist in the correlation of the Inferior-Oolite strata. The position of the *Concavum*-beds in the Bradford-Abbas district can be seen to be just above the thin bed containing *Ludwigia Murchisonæ;* and in my opinion they are the equivalents of the Gryphite- and Lower Trigonia-grits of the Cotteswold area.[1] A position equivalent to that of the former my father always assigned them; but, not taking sufficient account of the presence at Bradford Abbas of the *Murchisonæ*-zone below, he had recourse to the Yeovil Sands to supply the deficiency, that is, in correlating the Oolite-marl and Pea-grit series of the Cotteswolds with the Dorset strata.[2]

Lioceras concavum, *var.* formosum, *S. Buckman.* Plate X, figs. 1, 2; Plate A, fig. 15.

Discoidal, much compressed, subcarinate; whorls sub-convex with much depressed inner portion, and ornamented with broad but inconspicuous ribs, more falciform than sigmoidal. The ribs are, correctly speaking, not bifurcate, but some, intermediate, appear on the outer, and are not visible on the inner, area. Ventral area acutely sloping to a small carina, which is continued, though less conspicuously, to the end of the body-chamber. Inclusion extending over almost the whole of the preceding whorl. Inner margin scarcely concave, but much sloped. Umbilicus shallow, on account of the depression of the inner area, and open, on account of the marked slope of the inner margin. Termination of body-chamber plain, sigmoidal, with a strong bend forwards on the ventral area, where it is bluntly pointed. When the test is absent, the core shows, just before the end of the mouth, the usual furrow, due to the extreme thinness of the test at the outermost edge, and its rather quick thickening on the inside.

This variety of *Lioc. concavum* is chiefly noticeable for its resemblance to the typical form of *Ludwigia cornu*[3] depicted in Plate IV, figs. 3, 4. I have not been

[1] See p. 91.

[2] "On the so-called Midford Sands," 'Quart. Journ. Geol. Soc.,' vol. xxxv, p. 738, 1879.

[3] It was to the form with the smaller umbilicus that I first gave the name, and therefore I consider that as the type.

able to satisfy myself concerning the young specimens of this variety, but I should expect that they would prove difficult to separate from *Ludwigia cornu.* The umbilicus, however, is much smaller; the shell is more compressed on the inner area and not so much on the outer (that is, it is not so much flattened); the ribs, which are inconspicuous, though somewhat broad—generally giving a rather smooth appearance to the adult shell,—are straighter on the inner area, are not so numerous, and are more curved on the outer area. The best distinction lies in the ventral area and carina. *Ludwigia cornu is carinate,* that is, the ventral area slopes but slightly, and the carina stands up prominently and distinctly. *Lioc. formosum,* and in fact *Lioc. concavum* generally, no matter how trenchant the carina may seem, can only be called *sub-carinate,* because the ventral area slopes very much, and the carina is little more than a compression of the two edges of that area. The suture-lines, when visible, are a good guide. A specimen of this variety exhibits a true *Lioceras* suture-line (Pl. A, fig. 15, p. 123); the chambers are close together, with regularly decreasing lateral lobes, and with at least four well-marked auxiliary lobes.

It might almost be said that this variety can be separated with more ease from the typical *Lioc. concavum* than from *Ludwigia cornu,* because one does not require to find so much difference. The ribs more obscure, the inner area more depressed, a shallower and more open umbilicus with more sloping walls, and the inner whorls rather more exposed, are the characters which separate it from the type.

This variety comes with the type in the *Concavum*-beds of Bradford Abbas, Dorset, and seems to be scarce.

The beautiful specimen which has been figured (Pl. X, fig. 1, 2) is by far the best I have seen. The test is perfect on one side, and is extremely well preserved on the ventral area; while the termination is unusually complete on both sides, only a small portion of its test on one side being absent. The specimen was in the collection of my very kind friend, the late Mr. E. Witchell, F.G.S., who was always so ready to assist me in every possible manner with the most untiring good-nature. He lent me this specimen for figuring in this work, and Mrs. Witchell generously allowed me to add it to my own collection. Plate A, fig. 15, shows the suture-line taken from a specimen also in my collection. It is noticeable because of the absence of any of the larger digitations on the sides of the lobes.

LIOCERAS CONCAVUM, *var.* PINGUE, *S. Buckman.* Plate XII, figs. 1, 2.

Discoidal, somewhat compressed, subcarinate; whorls thick, with almost flattened sides showing the depression in the inner area, and very slightly ornamented with fine sigmoidal radii, which are projected forwards considerably on both the lateral and ventral areas. On the inner lateral area these radii are little more than lines of growth; on the outer they become small ribs, which, passing to the edge of the ventral area, die away into very fine striæ, and these unite on the carina at a somewhat acute angle. Ventral area, broad and rather flat, forming a convex surface broken by the small carina which runs along the middle. Inclusion extending to the edge of the inner margin of the preceding whorl, and forming an umbilicus regularly concave, except for a small recession where the body-chamber is present. Inner margin slightly sloping and distinctly concave. The termination, of which a slight portion is exhibited in Pl. XII, fig. 1, is, as shown by other specimens, strongly sigmoidal, like that of *Lioc. formosum.*

This variety is one of those forms which require careful examination to distinguish them from the young of a different species. I have had figured on the same plate (figs. 5 and 6) the young of *Lioc. giganteum*, which is the one form with which this variety may be confounded. But that form possesses a different umbilicus in which small steps are exhibited, because the whorls are not entirely occluded. I have endeavoured to show the difference in the nature of the umbilicus of the two specimens by the outline of the inner margins of the whorls (figs. 3 and 7). Of course, with every whorl the difference in this respect becomes more marked; and if the specimen of *Lioc. pingue* had attained the same diameter, but without the body-chamber being present, that is, if what is now body-chamber had been filled with air-chambers, all its umbilicus would have been regularly concave. The other chief difference between the two forms is the finer ribs on *Lioc. pingue.* The difference in the sectional view has been exaggerated, by the artist not having drawn enough inclusion in fig. 6. From all forms of *Lioc. concavum* with sigmoidal ribs *Lioc. pingue* is separated by being much thicker, with scarcely any carina; whilst its sigmoidal ribs separate it from those forms of *Lioc. v-scriptum* which it resembles somewhat in these respects. The nearest form to which it approaches is that figured in Pl. VIII, figs. 5 and 6; but this is not an adult of *Lioc. pingue*, because it is narrower, especially at the ventral area, and has a sharper carina, except on the body-chamber. One specimen of this variety in my collection shows an unusual length of body-chamber for the genus, namely 0·67 of a whorl, the normal amount being from 0·50—0·55, rarely 0·60. Hitherto I have found that the longer body-chamber accompanies the more compressed specimens; but this is an exception.

Lioc. pingue is a scarce fossil; it belongs to the *Concavum*-beds of Halfway House and Louse Hill only, and does not seem to occur at Bradford Abbas. It is generally in a rather poor state of preservation. Pl. XII, figs. 1 and 2, give a very good drawing of this variety. The carina in fig. 2 is perhaps a trifle too prominent. Fig. 3 shows a section of the regularly concave umbilicus. The specimen is from Halfway House and in my collection.

The largest specimen of this variety which I have seen measured three inches in diameter.

Lioceras concavum *var.* v-scriptum, *S. Buckman.* Plate VI; Plate IX, figs. 1—7; Plate X, figs. 5—8; Plate A, fig. 16.

1881. Ammonites concavus, *J. Buckman.* Quart. Journ. Geol. Soc., vol. xxxvii, p. 60, fig. 1.

Adult.—Discoidal, compressed, subcarinate; whorls broad, very slightly convex, with a small concave depression along the inner area, and ornamented with coarse, somewhat indistinct ribs on the outer area, which are continued as lines of growth on the ventral and inner areas. The ribs and lines of growth form sigmoidal curves, being projected on the lateral, recurved, and then slightly projected on the ventral, area. The body-chamber is ornamented merely with very fine lines of growth. The carina is not distinct, but is carried on a sloping ventral area, and scarcely rises above the angle which the two slopes would form if continued; it is still less conspicuous on the body-chamber, where also the ventral area is flatter. The inner margin is sloped and concave. The inclusion, except at the body-chamber, occupies nearly the whole whorl, forming an umbilicus almost regularly concave, the sides of which are scarcely interrupted by the projection into them of some of the indistinctly-defined margins of some of the inner whorls. The termination to the body-chamber is almost plain, only slightly constricted, and sigmoidal, similar in curvature to the ribs. (The ventral area is somewhat expanded just at the termination). In cases where the test is absent, two well-marked constrictions, caused by the thickening of the test (Pl. IX, fig. 3), are visible on the core; but they are scarcely perceptible when the test is present.

Immature.—At a diameter of 16 lines the shell is less compressed; the whorls are convex, with scarcely a distinct inner margin, but sloping towards the centre; and they are ornamented with ribs, which being projected on the lateral area and sharply recurved, are in shape like an expanded ⋖. These ribs are most conspicuous on the outer area, disappear on the edge of the ventral area, are continued as lines of growth across the carina at right angles, instead of being curved forwards, and are very seldom, if ever, bifurcate. The ventral area is broad and flattened, and carries a very small carina (shown perhaps too distinct in Pl. IX, fig. 5). The inclusion is a trifle more than three-fourths of the preceding whorl, leaving the umbilicus somewhat open. This, together with the subsequent increase in the inclusion, gives a peculiar flatness to the inner portion of the umbilicus in the adult, and in fact in *Lioceras* generally. The termination shows us a small pointed process on the lateral area; but on the ventral area, where the marginal edge meets the carina at right angles, there is no ventral process.

At a diameter of 25—30 lines the shell has a very similar appearance. The V-shaped ribs are very distinctly shown; the inner margin begins to become distinct, a concave depression to exist along the inner area, and the proportionate contraction of the umbilicus commences.

The change from V-shaped to sigmoidal ribs is, of course, gradual, and takes place between the diameter of four and five inches by the ribs being less projected on the lateral area, and the ribs (or rather striæ) more projected on the ventral area, thus meeting the carina at a more and more acute angle.

The ornamentation of the young forms of this variety is very striking; but at the same time we must not lay too much stress upon the V-shaped character of the ribs. The similarity which the specimens present to *Lioc. concavum* in every other way tend at once to show that this form of ribbing was not a character of great importance; and this view is confirmed when we see that the V-shaped ribbing gives place to the sigmoidal before maturity is reached. The V-shape reminds us to some extent of the ribs of *Ludwigia*, especially *Lud. obtusa;* but we can see that we have no specimen of *Ludwigia* to deal with in the present instance, both on account of the suture-line, and because on the inner area the ribs are scarcely developed, while they are strong on this area in *Ludwigia;* moreover we scarcely ever meet with any bifurcation of the V-shaped ribs, which again is the rule in *Ludwigia*, where the strong rib on the inner area produces two smaller ribs on the outer area.

The character of the V-shaped ribs generally escapes observation. The difference between *Lioc. v-scriptum* and *Lioc. concavum* is striking, but on first acquaintance with the shells is very seldom appreciated. There is a greater angle on the lateral area in *Lioc. v-scriptum* than in *Lioc. concavum;* but this character varies, and therefore is not thought to be of much importance. The real difference between the two styles of ribbing is only understood when the following facts are grasped, namely, that in *Lioc. v-scriptum* the external edge has been retarded, and thus, instead of the ends of the radii being projected or thrown forward on the ventral area, and so causing the radii to form a kind of hook on the outer area, they are retarded and cross the carina at right angles instead of joining it with a forward sweep. When once this is noticed it is easily recognised, and although complicated by the V-shaped changing into hook-shaped ribs, yet it materially aids in separating these forms. As a consequence of this retardation of the ventral area, we find no ventral process in specimens which possess the V-shaped style of ribbing. Even when such specimens are adult and their V-shaped ribbing has given place to sigmoidal, the ventral process is not greatly developed. What may have caused this retardation I cannot at present say, but that it was no detriment to the forms which possessed it, may be seen from the fact that those with V-shaped ribs are certainly more numerous in the Bradford-Abbas district than those with sigmoidal ribs. The V-shaped character of the ribbing is not confined to *Lioc. v-scriptum;* but the forms which I have united under this name certainly show it in a marked degree. Besides this character, they also have a rather flat and broad ventral area, with a small carina which is necessarily less distinct than if the ventral area were as much sloped as it is in the type.

What we must call sub-varieties of *Lioc. v-scriptum* are met with—for instance, one form with a much smaller, quite concave umbilicus. Of this I have figured a fine large adult as *Lioc. concavum, var. A,*[1] Pl. VI; but I believe the above is its proper position. A young specimen of this form is figured[2] in Pl. IX, figs. 5, 6. This sub-variety is scarce, and I have not had many specimens to examine; the adult specimen, being too large, does not show the reflexed ribs.

Another sub-variety has a larger, deeper, and yet regularly concave umbilicus, and is considerably thicker. An adult specimen of this, Pl. X, figs. 5, 6, shows the change from V-shaped to sigmoidal ribs very clearly, which change takes place when the shell has a diameter of about four inches. In this form the inner margin is deep, the concave depression of the inner area is broad and not very perceptible, while the whorls slope towards the external edge from the middle of the lateral area.

Lioc. v-scriptum is most likely to be confounded with forms of *Lioc. concavum;* but the V-shaped ribs, less compressed appearance, and small carina on a flattish ventral area, should distinguish it. Young specimens which, having the body-chamber, exhibit some tendency to recession from the line of coil at the period when the change from more open to narrower umbilicus usually takes place, are easily confounded with specimens of *Lioc. apertum.* Such a one is figured in Pl. X, figs. 7, 8; and a form somewhat intermediate between *Lioc. v-scriptum* and *Lioc. concavum,* exhibiting a similar tendency, in Pl. XV, figs. 5, 6. The difference consists in *Lioc. apertum* having coarser ribs and a definitely larger umbilicus, which remains constant in size at the different ages; while the umbilicus of these forms of *Lioc. concavum* and *v-scriptum* exhibits an accidental resemblance, though only at a certain period of growth, owing to the recession of the inner margin on account of the presence of the body-chamber. Of course the close relationship between *Lioc. v-scriptum* and *Lioc. apertum* is apparent. Either they may be descended from a common ancestor, or *Lioc. apertum* may be an instance of a sub-variety of *Lioc.*

[1] For "var. A" substitute "var. *v-scriptum.*"

[2] Its carina, especially in fig. 6, is drawn too prominent, giving to the specimen the appearance of another variety.

v-scriptum, becoming gradually sufficiently pronounced to constitute a definite species.

Lioc. v-scriptum has some resemblance to *Lioc. fallax*, under which heading the differences are mentioned. It has also much resemblance in general shape to *Lioc. giganteum ;* but the differences consist in the ribs being coarse and V-shaped, instead of fine and sigmoidal, the carina less prominent, and the umbilicus regularly concave. As regards the latter character, a complete examination of *Lioc. concavum* and all its varieties indicates that an almost entirely concave umbilicus is a most constant feature in the adult.

Lioc. v-scriptum is a somewhat common form in the *Concavum*-beds of Bradford Abbas, Dorset. I have no specimens actually labelled "Halfway House," though I have little doubt it occurs there. A small specimen from Stoford, Somerset, is in my collection, and another labelled "East Coker" in that County. This latter specimen would seem to indicate that some trace of the *Concavum*-beds is represented in the quarry there.

Plate IX, fig. 1, represents an adult specimen of the middle form of *Lioc. v-scriptum*, showing the termination of the mouth-border. The greater portion of the test is present, and fairly well preserved. A portion of the sutures is shown *in situ* (fig. 4); and the cross indicates the commencement of the body-chamber. The other side of this same specimen was figured in my father's memoir[1]; and fig. 3 illustrates a portion of this view of the specimen, which is without the test, and thus shows the constrictions. My father supposed[2] that this specimen possessed a long lateral process, but I can see no indication of it; and the termination, as indicated by the fine lines of growth, is perfectly complete on the side shown in my fig. 1. Fig. 2 gives the front view of the same specimen. The test is absent on the top ventral area of the body-chamber, and should have been so shown in fig. 1 just along the edge, thus accounting for the depression towards the top of the mouth of fig. 1. The slight increase in the thickness of the upper portion of the body-chamber towards the termination causes the concavity on the inner area to appear more pronounced. This specimen was collected by my father at Bradford Abbas. Pl. X, figs. 7, 8, exhibit what may practically be taken as a young form, the only difference being a slight tendency to increase the diameter of the umbilicus rather more than in the true young forms. Otherwise this form shows the characters and proportions very well, especially the small carina and the V-shaped ribs. It was chosen for figuring to compare with *Lioceras apertum* (Pl. X, figs. 10, 11). This specimen is from Bradford Abbas. Pl. IX, fig. 7, illustrates a really young specimen of the middle form with the lateral process as developed in youth. This process is shorter and more pointed than that met with in *Lud. cornu*. (It

[1] 'Quart. Journ. Geol. Soc.,' xxxvii, p. 60.

[2] Loc. cit.

is probable that the change from a pointed to a rounded process accompanies the change in the ribs.) The open umbilicus of this specimen is quite in accordance with what may be observed in the inner whorls of the larger specimen on the same plate (fig. 1). I collected this fossil at Bradford Abbas. In Pl. VI under the name "var. A," which, however, may now be erased, is depicted the slightly thinner form of *Lioc. v-scriptum* with smaller umbilicus. This and another specimen of *Lioc. concavum*, which has about one inch more in the length of whorl, are by far the largest specimens of any form of the species or its varieties with which I am acquainted; about half a whorl less when the specimen is perfect, or even smaller, are the sizes more usually found. These two specimens I obtained at the same place, namely, the railway-cutting at Bradford Abbas, and to the best of my recollection on the same day; but specimens of this size must be scarce because I do not remember to have obtained another, nor does my father's collection exhibit anything so large. Pl. IX, figs. 5, 6, show a small specimen of this form with the narrow umbilicus from Bradford Abbas. The carina in this figure is rather too prominent. On Pl. X, figs. 5, 6, we have the largest specimen which I possess of the thicker form with broader umbilicus. The carina, where the whorl enters the aperture, seems, on account of a blot, too acute, but is correct at the top and bottom of the figure. The specimen was obtained by my father, and, judging from the matrix, came from Bradford Abbas.

The suture-lines of *Lioc. v-scriptum* are shown in Pl. A, fig. 16, and a portion *in situ*, Pl. IX, fig. 4. The former, which was taken from the specimen figured on Pl. X, figs. 5, 6, shows all the characters of the suture-line of *Lioceras*, with a well-developed accessory lobe in the siphonal saddle, and a gradually decreasing array of lateral and auxiliary lobes (of the latter there are four fairly well pronounced). The latter figure shows the way in which the preceding lobes are penetrated by later lobes, a character which, besides perhaps indicating slower growth, gave greater support to the side, and was certainly a most persistent feature in the genus *Lioceras*.

THE OTHER VARIETIES OF LIOCERAS CONCAVUM (*Sow.*). Plate VIII, figs. 3—8; Plate IX, figs. 8—10; Plate X, figs. 3, 4, and 9; Plate XV, figs. 5, 6.

If we examine all the varied forms which seem to arrange themselves under the general title *Lioc. concavum and varieties*, we shall observe, as I pointed out in treating of the type (p. 57), a very general resemblance in certain important features, and that they may be divided roughly into two classes, the one possessing sigmoidal or subfalciform ribs, and the other, at any rate during the earlier stages of growth, the V-shaped ribs. The amount of variation which the species exhibits seems to be endless; yet one fact should be noticed, namely, that if we collect enough specimens we find the variations must have been constant for some definite period, and therefore we can group two or three specimens with one form, half-a-dozen with another, a dozen with a third, and so on; and both young and old of each of these various forms agree exactly among themselves, but differ from the type in certain features.

I cannot attempt to mention all these different forms, but will content myself with a few remarks upon the commoner, or the more striking, in the following manner:

I. Forms with Falciform Ribs.

(Pl. II, figs. 6, 7; Pl. VIII, figs. 1, 2.) The typical form (Sowerby's), pp. 56—62.

α.[1] (Pl. VIII, figs. 3, 4.) Variety with finer ribs. Bradford Abbas; scarce.

β. Ribs intermediate between those of the type and *α*; umbilicus much smaller. Bradford Abbas; but chiefly found at Louse Hill; also at Corton Downs, Somerset.

γ. (Pl. X, figs. 3, 4.) Thicker; umbilicus small but deep; ventral area broader and flatter. Pl. VIII, figs. 5, 6, is probably the adult form. Bradford Abbas; scarce.

δ. (Pl. XII, figs. 1, 2; *Lioc. pingue.*) Still thicker; fine ribs; very slight carina; a form somewhat isolated. Peculiar to Halfway House and Louse Hill.

ε. Allied to the type; umbilicus a trifle smaller; ventral area and carina more acute. Scarce; Bradford Abbas.

ζ. (Pl. X, figs. 1, 2; *Lioc. formosum.*) Rather smooth; umbilicus larger than type; ventral area acute; inner area more compressed. Scarce; Bradford Abbas.

II. Forms with V-shaped Ribs.

1. *Carina fairly prominent.*

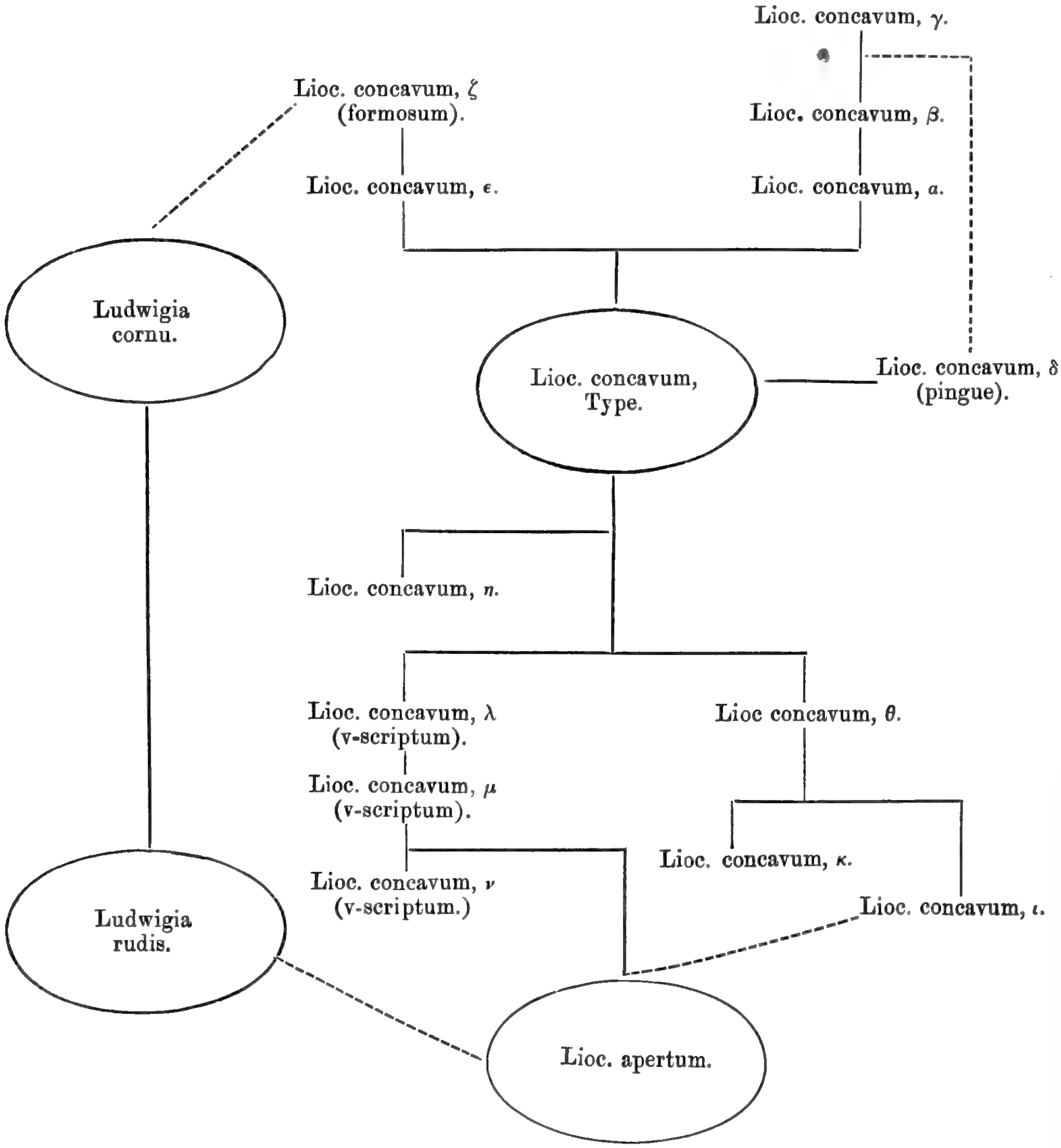
η. Like the type in shape; ribs fine and numerous; ventral area slightly flatter. Fairly frequent. Bradford Abbas, Dorset; Dundry, Somerset.

θ. Thicker; ribs coarser. Fairly frequent. Bradford Abbas.

ι. Smaller umbilicus. Bradford Abbas, Dorset; Dundry, Somerset. Pl. VIII, figs. 7, 8, is perhaps the same, but it has peculiar small knobs on middle of lateral area.

[1] This does not refer to Plate VI, var. A.

Table I.—*Arrangement of the Varieties of* Lioc. concavum *according to the amount of their difference from the Type.*



κ. (Pl. X, fig. 9.) Similar to θ, but the inner area is much compressed; peculiar raised ridges on the middle of the lateral area; ribs strongly recurved. Unique specimen; Bradford Abbas.

2. *Carina nearly obsolete.*

λ. (Pl. VI;[1] Pl. IX, figs. 5, 6.) Small umbilicus. Bradford Abbas.

μ. (Pl. IX, figs. 1, 2; Pl. X, figs. 6, 7, 8.) This is a slightly thicker form; umbilicus larger. Fairly numerous, especially when small. Bradford Abbas.

ν. (Pl. X, figs. 5, 6.) Still thicker; larger umbilicus. Fairly numerous. Bradford Abbas and Halfway House, Dorset; and Stoford, Somerset. (λ, μ, and ν form the variety *Lioc. v-scriptum.*)

ο. (Pl. XV, figs. 5, 6.) Much compressed; sides nearly parallel; open umbilicus. Scarce. Bradford Abbas.

In the forms α, β, γ, and δ the acuteness of the carina and ventral area decreases in this order; but ε, ζ have the ventral area very acute. The adult of η is very much like the type; but its umbilicus is regularly concave. It is rather doubtful whether it has more claim to be placed in the Class I or in II. Its ribs are certainly much projected on the lateral area, and form a rather acute angle; but at the same time they are projected slightly on the ventral area, and very soon (when the diameter is about two inches) become subfalciform. Some young specimens (when the diameter is about half an inch), if I am right in placing them here, show strongly-marked V-shaped ribs. The specimens included in θ are exactly like *Lioc. v-scriptum* but have a sharper ventral area and more prominent carina. The ribs change when the diameter of the shell is about three inches.

In Plate IX, figs. 8, 9, 10, an abnormal form is depicted. This really belongs to ι. From some cause one side (fig. 9) shows no concave inner margin, but a much larger umbilicus and some strong depressions; while fig. 10 illustrates the difference which the front view exhibits. (This is not the only case of malformation which I have met with.) The test is perfectly preserved over the whole specimen, and so there can have been no crushing during fossilisation.

The annexed Table I will show at a glance the greater or less similarity in shape between the various forms which I have mentioned. It should, however, be borne in mind that those which are placed in an intermediate position may not be intermediate in the strict sense of the term, that is, they may not be in any way intermediate in point of descent. Possibly an intermediate form possesses characters which its neighbours do not show, and was not the descendant of the one, or the ancestor of the other. This arrangement may not be natural, but

[1] Erase the words "*var. A*" on Plate VI, and substitute "*Variety v-scriptum.*"

it is convenient; and all the forms are not in a false position. As an example of what I mean I may note that *Lioc. apertum* might be described as intermediate between *Lioc. v-scriptum* and *Lud. rudis*, but it is evidently nothing of the kind; it is neither ancestor nor descendant of *Lud. rudis*.

In this Table the dotted lines show that there exists some resemblance between the forms which they connect; but this resemblance is not so great as that which exists between the forms joined by the unbroken lines. The most curious fact here brought under our notice is that *Lioc. concavum*, variety *formosum* at the one end, and *Lioc. apertum* at the other, are the two forms which respectively have the most resemblance to certain *Ludwigiæ*, the first to *Ludwigia cornu*, and the second to *Ludwigia rudis*. But the two species of *Ludwigia*, whose very close relationship to each other is undoubted, belong to a genetic series different from that of *Lioceras*. This fact shows very well the extraordinary tangle which has to be unravelled, and the close attention that is required, before coming to a decision either as to the separation or the lumping of various forms.

LIOCERAS APERTUM, *S. Buckman*. Plate X, figs. 10, 11; Plate XV, figs. 3, 4, 7—10.

Discoidal, somewhat compressed, subcarinate; whorls flattened, with a concave depression in the inner area when the inner margin is formed, and ornamented, up to attaining a diameter of about fifteen lines, with simple, slightly bent ribs. After this diameter has been attained the ribs gradually become more bent, less conspicuous on the inner area, and more conspicuous on the outer; and not being projected forwards on the ventral area they partake of the V-shape. The ventral area is smooth, very little sloped, and ornamented with a very slight carina. The inner margin is concave, and becomes more distinctly formed at about the time the ribs change; but before that period it is a mere undefined slope. The inclusion in young specimens reaches to about half the preceding whorl (Pl. XV, fig. 7); in older individuals to about two-thirds (Pl. XV, fig. 3), and in larger forms to about three-fourths (Pl. X, fig. 10). The umbilicus is shallow, showing portions of all the inner whorls ornamented with very small ribs.

A less compressed form (Pl. XV, figs. 9 and 10) shows somewhat coarser and less bent ribs, and a slightly deeper umbilicus; but it is chiefly interesting for the mouth-appendages which it exhibits. These consist of two lateral processes, evidently of some length; but there is no process on the ventral area, the end of the mouth crossing the carina at a right angle.

This most peculiar species has been a source of considerable trouble. At first glance it seems to be intermediate between *Ludwigia rudis* and the young of *Lioc.*

v-scriptum. Pl. X, figs. 10, 11, exhibit the largest form of this species in contrast with a young form of *Lioc. v-scriptum*, figs. 7, 8; and on Pl. XV the young form of this species is contrasted with *Ludwigia rudis* and with another form of *Lioc. concavum*. If this latter (Pl. XV, fig. 5) be compared with Pl. X, fig. 10, it will be seen that it looks like a reduced figure thereof; but if it be compared with what *Lioc. apertum* is when at the same diameter, it will be found to differ in the smallness of its umbilicus and the character of its ribs. Further investigation, too, will show that Pl. XV, fig. 3, is exactly the young form of Pl. X, fig. 10, corresponding in every way, but having (as we should expect, because it possesses the body-chamber) an umbilicus just a fraction larger than that of Pl. X, fig. 10, at the same diameter. I am thus particular, because it is necessary for me to show, if possible, the actual relationship of the young and old of any form, whether species or variety, and we see that on account of the great apparent similarity of Pl. XV, fig. 5, to Pl. X, fig. 10, anyone might be easily misled unless he were most careful. On the other hand, the resemblance that exists between *Lioc. apertum* and *Ludwigia rudis* is most striking (especially between figs. 9, 10 and 11, 12, on Pl. XV); and is an instance of that convergence in shape of members of different genetic series, which is recognised as taking place.[1] We have already had to deal with a similar, but not so pronounced, convergence between *Ludwigia Murchisonæ*, var. *Baylii* and *Lioc. bradfordense* (p. 23); and now we have two forms extremely similar in appearance which it is necessary to put into two different genera; and though *Lioc. apertum* looks as if it were intermediate between *Lioc. v-scriptum* and *Ludwigia rudis*, yet it is in reality nothing of the kind in point of descent. *Ludwigia rudis* is in no way descended from *Lioc. v-scriptum* through *Lioc. apertum*, but comes most probably from *Ludwigia costosa*[2] of the *Opalinum*-zone. *Lioc. apertum* is, of course, descended from *Lioc. elegans* (Young) of the Upper Lias, very probably through *Lioc. concavum* and *Lioc. v-scriptum*.

We need not say much about the differences of the sutures of *Lioc. apertum* and *Ludwigia rudis*, because the specimens are so small that the smaller auxiliary lobes are merely little denticulations. There are differences however. The sutures of *Lioc. apertum* (Pl. A, fig. 17) are in miniature exactly like those which belong to other species of *Lioceras;* for instance, Fig. 1, p. 36; Pl. IV, fig. 8; Pl. IX, fig. 4; and Pl. A, figs. 10 and 12—16. On the other hand, the sutures of *Lud. rudis* (Pl. A, fig. 7) are simple, and agree precisely with those of the different species of *Ludwigia;* for instance, Pl. A, figs. 1—6. They exhibit the disproportion in size between the superior and inferior lateral lobes

[1] See E. Haug, "Ueber die Polymorphidæ," 'Neues Jahrbuch für Mineralogie, &c.,' 1887, Bd. ii, pp. 89—163, where convergence between species whose original sources were far wider apart is treated of.

[2] See p. 102.

so characteristic of *Ludwigia*, as well as the other often-mentioned differences which exist between the suture-lines of the two genera.

The other differences between the two species may be well observed on Pl. XV, where I have placed them together. *Lud. rudis* possesses coarse ribs, more conspicuous (especially in the young), on the inner area; they very frequently bifurcate, which is seldom if ever the case with the ribs of *Lioc. apertum.* The umbilicus is larger, and the portions of the whorls exposed are somewhat tumid, showing coarse ribs often with the point of bifurcation; while in *Lioc. apertum* the whorls of the umbilicus are inclined to be concave, which is due to depression in the inner area, and they possess much smaller ribs (it is almost impossible to delineate these differences in a plate). *Lud. rudis* has convex and more tumid whorls, with a more distinct carina. *Lioc. apertum* has compressed whorls with parallel sides, a slightly concave inner area, and a very indistinct carina. *Lud. rudis* has the ends of its ribs slightly bent forward on the ventral area, and possesses a ventral appendage to the body-chamber. *Lioc. apertum* has neither of these characters. The inner margin of *Lud. rudis* is not formed until a later date. It will thus be seen that *Lioc. apertum* has far more affinities with *Lioc. concavum* than with *Lud. rudis.*

Lioc. apertum occurs in the *Concavum*-beds at Bradford Abbas, but cannot be regarded as an abundant shell. When we consider the number of young specimens of the different species of *Lioceras* and *Ludwigia* with which it occurs, we cannot be surprised at any difficulty in accurately determining it; and had I been unacquainted with the large specimen I should have hesitated to describe the species.

Pl. X, figs. 10, 11, represent the largest specimen which I have seen. It was in the cabinet of the late Mr. E. Witchell, F.G.S., who collected it at Bradford Abbas, and very kindly lent it to be figured in this work. As shown by the × the whole of the body-chamber is probably present. The test on the specimen is well preserved, and only allows a small portion of the sutures to be seen. Pl. XV, figs. 3, 4, show a smaller typical specimen, with most of its very thin test well preserved. This, from Bradford Abbas, is in my collection. Pl. XV, figs. 7, 8, illustrate a still younger specimen of the same typical form (probably from Bradford Abbas) to compare with figs. 14, 15. In Pl. XV, figs. 9, 10, a slight variety, with somewhat thicker whorls and smaller umbilicus, and with the termination of the mouth-border, is delineated. The test on a part of the specimen is fairly well preserved. It came from a small opening made at Bradford Abbas, where the *Concavum*-beds lay just under the surface, and about a quarter of a mile north of the well-known quarry. The crosses on Pl. XV indicate the last suture-line, and thus tell us that the body-chamber in this species was a trifle more than is usually possessed by *Lioceras*, being more than half a whorl in length.

Lioceras fallax, *S. Buckman.* Plate XIV, figs. 10, 11.

Discoidal, compressed, subcarinate; whorls subconvex, ornamented with coarse, broad, rounded, subfalciform ribs, projected forwards on the ventral area, more conspicuous on the outer than on the inner area, nowhere very distinct, but appearing more like large undulations on the sides. Ventral area narrow, and acutely sloping towards a carina, which, though seemingly much elevated, is not really very distinctly separated from the sloping ventral area. Inner margin concave but rather upright. Inclusion over about three-fourths[1] of the whorl. Umbilicus evidently very open in youth, but more closed in maturer age. It exposes portions of the inner whorls with an appearance somewhat tumid owing to the ends of the ribs being present.

Lioc. fallax is in general shape and proportions very much like *Lioc. giganteum;* but there are many characters of ribbing, coiling, &c., which seem to point to its being really more distinct than would at first be supposed. It is possible that badly-preserved specimens of this species and of *Lioc. giganteum* would be difficult to separate; but it is always better to reject badly-preserved examples since they frequently lead to erroneous ideas. I consider that the ornamentation and mode of growth exhibited by this species preclude any idea of its being a descendant of *Lioc. giganteum.* In youth it evidently possesses, judging from the inner whorls, an umbilicus more open and also flatter than that of *Lioc. giganteum,* and yet has those portions of the whorls visible in the umbilicus more tumid. At a little later period the umbilicus becomes somewhat contracted and appears deeper, owing to the presence of a rather upright inner margin (the inner margin is more sloping against the body-chamber, but is drawn rather too much so in the figure). This is the time when, the umbilicus being somewhat similar in size, this species has most resemblance to *Lioc. giganteum.* But, after all, its broad coarse ribs, few in number, its whorls, with their more pronounced slope from the middle towards an ill-defined ventral area, and its larger carina, separate it very distinctly. The latter characters and the larger umbilicus separate it from *Lioc. v-scriptum,* the thick form. Its ribs have somewhat the same coarse character as those of that variety, but are subfalciform and somewhat more prominent. Altogether this species is rather more distinct than any other species of *Lioceras,* and seems somewhat isolated. Its descent is not clear. I do not think it has come from *Lioc. giganteum* on account of the reasons which I have given. It is more in character with the *Lioc. v-scriptum* forms; but we do not know whether its ribs are V-shaped or otherwise in youth. Its carina is

[1] In the figured specimen it is about two-thirds owing to the recession of the inner edge of body-chamber.

also much too prominent to be in keeping with those forms, and its ventral area is too acute. For my part I should prefer to consider it more nearly allied to them than to *Lioc. giganteum* but that its immediate ancestor has yet to be discovered.

The specimens of this species which I possess are all probably nearly adult, and came from the *Concavum*-beds at Bradford Abbas, Dorset. The largest measures seven inches in diameter, and possesses but little of the body-chamber. The specimen figured (Pl. XIV, figs. 10, 11) is just under this measure, but possesses most of the body-chamber, as the position of the cross shows. The test on the side drawn in the figure is not very well preserved, being somewhat decomposed, and some of the characters of the ribbing have had to be delineated by observation of the test on the other side. The specimen possesses, as is shown in the figure, a very thick test.

The genus *Lioceras*, the account of which is now brought to a close, is very interesting because of the number of closely-allied species which it produced, and because of the manner in which those species varied. Roughly speaking, the genus may be divided into three portions, although it would perhaps be impossible to draw any very marked distinctions between them. They are as follows:

1. The smooth *Liocerata*:—*Lioc. opalinum*, *Lioc. decipiens*, and their varieties.
2. The ribbed *Liocerata*:—*Lioc. elegans* (Young),[1] *Lioc. bradfordense*, *Lioc. concavum*, *Lioc. fallax*, *Lioc. apertum*, and their varieties.
3. The doubtful *Liocerata*:—*Lioc. ambiguum* and its variety.

The last division contains forms smooth or irregularly ribbed, and with a suture-line which is different (p. 29, &c.). I fancy it is quite possible they may belong to a different genetic series, and may be an instance of convergence. A species not yet recognised as British, namely, *Am. opalinoides*, Ch. Mayer (taking the reference to Zieten's fig. 1, pl. vi, 'Verstein. Württ.,' as the type) may be another species which belongs to division 3.

One especially singular feature which this genus brings to our notice is that in *Lioc. apertum* it would appear that the V-shaped ribs are continued without change. This is altogether contrary to the usual rule, which is that the young of a species resemble the ancestor, while the adults exhibit the greater change. At this rate it would be correct to derive *Lioc. v-scriptum* from *Lioc. apertum*, which seems entirely opposed to what we know about the relationship of the other species of the genus.

[1] This species occurs in the lowest zone of the Upper Lias and was fully treated of by Dr. Wright, 'Monograph Lias Amm.,' p. 447. It must be borne in mind that it is entirely distinct from Sowerby's pecies; but see p. 38.

HILDOCERATIDÆ.[1]

Genus—PSEUDOLIOCERAS,[2] *S. Buckman.*

(*Type*—PSEUDOLIOCERAS COMPACTILE, *Simpson* sp.)

Definition.—Discoidal, compressed, hollow-carinate; whorls broad and subconvex, ornamented with subfalciform radii which approach the carina at an acute angle. The ribs are distinct only on the outer area, not prominent, rather broad, and rounded. The ventral area exhibits a very narrow space on each side of the carina, which space is sometimes scarcely defined from the lateral area; but when the test is absent the ventral portion is an ill-defined, scarcely carinate, convex area joining the two sides of the whorl. The carina is sharp, distinct, somewhat prominent, and hollow.[3] When the test is absent, some slight indications of a

[1] Also substitute this word for Hildoceratinæ on p. 21, heading; for reason see p. 125, *et seq.*

[2] ψεῦδος, false.

[3] A "hollow-carina" is one which is partitioned off from the rest of the specimen by a spiral band at its base. Such a carina was formed because the inner ventral portion of the animal in the last chamber did not occupy the carina itself, but was attached to an extra internal partition which shut off the raised carina. This partition-band was flat on its upper side and concave beneath. The two sides of the carina, together with the partition-band, enclosed a subtriangular hollow space (now, of course, filled with matrix or crystal), separated entirely from the air-chambers, and, for part of its length, from the animal. The siphuncle does not lie within the carina of hollow-keeled Ammonites, but is situated beneath the partition-band (Plate A, fig. 38). When the test is absent from hollow-keeled Ammonites, the core or cast of the specimens is generally rounded on the ventral area, and gives no idea of the large carina which the specimen would possess were the test uninjured (Plate A, fig. 38); but in some genera the ventral area of the core shows a small indication of a carina (Plate A, fig. 47), which, however, bears no proportion to the large carina actually possessed by the specimen. The ventral lobe, of course, embraces the siphuncle, and is attached to the partition-band, but does not have any connection with the inner walls of the carina. This carina, therefore, forms a separate hollow tube (the partition-band being the base), which runs round the periphery of the Ammonite; and the matrix in this hollow tube has sometimes been mistaken for the siphuncle. (In some specimens the matrix with which this tube is now filled contains a black substance.)

In the solid-keeled Ammonites the structure of the carina is quite different. There is no trace of a hollow tube, nor of a partition-band; the ventral area of the core partakes of the shape of the test, being carinated in proportion (Plate A, fig. 27); the siphuncle lies within the carina, and is embraced by the ventral lobe, which is attached to the inner walls of the carina.

It must, however, be particularly noticed that a part of the body-chamber of the hollow-keeled Ammonites does not exhibit the hollow keel. The hollow tube is continued beyond the last air-chamber for about one-fourth the length of the body-chamber. My specimens (species of various genera) seem to show that at this point it ends suddenly, and they then become solid-keeled. Upon the body-carina are visible, even over the air-chambers (but see foot-note). The inner margin is upright, well-developed, and straight. The inclusion seems to be always considerable, and scarcely any portions of the inner whorls are exposed. The umbilicus is small, rather deep, formed of a series of very small steps ; it has

chamber in some species the carina, after the hollow tube has ended, continues to be of the same size, and the core, which was formerly non-carinate, now exhibits a large carina; that is to say, the animal in that part of the body-chamber occupied the carina without the intervention of a partition. In other cases, after the termination of the hollow tube the carina decreases in size.

It is important that these facts concerning the change in the ventral area of the body-chamber from a hollow-keeled to a solid-keeled state should be correctly understood, because otherwise an examination of the carina of the body-chamber might lead to the erroneous supposition that the whole Ammonite was necessarily solid-keeled. It is therefore possible for the same specimen to exhibit both solid-keeled and hollow-keeled states; but for that to be apparent a considerable portion of the body-chamber must be present.

From the above remarks it will be seen that we have a most important and peculiar structure in the carina of certain species of Ammonites. What its functions may have been I cannot say. Whether the partition-band is part of the inner shell, or a separate growth, is uncertain; but I incline to the latter idea, because the partition-band separates cleanly away from the test, and is often present when the test is wanting. In many genera the hollow carina is a most conspicuous feature, notably in *Haugia, Harpoceras, &c.*, and the ventral area of the core is rounded ; in other genera, such as *Pseudolioceras*, the feature is not so conspicuous, and the ventral area of the core shows a very slight indication of a carina ; while in *Witchellia*[1] the hollow carina varies somewhat in size, and the ventral area of the core shows a slight carina bordered by two furrows which are not seen on the test.

The value of the hollow carina for the purposes of classification is uncertain. When I first noticed the feature I hoped that it would enable me to make some very clear definitions. This hope must, I am afraid, be abandoned. It would seem that this structure is to a certain extent of generic value since it enables us, for instance, to separate *Pseudolioceras* from *Lioceras ;* but it does not assist us to distinguish *Haugia* from *Harpoceras.* If Ammonites are to be classed according to their descent, it seems to be impossible to keep the hollow-keeled Ammonites in one family and the solid-keeled in another; because, according to my reading of the facts, the hollow-keeled are sometimes descended from solid-keeled, and *vice versâ.* Should we, however, reject the theory of evolution entirely, we could not arrange the Ammonites as the solid-keeled family and the hollow-keeled family without doing violence to what is expressed by similarity of other structures, such as ribs, suture-line, &c. ; and we should find that in the one family were included *Ammonites*, the most diverse in these respects, but agreeing only in possessing a hollow carina; while those *Ammonites* which were excluded from this family differed in no way from certain included members except in this matter of keel-structure.

Taking all these points into consideration, I can only conclude that, functionally, the hollow carina was not of any great service to the Ammonite; that it was a character which, perhaps by disuse, became undeveloped in certain species without any detriment to them, or again was developed if circumstances so required. I cannot at present see my way clear to make any use of it in classification except so far as genera are concerned. I am even doubtful if I should venture to create a genus merely on the presence or absence of a hollow carina in the species; but hitherto I have not had to

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[1] WITCHELLIA, nov. gen., dedicated to the memory of my kind friend Mr. E. Witchell, F.G.S. The type is *Witchellia læviuscula*, Sow. sp. ; and to this genus belong also *Am. jugifer*, Waag., *Am. Sutneri*, Branco, *Am. deltafalcatus*, Quenstedt.

a flattened middle, indicating that in extreme youth there was less occlusion. The suture-line (Plate A, fig. 22) shows a siphonal lobe with short, somewhat divergent terminal points; the siphonal saddle is rather large, encroached upon by some digitations from the lobes, and unequally divided by a fairly well-developed accessory lobe; the interior portion of this saddle is larger and deeper. The superior lateral lobe is large, with several lateral digitations and some slight amount of trifurcation at the end; the superior lateral saddle is rather deep and narrow; the inferior lateral lobe is quite small in proportion to the superior; the first auxiliary lobe is fairly well developed, and digitations seem to indicate the presence of a whole series of smaller auxiliary lobes. The position of the septa with regard to one another indicates a medium-sized chamber, not so large as in *Ludwigia*, but rather larger than in *Lioceras*.

Remarks.—This genus appears at first sight to be intermediate between *Harpoceras* and *Lioceras*, to both of which it has very considerable similarity in form. From *Harpoceras* it may be separated by the following characters:—It does not possess such a pronounced hollow carina, its radii have not the strongly-marked sickle-shape, with its sweeping curve on the outer area, and its long forward bend on the ventral area; its ribs are only developed on the outer lateral area, and are then broader, more distant, and more regularly rounded; its suture-line has a broader siphonal lobe, with shorter, more divergent terminal points, a smaller inferior lateral lobe, and a greater number of auxiliary lobes. From *Lioceras*, which it particularly resembles in the character of its ribbing, it may be separated by its having a hollow instead of a solid carina, a straight and upright inner margin, and a different suture-line. The sutures have a larger accessory lobe in the siphonal saddle, a smaller inferior lateral lobe, and a less distinct series of auxiliary lobes.

The genus *Pseudolioceras* contains at present but few species, and its vertical range is not very great. The earliest form is probably *Pseudolioceras lythense* (Young and Bird), which occurs in the Upper Lias. A direct descendant of this is very probably found in *Ps. compactile* (Simpson), which occurs in the lower part of the Cotteswold Sands with a variety of *Hildoceras bifrons* (Section VI, p. 45), and at what is perhaps a slightly higher horizon in the Sands, with *Lytoc. sublineatum* (Section VII, p. 46); but only lately have I found it in the *Striatulum*-beds. In the *Opalinum*-zone at Haresfield (Bed 15, Section V, p. 43) and at other places other specimens of the genus occur which must be considered as varieties of *Ps. Beyrichi* (Schloenbach). (This species is doubtless a direct

deal with that question, because other characters, namely, ribbing, suture-line, &c., have also varied sufficiently.

This hollow-keel structure seems to be little, if at all, known in England. For further information concerning it the works of Quenstedt, Waagen, Haug, Vacek, and Denckmann may be consulted with advantage.

descendant from *Ps. compactile*, and these specimens approach in shape somewhat nearer to the parent form than Schloenbach's figures do.)

The fact that this genus occurs at about the same horizon as *Harpoceras falciferum* would seem to preclude any idea of its being descended from the genus *Harpoceras*. Its state of development, too, prevents this conclusion, because it is, in my opinion, more developed in some respects and less developed in others than is the genus *Harpoceras;* or, in other words, it differs from the parent stem more in some ways than *Harpoceras* and less in others.[1] It also stands just in the same relation to the genus *Lioceras*, which first appears at about the same, or even at a somewhat lower, horizon.[2] It is not, therefore, the parent of *Lioceras*, and, being less developed, it can scarcely be its descendant. The fact is that we have in the Upper Lias three distinct stem-forms derived from some common ancestor which existed prior to the *Margaritatus*-zone. The descendants of two of these three stem-forms are traceable into the Inferior Oolite as parallel genetic series. Doubtless to this cause we owe that convergence of certain species among them—species belonging to different genera—which makes the separation and definition of genera and species an intricate task. When, however, we are able to trace the different species back to their parent forms, we can recognise and appreciate the reasons for their separation. By inducing close observation of the characters of the various species, this mode of generic subdivision should become of considerable assistance and benefit to such researches.

According to my interpretation of Ammonite-evolution, this genus is the parent of the next genus *Hyperlioceras*, and is itself descended from *Am. Curioni*, Meneghini, of the *Margaritatus*-zone. Commencing in the Upper Lias, it underwent certain modifications in course of time, and finally died out with the *Opalinum*-zone, having given birth (probably through *Ps. compactile*) to the forms in the *Concavum*-beds which, because they possess certain characters peculiar to themselves distinguishing them from their parent genus, I have placed in a genus *Hyperlioceras*.

[1] See pp. 134, 138, 139.

[2] Prof. Blake quotes *Lioceras elegans* (*Harpoceras concavum*, 'Yorkshire Lias,' p. 303) from the zone of *Am. annulatus*, *Harpoceras falciferum* (his *Harp. serpentinum*) from the so-called *Serpentinum*-zone, and *Ps. lythense* (*Harpoceras lythense*, p. 304) from the zone of *Am. communis*. Dr. Wright quotes the last (*Harp. lythense*, 'Monogr. Lias Amm.,' p. 445) from the *Serpentinum*- (*i. e. falciferum*) zone.

PSEUDOLIOCERAS COMPACTILE (*Simpson*). Plate XX, figs. 3—6.

1855. AMMONITES COMPACTILIS, *Simpson.* Fossils Yorkshire Lias, p. 75, No. 119.
1874. AMMONITES LYTHENSIS, *Dumortier* (non *Young* and *Bird*). Études pal. Bassin Rhone, iv, pl. xi. figs. 9, 10.
1876. HARPOCERAS COMPACTILE, *Blake.* Yorkshire Lias (Cephalopoda), p. 308, pl. viii, fig. 6.
1884. — — *Haug.* Ammonites nouvelles ou peu connues, Bull. Soc. géol. France, 3e série, t. xii, pl. xiv, figs. 1 *a—c.*
1884. AMMONITES COMPACTILIS, *Simpson.* Fossils Yorkshire Lias, 2nd edit., p. 110.
1885. HARPOCERAS COMPACTILE, *Haug.* Beiträge Monog. Harpoceras, Neues Jahrbuch für Min., &c., Beil.-Bd. iii, p. 623, pl. xi, fig. 15.
1885. AMMONITES FALCODISCUS, *Quenstedt.* Ammon. Schwäbischen Jura, pl. liv, figs. 23, 24, 24 bis, 25, and 48.
1887. AMMONITES WÜRTTENBERGERI, *Denckmann.* Fauna Ob.-Lias Dörnten, Abh. geol. Specialkarte Preussen und Thüringischen Staaten, Bd. viii, Heft 2, pl. i, figs. 1, 2; pl. iv, fig. 7.

Discoidal, compressed, with a hollow carina; whorls broad, subconvex, sloping gradually towards the ventral area, ornamented with simple subfalciform radii, which develop, on the outer lateral area only, into broad, wave-like, slightly curved ribs. The inner area is slightly subconvex, and crossed by fine straight striæ. The ventral area is extremely narrow, being in fact almost occupied by the carina, which is thus bordered by two very small depressions cutting it off from the lateral area. The carina is prominent, and of the hollow type. The inner margin is deep and upright, and its upper edge is raised just slightly above the level of the whorl, thus creating a concave depression in the inner area. About five-sixths of the inner whorl is occluded, so that the umbilicus is small and deep, formed of small steps, and quite smooth. The aperture is acutely sagittate.

This species has only recently been satisfactorily determined, although its name has been in use for a number of years. Simpson described it in the year 1855 in the following terms:—" Much depressed, inner volutions nearly concealed, outer whorl more than half the diameter; radii waving, nearly obsolete; obsoletely striated; keel rounded, entire; aperture acutely triangular or ovate; diameter an inch and a half." With this description he gave no figure, so that to anyone unacquainted with the Yorkshire fossils the chances of correctly determining the species would be extremely small. Therefore this species cannot be said to have had any real existence until, in 1876, Prof. Blake revived the name, and gave a figure of the fossil. I believe that, fortunately, no question of priority arises, the species not having been mentioned as new by any other name. Even Prof. Blake does not give us all the points about this Ammonite, because he commits the too common fault of neglecting to delineate a front view; but his description makes up, so far as any description can, for the absence of this figure. In 1884 Dr. Haug gave two good figures of this species (the front view, however, appears to show the carina less separated from the ventral area than in my specimens), and he also gave a figure of the suture-line, which had not been previously done. It agrees exactly with the one I have depicted for a species of the same genus in Plate A, fig. 22, and shows the four characteristic denticulations between the first auxiliary lobe and the umbilicus. Prof. Blake's figure, which must be considered as the one upon which the species is founded, does not show the umbilicus very clearly, but causes it to appear concave, like that of *Lioceras concavum.* He also says in his description that "the truncated inner edge is slanting." Dr. Haug, however, says, "Les tours tombent à l'angle droit sur l'ombilic" (p. 350). This statement agrees with my description.

As a synonym of this species Dr. Haug quotes (with a query) *Am. concavus*, d'Orb, 'Ceph.,' pl. 116; but Dr. Wright quotes the same reference as a synonym of *Pseudolioceras lythense* ('Monogr. Lias. Am.,' p. 444). D'Orbigny's figure evidently belongs to the genus *Pseudolioceras*, and, as Dr. Wright has well shown, has nothing to do with *Lioc. concavum* (Sowerby). It is most probable that the form represented by d'Orbigny's figure belongs no more to *Ps. lythense* than to *Ps. compactile*, but must be added to the same genus as a species which presents quite as much difference from its fellows as they do from one another.

Pseudolioceras compactile occurs in certain rock-bands rather low down in the "Cotteswold Sands."[1] I should prefer to consider these strata as Liassic, and therefore it may be thought that this species occurs in beds outside the limits of my Monograph. But authors are not unanimous in considering these strata as Liassic;[2] and since Dr. Wright has omitted to figure this species in his 'Monograph on Lias Ammonites,' I hope to be excused for inserting it here. It forms a very good introduction to the next species, and to the succeeding genus *Hyperlioceras,* which is in fact its direct descendant.

I have obtained this species from the following localities in Gloucestershire:—Coaley Wood (Section VI, Bed 17) and Nibley Knoll (Section VII, Bed 30); also Stinchcombe in the *Striatulum*-beds. It is rather scarce. The small specimen mentioned as having been obtained at the bottom of the Cotteswold Sands at Stinchcombe (Section VIII, Bed 2) might perhaps be more correctly assigned to *Pseudolioceras lythense* than to this species. Prof. Blake (p. 309) quotes the species from Yorkshire as from the "zone of *A. jurensis* at the Peak, where it is not

[1] Only recently have I found this species also in the *Striatulum*-beds, which overlie the Cotteswold Sands.

[2] See p. 50.

uncommon and very characteristic." Dr. Haug (p. 352) states that the species occurs at Saint-Romain (Rhône) and Clapier, and that he has seen specimens in Alsace from the *Lytoceras-jurense*-beds.

Plate XX, fig. 3, gives a side view of a fine specimen which was obtained from Coaley Wood (Bed 17), with the variety of *Hild. bifrons.* Fig. 4 exhibits the front view. Fig. 5 represents the side view of a young example, with a large portion of body-chamber present (the cross marks the position of the last suture). The body-chamber shows that the carina is filled by the core,[1] *b*, while the letter *a* indicates the carina with the test present. Fig. 6 illustrates the back view of the same specimen, which shows that in youth the species possessed a broader and more distinct ventral area. This specimen came from Bed 28 at North Nibley.

Pseudolioceras Beyrichi (*Schloenbach*), *var.* Plate XX, figs. 7—10; Plate A, fig. 22.

1856. ? Ammonites lythensis, *Oppel.* Juraformation, p. 246 (pars).
1865. — Beyrichi, *Schloenbach.* Jurass. Amm.; Palæontographica, vol. xiii, pl. xxvii, figs. 4, 5.
1885. Harpoceras Beyrichi, *Haug.* Beiträge Monog. Harp.; Neues Jahrbuch für Min., &c., Beil.-Bd., iii, p. 623.
1887. Ammonites (Harpoceras) Beyrichi, *Denckmann.* Fauna Ob.-Lias Dörnten; Abh. geol. Specialkarte Preussen und Thüringischen Staaten, Bd. viii, Heft 2, p. 67.

Discoidal, compressed, with small hollow carina; whorls distinctly convex, ornamented with simple, subfalciform radii, which develop on the outer area into rather obscure but broadish, wave-like ribs, with their ends projected towards the front. The inner area falls away towards the umbilicus, and is thus depressed; it is smooth, and crossed by fine straight striæ. The ventral area passes so gradually into the lateral that it is scarcely defined. The carina is of the hollow type; it is small, and not very distinct from the ventral area. When the test is absent a very slight trace of carina appears on the ventral area, which is therefore not completely rounded. The inner margin is upright. Quite five sixths of the inner whorl is occluded. The umbilicus is small, not very deep, shows portions of the inner whorls like small steps, and is quite smooth. The aperture is sagittate.

Our specimens cannot be considered as exactly typical of Schloenbach's species, which shows an aperture rather more gibbous towards the carina, and with its broadest part rather beyond the middle. Our specimens exhibit the broadest part of the aperture at about the middle, and they slope thence towards the carina.

[1] See footnote, p. 81.

From *Ps. compactile* they are separated by having rather thicker, more convex whorls, and a plain, sloping, indistinct ventral area, instead of a very narrow flattened depression; and instead of a subconcave inner area with its inner marginal ridge making a deeper umbilicus, they have a depressed inner lateral area causing the umbilicus to be shallow. The two specimens which are figured (Plate XX, figs. 7, 8, and 9, 10) differ from each other considerably in the size and form of the umbilicus. Fig. 9, moreover, is somewhat less compressed towards the inner area. In reality these specimens appear to be forms partly intermediate between *Ps. compactile* and the true *Ps. Beyrichi*, but are more easily separable from the former, which is just what we should expect from their position.

This species occurs in the *Opalinum*-zone. I have obtained it at Haresfield Hill in Bed No. 15 (page 43), at North Nibley in Bed 6 (page 46), and at Coaley Wood; but it is certainly scarce, and seems to be of rather small size. Schloenbach quotes it from various places in Brunswick and Hanover, from the zone of *Trigonia navis*. His figured specimens are much larger than any of mine.

Plate XX, figs. 7 and 8, illustrate a specimen from Coaley Wood. It has only the beginning of the body-chamber present. Figs. 9 and 10 show another specimen from North Nibley. It has a larger, more excavated umbilicus than fig. 7; and the umbilicus shows some small ribs. In the above figures the letter *a* marks the carina when entire, the letter *b* the rounded ventral area without the test.

HILDOCERATIDÆ (*continued*).

Genus—HYPERLIOCERAS,[1] *S. Buckman.*

(*Type*—HYPERLIOCERAS DISCITES, *Waagen* sp.)

Definition.—Discoidal, much compressed, strongly carinate, and involute, except when, in adult age, the body-chamber is present. Whorls, with their sides generally more or less parallel. Ribs, in youth, nearly straight, then projected more and more on the lateral and ventral areas, and finally forming subfalciform radii, which very seldom bifurcate. The ribs disappear at an early age, and then the very smooth appearance is assumed, the whorls being ornamented only with very fine sigmoidal lines of growth, projected forwards considerably on the lateral and ventral areas, forming strong curves upon the test. The ventral area is narrow and flat; it carries a large, prominent, solid carina with a rounded outer edge, and the carina occupies about one third of the ventral area. Even when the test is absent the core is strongly carinate, while the siphuncle lies inside the carina (Plate A, fig. 27). The inner margin is concave, but varies in its slope, the

[1] From ὑπέρ, λεῖος, κερὰς, very smooth horn.

upper edge sometimes overhanging the lower. The inclusion is usually considerable. The adult shells have a sigmoidal shaped mouth-border; but the young possess a short, pointed process on the lateral area. In the sutures (Plate A, figs. 23, 24, 25), the siphonal lobe has two short terminal branches; the siphonal saddle has an accessory lobe dividing it into two rather unequal portions, and is somewhat trenched upon by the digitations of the lobes; the superior lateral lobe is not much longer than the siphonal, and is sometimes scarcely trifurcate; the accessory lobe in the superior lateral saddle is feebly developed; the inferior lateral lobe is about half the size of the superior lateral; the first auxiliary lobe is well developed. There are about five more auxiliary lobes (besides denticulations), but sometimes two may coalesce to form a rather larger one, and thus make three small and one large lobe besides the first one (Plate A, fig. 26). Generally speaking, the succeeding superior lateral lobe just penetrates the preceding, but the septa are rather farther apart from each other than those in *Lioceras*, though closer than those in *Ludwigia*.

Remarks.—The possession of a very strong carina on a peculiarly flattened ventral area, the longer series of auxiliary lobes, and the less developed accessory lobes in the siphonal and superior lateral saddles separate this genus from *Lioceras*. The carina being solid instead of hollow, the inner margin being concave instead of straight, and the test very soon becoming smooth, separate the genus from *Pseudolioceras*.

This genus is the direct descendant from *Pseudolioceras*, and I believe may have sprung from *Ps. compactile*. We have seen, however, that the genus *Pseudolioceras* appears to end in the *Opalinum*-zone, and I have found no species of *Hyperlioceras* earlier than the *Concavum*-beds. Therefore a gap, consisting of the period known as the *Murchisonæ*-zone, has to be filled up; though I may observe that Moesch[1] quotes his specimens of *Hyperlioceras Desori* from that zone. Since I incline to the opinion that *Hyperlioceras* is probably descended more directly from *Pseudolioceras compactile* than from any other later species, we ought to meet with some connecting forms in the *Opalinum*-zone. At any rate we have an interesting Ammonite-form traceable, with but a small break, from the Upper Lias to the *Concavum*-beds of the Inferior Oolite, and undergoing a very distinct change during that period.

Allusion has previously (p. 21) been made to the forms which I place in this genus. Then I regarded them as a division (a strongly carinate group) of the genus *Lioceras*, especially observing the close similarity which they bore to *Lioceras decipiens*, *intermedium*, &c., and I supposed them to be a mutation of some smooth forms of that genus which we did not know. There were not then in my possession any specimens of the genus *Pseudolioceras*; but, having obtained some, I came to the conclusion that

[1] "Der Aargauer Jura.," 'Beitr. geol. Karte Schweiz,' p. 295.

Hyperlioceras was undoubtedly descended from *Pseudolioceras*, and had, therefore, nothing to do with *Lioceras* beyond being a parallel coeval genus, possessing a similar aspect. The suture-line of *Hyperlioceras*, with its array of small auxiliary lobes, at once suggests to us the genus *Pseudolioceras;* and the peculiar carination of the ventral area upon the body-chamber of the young forms of *Pseudolioceras* (Plate XX, fig. 6) brings the *Hyperlioceras*-character to our minds. In the shape of *Hyperlioceras discoideum* we see a distinct reversion to the shape of *Pseudolioceras compactile*, such as the triangular aperture, very sharp external edge, and small ventral area almost occupied by the carina. In the mode of ribbing generally there is no great difference between the two genera; *Hyperlioceras* has subfalciform ribs in youth, which very quickly give place to a smooth test, ornamented with what must be called sigmoidal striæ. Why the hollow carina of *Pseudolioceras* should have given place to the very strong solid carina of *Hyperlioceras*, I cannot say; and the concave inner margin of the latter genus is another singular fact. If I am correct in deriving *Hyperlioceras* from *Pseudolioceras*, it seems very strange that it should possess the concave inner margin like *Lioceras,* which genus it also approaches in many other respects, while the inner margin of *Pseudolioceras* is straight, and falls at right angles towards the umbilicus. We see, however, that the inner margin of *Ludwigia* is also concave; and we thus have the extraordinary fact that three practically coeval genera, belonging to three different genetic series, have an inner margin of the same peculiar shape. We happen also to find the same concave inner margin in *Hildoceras*, a genus coeval with *Pseudolioceras* and the earlier forms of *Lioceras*, but evidently in no way so closely allied to them as those genera are to each other. Consequently, though we recognise the peculiar fact that several different genera of Ammonites, existing more or less together during a limited period, possessed in common a character like this, yet we must come to the conclusion that the presence of a concave inner margin is no indication of intimate consanguinity, and, in these forms, is of no value for the purpose of classification.

All the species of this genus with which I am acquainted are especially peculiar to the *Concavum*-beds, and occur chiefly at Bradford Abbas;[1] but, singularly enough, specimens of the same species were obtained by the late Mr. E. Witchell, F.G.S., from the Gryphite-grit of Frith Quarry and Rodborough Hill, near Stroud, Gloucestershire. Not only so, but several other species of Ammonites which are found in, and are essentially peculiar to, the *Concavum*-beds at Bradford

[1] Mr. E. Wilson, F.G.S., has discovered species of this genus at Dundry in Somerset. With his usual kindness he has submitted them to me for examination. They are very poorly preserved, and are not sufficiently numerous for me to say what their characters may be, except that they belong to the genus *Hyperlioceras.* They come from a rubbly rock (marl and stone intermixed), associated with *Terebratula Eudesi.* This rubbly rock is probably the exact horizon of the Bradford-Abbas *Concavum*-beds, and reminds one very forcibly of similar deposits near Sherborne in Dorset.

Abbas and the neighbourhood were obtained by Mr. Witchell from the same horizon as these species of *Hyperlioceras.* By the kind permission of him and his family I have frequently been able to examine and identify all these specimens.

These discoveries are of the highest importance for the correlation of the beds of the Inferior Oolite in the Cotteswolds with those of Dorset; first, because the Gryphite-grit is an horizon well-marked and easily recognised over a wide extent of country; and secondly, because Ammonite-remains are very scarce in the Cotteswolds. The conclusion which we naturally draw from this similarity of the Ammonite-fauna is that the Gryphite-grit is of the same age as the Bed No. 5 (section, page 5) at Bradford Abbas, and that the Gryphite-grit consequently belongs to the so-called *Sowerbyi*-zone on the same horizon as the *Concavum*-beds. This idea forced itself upon me lately, when, during some work among the rocks of the North Cotteswolds,[1] I found in strata but little below the horizon of the Gryphite-grit Ammonites which I recognised as characteristic species for the Bradford-Abbas *Concavum*-beds; and my opinions became confirmed when Mr. Witchell drew my attention to what he had discovered near Stroud. My father[2] always argued in support of a somewhat similar opinion, if we consider that the most important member of the so-called "Dorset Cephalopod-bed" is the *Sowerbyi*-zone (*Concavum*-beds) at Bradford Abbas; and I found that Dr. Waagen[3] had put forward what is practically the same view as mine. Dr. Wright[4], however, and Prof. Judd,[5] placed the Gryphite-grit in the zone of *Am. Parkinsoni;* and Mr. Witchell[6] placed it in the zone of *Am. Humphriesianus.* With these determinations the Ammonite-fauna does not, in my opinion, agree; and, whilst recognising the fact that the next horizon above the Gryphite-grit, namely, the Upper Trigonia-grit, certainly belongs to the zone of *Am. Parkinsoni*, I have to come to the conclusion that the zone of *Am. Humphriesianus* has not yet been detected in the Cotteswolds.

Hyperlioceras is, as I have said, peculiar to the *Concavum*-beds, and at present I have not found at a higher horizon any species of *Ammonites* which belong to this genus, or could be supposed to have descended from it. Though not uncommon in the Bradford-Abbas district, the genus attains to nothing like the importance of *Lioceras.*

Most of the species of *Hyperlioceras*, as well as *Lioceras intermedium*, have been quoted from Dorset by the name of *Am. læviusculus*, chiefly on account of the

[1] "The Inferior Oolite between Andoversford and Bourton-on-the-Water," 'Proc. Cotteswold Field Club,' vol. ix, part 2, p. 130, 1887.

[2] "On the so-called Midford Sands," 'Quart. Journ. Geol. Soc.,' p. 738, 1879.

[3] "Ueber die Zone des *Am. Sowerbyi,*" 'Geogn. pal. Beitr.' Bd. i, Heft 3, p. 579, 1867.

[4] "The Inferior Oolite," 'Quart. Journ Geol. Soc.,' vol. xvi, p. 37, *et seq.*, 1860; "Monog. Lias Amm.," 'Pal. Soc,' vol. xxxiii, pp. 150, 154, &c.; also in several other papers.

[5] "The Geology of Rutland," 'Memoirs of the Geological Survey,' p. 8, 1875.

[6] "The Geology of Stroud," p. 39, 1882.

smoothness of the test; but they may readily be separated from it, as they possess a solid instead of a hollow carina, a concave inner margin, and very different sutures. *Hyperlioc. discoideum* is, on account of its peculiar shape, labelled *Am. Truellii* in some public and private collections. This is a very grave error, which this generic subdivision of Ammonites will in the future, I hope, serve to obviate by really emphasizing the great differences existing between such species of Ammonites, and by drawing more particular attention to structural details.

HYPERLIOCERAS WALKERI, *S. Buckman.* Plate XVI, figs. 1—11.

Adult.—Discoidal, much compressed, strongly carinate; whorls, very flat and broad, with their sides almost exactly parallel (not swollen), ornamented merely with very fine, rather strongly curved, sigmoidal lines of growth. Ventral area much flattened, sharply defined, carrying a broad, prominent, solid carina, with its outer edge rounded. Inner margin shallow, concave, fairly upright, but more sloping in the neighbourhood of the body-chamber. Inclusion nearly four-fifths of the preceding whorl, but less where the body-chamber comes. Umbilicus small and shallow, formed of a series of small steps, mostly flat and smooth, only the inner ones showing traces of small ribs.

Immature.—Up to a diameter of about eight lines the whorls are ornamented with straight, simple ribs, very slightly bent forward on the lateral area. At this age the carina is well formed and distinct, and the ventral area flat and quite smooth; but the inner margin can scarcely be said to have appeared. Beyond this size the ribs gradually change, becoming more and more subfalciform in shape. At about seventeen lines in diameter they gradually fade away, giving place to extremely fine lines of growth, which have more of a sigmoidal curve. The carina is now large and trenchant showing no indication of any hollow space, is much compressed laterally, and is slightly rounded on its outer edge. The ventral area is narrow and flattened; the sides of the whorls are very nearly parallel, though slightly swollen about the middle. At a diameter of fourteen lines we find the inclusion to be a trifle more than half the whorl (at an earlier stage we ought to find it less), but at thirty lines we find that it is four fifths of the preceding whorl. The termination is furnished with short lateral lappets in the young (Plate XVI, fig. 7).

Three varieties of this species have been depicted on Plate XVI; and they were chosen because they exhibited certain slight differences. Each form, when adult, attained a diameter of about the size shown by fig. 1; but it was unnecessary to delineate the adult of each variety since the differences can be indicated verbally with the aid of that figure. The forms may be conveniently classed as follows:

α. (Plate XVI, figs. 1—4.) Median, typical form.

β. (Plate XVI, figs. 5—9.) Very flat form, with wider umbilicus.

γ. (Plate XVI, figs. 10, 11.) Thicker than α, with smaller umbilicus.

In considering the comparative width of the umbilicus the amount of body-chamber must be taken into consideration. For instance, fig. 5 has no part of the body-chamber present; but fig. 1 is noticeable for the great increase in the width of the umbilicus after the body-chamber commences, and even a little before. The cross marks the position of the last suture, and, when we consider that half a whorl from that point may be reckoned for body-chamber, and that the increase in width continued from that period at the same ratio, we see the great difference which the presence of the body-chamber makes in the size of the umbilicus, since the inclusion at the mouth would be barely half a whorl.

This sudden umbilical expansion[1] and the strong carina distinguish this species from any of the *Liocerata*, such as *Lioceras decipiens*. The young forms are not so easily separated from *Lioc. intermedium*, but are more compressed on the outer lateral area, and possess a more distinct carina on a flatter ventral area. The last sentence of the paragraph explaining the differences between *Lioc. intermedium* and this species (page 34, lines 23 and 24 from top) became somewhat involved in passing through the press. What I intended to say was, that in making comparisons between the two species as regards the ventral area care should be taken to choose specimens from the one species which possessed an amount of body-chamber similar to that which the specimens of the other species had, or else that the specimens of both should be without body-chamber, since it is not right to compare the ventral area and carina on the *body-chamber* of *Hyperlioc. Walkeri* with the ventral area and carina on the *air-chambers* of *Lioc. intermedium*, for the reasons which I had then just given.

The umbilicus in this species is wider than that of the other species of the genus, and is wider than we should expect to find in course of development from its ancestor.[2] This may be a case of reversion, since the development of the full number of auxiliary lobes would appear to indicate descent from a highly involute *Hyperlioceras* (in the *Murchisonæ*-zone), which had improved, by development of more auxiliaries, on the suture-line of *Pseudolioceras*. Without the intervention of a highly involute *Hyperlioceras* there would have been no reason for the development of more auxiliary lobes, because *Hyperlioc. Walkeri*, with its narrower whorls,[3] would not have required them.

The horizon of this species is the *Concavum*-beds at Bradford Abbas, Dorset;

[1] None of the *Liocerata* which I have seen show such an expansion as this would be. *Lioc. decipiens* shows nothing like as much. [2] See p. 139.

[3] That is, narrower when compared with what usually obtains in *Pseudolioceras* and *Hyperlioceras*.

but it cannot be regarded as common. In Gloucestershire Mr. Witchell found some medium-sized examples in the Gryphite-grit of Frith Quarry, near Painswick, and of Rodborough Hill, near Stroud.

Plate XVI, fig. 1, representing the type form of this species, is a fine adult specimen, the largest I have seen, having part of the body-chamber present, and the test very well preserved. Fig. 2 shows the front view, with the flat ventral area and large prominent carina. Figs. 3 and 4 illustrate a smaller specimen of the size more usually found, showing the transition from ribs to almost entire smoothness. Some portion of the body-chamber is present, and its continuation onwards is indicated on the specimen, as may be seen in the figure. Both these specimens were collected by my father. Figs. 5 and 6 show a very good specimen with its test very well preserved. This is a form with wider umbilicus. It has no portion of the body-chamber, and is more compressed. It is from Bradford Abbas, and was collected by myself. Figs. 7 and 8 give a smaller specimen, having the commencement of the lateral process, which, however, is not too well preserved, and is, perhaps, drawn a little too broad. The rest of the test is well preserved, and shows the nature of the ribbing. Fig. 9 is a smaller specimen, which shows how the plain and almost straight ribs gradually become more bent. Figs. 10 and 11 depict a young specimen of the narrow-umbilicate and somewhat thicker form. These specimens are not localised; but they were all collected by my father, probably at Bradford Abbas; they are now in my cabinet. The fig. 24 on Plate A gives the suture-line of this species, taken from the other side of the large type specimen (Plate XVI, fig. 1). It will be noticed that all the saddles are rather broader, and the lobes rather shorter, than in the other suture-lines of the genus. There is also a very considerable development of small lobes in the siphonal saddle.

Specimens of this species have been in my cabinet for some years, ticketed with the specific name now proposed, and which was given in compliment to my friend Mr. J. F. Walker, M.A., F.G.S., &c.

HYPERLIOCERAS DISCITES (*Waagen*). Plate XVI, figs. 12, 13; Plate XVII, figs. 1—5; Plate XVIII, figs. 1—5; Plate A, fig. 23.

1867. AMMONITES DISCITES, *Waagen*. Zone des *Ammonites-Sowerbyi*, Geogn. paläont. Beiträge, pl. 28 (5), figs. 2 *a*, *b*.

Discoidal, compressed, strongly carinate; whorls flat, broad, with their sides nearly parallel, ornamented in youth with subfalciform radii, which become ribs on the outer lateral area, and change sooner or later, according to the variety, to sigmoidal lines of growth. Both radii and lines of growth are projected forwards on the lateral and ventral areas. The test in the adult is very smooth. The ventral area is narrow, flattened, and carries a broad strong carina, which occupies about one-third of the area, and is rounded on its outside. Inner margin concave, upright in the earlier portions, but sloping as it approaches the body-chamber. Inclusion to the extent of nearly the whole of the preceding whorl, but lessening in amount for the distance of a whorl or so before the completion of the body-chamber in the adult. Termination sigmoidal, leaving on the core constrictions similar to those noticed in *Lioceras*.

Of this species I have seen no specimens which correspond in every detail to Waagen's figure; but yet they are so closely similar that they cannot but be included under the same specific name. The following forms may be noticed, and thus the differences can be indicated.

Type.—Waagen's form, with which none exactly correspond.

α. (Plate XVII, figs. 1, 2.) Most like the type in size of umbilicus and in shape, but slightly more compressed on the inner area, and quite smooth.

β. More compressed than *α*; very narrow and upright inner margin.

γ. (Plate XVII, figs. 3, 4; Plate XVIII, figs. 1—2.) An umbilicus almost regularly concave and distinctly larger than that of the type. Umbilicus in Plate XVII, fig. 1, $\frac{15}{100}$ of the diameter at six inches size.

δ. Similar to *γ*; but umbilicus not so concave, yet smaller.

ε. Similar to *γ*; but generally rather thicker. Umbilicus larger, being $\frac{24}{100}$ of diameter at six inches, without any body-chamber present.

ζ. (Plate XVII, fig. 5; Plate XVIII, figs. 3—5.) Considerably thicker, marked concavity in inner area, deep umbilicus, and high inner margin.

It must not be thought that these various divisions are founded on single specimens; on the contrary, a number of examples of each are in my cabinet.

Hyperlioceras discites is therefore, as found in England, rather variable; and it is singular that no forms agree exactly with Waagen's figure, which has a rather small umbilicus, is rather wider towards the inner area, and is not smooth like the form *α*. The species and its varieties differ from *Hyperlioceras Walkeri* by being thicker, having more convex sides to the whorls, and a much smaller umbilicus, with great inclusion of the preceding whorl. Even the variety *ε*, which exhibits the largest umbilicus, has nearly the whole of each whorl occluded (the width of the umbilicus being caused by a deeper and more sloped inner margin), and is distinct on account of its greater thickness.

The resemblance between some specimens of this species and *Lioceras concavum* is very great, and is certainly rather singular. The variety *γ* possesses a hollow, concave umbilicus, almost exactly like that of *L. concavum;* and this has not infrequently caused some confusion to arise between these species. The large distinct carina on a flat ventral area is, however, a very marked feature in *Hyperlioceras discites*, and this alone will distinguish the one species from the other; but, in addition to this, we have the very fine, smooth texture of the test. The similarity between the two forms is a slight instance of convergence.

This is the most frequent species belonging to the genus, and is not uncommon at Bradford Abbas, Dorset, in the *Concavum*-beds. The large size which it sometimes attains is shown in Plate XVIII, fig. 1. Had this specimen been obtained perfect, as it evidently was before being disturbed, it must have reached the giant size of about ten inches in diameter. Even now it is the largest specimen of the species in my possession. In Gloucestershire I have obtained a specimen of this species from certain strata which lie above the Harford Sands and below the Gryphite-grit, in the third railway-cutting west of Bourton-on-the-Water Station. These strata are probably equivalent to the Lower Trigonia-grit of other parts of the Cotteswolds.[1] In the neighbourhood of Stroud Mr. Witchell obtained several specimens from the Gryphite-grit of Frith's Quarry near Painswick, and of Rodborough Hill. Dr. Waagen (p. 600 (94)) quotes this species from Wentzen and Dohnsen, North Germany.

Plate XVII, figs. 1 and 2, illustrate the nearest approach in shape to Dr. Waagen's figure which I have been able to obtain; but this differs in its extremely smooth test (very well preserved) showing no trace of ribbing. Figs. 3 and 4 represent a specimen with more ribs and an almost concave umbilicus. It shows the complete mouth-border. Plate XVIII, figs. 1 and 2, illustrate an extremely well-preserved adult example. It has certain longitudinal lines and other marks, also the remains of an extremely thin layer of test overlying the actual outer test of the whorl,[2] all of which indicate the portion covered by the body-chamber of the next whorl; and the former, in all probability, correspond to similar marks exhibited by *Amaltheus*. The great increase in the width of the umbilicus in the turn of a whorl is shown by the innermost of the longitudinal lines; and this is an indication of where the curve of the inner margin was continued. This specimen came from Anbury Quarry,[3] Bradford Abbas. Plate XVII, fig. 5, is the side view of a

[1] See p. 91.

[2] These remnants of test belonged to the inner part of the overlapping whorl, which probably was broken away when the specimen was extracted from the quarry,

[3] In "Eine Studie über die obere Liasgrenze," Ool. Cap. San Vigilio ('Abhandl. k. k. geol. Reichsanstalt,' Bd. xii, No. 3), Dr. Vacek, being unacquainted with the localities and the different facies of the exposures, has (p. 129) fallen into some unfortunate mistakes. Among others, he fancies that the Ammonite-bed at Babylon Hill and at Bradford Abbas are upon two different horizons, and that Babylon Hill and Bradford Abbas are two very different places. This is not the case. As I stated, at page 5, the one quarry is the exact counterpart of the other. The quarry at Babylon Hill (otherwise called Anbury, Hanbury, or Henbury quarry) lies just over half a mile north of the famous East-Hill Quarry; while the latter is just under half a mile north of the railway-cutting in the village. The strata which they exhibit are as similar in appearance as it is possible to be; and the fauna which

thick variety. The carina at the top of the figure gives it an appearance of being hollow-keeled; but this is only due to the ventral area being broken away, and the outline not being so represented by the artist. Plate XVIII, fig. 3, is the front view of the same fossil, in outline. This specimen came from Bradford Abbas, and was collected by my father. Plate XVIII, figs. 4 and 5, illustrate the two views of a smaller specimen of this peculiar variety, which is smooth at a very early age. Plate XVI, figs. 12 and 13, give a young specimen of the species, with its test well preserved.

HYPERLIOCERAS DESORI (*Moesch*). Plate XVII, figs. 6 and 7.

1867. AMMONITES DESORI, *Moesch*. Der Aargauer Jura; Beiträge Geol. Karte Schweiz, pl. i, figs. 8 *a*, *b*.
1885. HARPOCERAS DESORI, *Haug*. Beiträge Monog. Harpoceras; Neues Jahrbuch für Min., &c. Beil.-Bd. iii, p. 624.

Discoidal, compressed, strongly carinate, almost without umbilicus; whorls broad, ornamented with sigmoidal lines of growth well curved on lateral and ventral areas (faintly marked ribs on outer area); whorls sloping slightly from the middle towards the ventral area, which is flat and narrow, and carries a large distinct carina. Inner margin concave, with the upper portion *overhanging* the lower, thus still further occluding the very small umbilicus, and causing it to resemble a female screw. A small portion of each of the inner whorls is not

they yield is—with the fewest possible exceptions in the case of the railway-cutting,—exactly the same (see above, p. 5). Fossils for which I give the locality as Bradford Abbas may have come from either of these three places, or from some of the numerous openings which have from time to time been made in different parts of the parish. I never thought it necessary to use distinctive labels for the specimens from these places, save in a few exceptional instances; but I was most particular to do so in other cases when any question of a different development of strata came in, even though the localities might be very close together. Babylon Hill lies within the parish of Bradford Abbas, and has probably supplied many of the fossils labelled as from Yeovil, a town in the adjoining County of Somerset.

In order to make everything as clear as possible, I would expressly mention a matter which still does not seem to be properly understood, namely, that the Cephalopoda-bed of Gloucestershire, and the Cephalopoda-bed of Dorset, are on two totally different horizons. The former contains the *Opalinum*-zone and *Striatulum*-beds; the latter name was loosely used to cover the half dozen feet of rock at Bradford Abbas containing the *Murchisonæ*-zone, the *Concavum*-beds, and the representatives of the *Sauzei*- and *Humphriesianum*-zones. It was also extended to include the greater development of *Humphriesianum*-zone near Sherborne. Considering that the term "Cephalopoda-bed" was applied to the Dorset Inferior-Oolite strata under the totally erroneous idea that they coincided with the Gloucestershire bed of that name, it seems to me advisable that the term should be dropped altogether so far as Dorset is concerned.

covered, but this, owing to the overhanging of the margins, can scarcely be seen from outside.

This species bears considerable resemblance to *Hyperlioceras discites*, Waagen, but is at once separable by its very small, peculiarly-constructed umbilicus (occupying only $\frac{9}{100}$ of the diameter), and by the overhanging inner margin. It is also somewhat thicker, and its sides less parallel.

Dr. Haug says of this species[1]:—"In der hiesigen Universitäts-Sammlung liegen zwei Exemplare aus Sud-England, welche ganz mit Moesch's Abbildung übereinstimmen. In der Jugend ist die Art glatt und kann daher nicht mit *Harp. discites*, Waag., vereignt werden. Da *Am. Desori*, Pictet, einer anderen Gattung angehört, so liegt kein Grund vor den Moesch'schen Namen zu ändern."

Where the test is absent my specimen shows a few obscure ribs, which do not seem to be visible on the test itself of the other side; but I cannot say anything about its appearance in youth. Among the varieties of *Hyperlioceras discites* I have placed a very smooth form. I therefore doubt if any distinction can be made on the score of smoothness; but I think that the very small umbilicus, the differently-shaped, thicker whorls, and the overhanging inner margin, are sufficient to separate the two species. Dr. Waagen[2] quotes *Ammonites Desori*, Moesch (non Pictet) as a synonym of his *Ammonites discites*, but, as his figure of the latter represents (in my opinion) a sufficiently distinct species, I have followed Dr. Haug in giving effect to Moesch's name.

This species is extremely scarce, in fact, I only know of the one example which I have figured. It is, in all probability, from the *Concavum*-beds of Bradford Abbas. Moesch quotes his example from the "*Murchisonæ*-Schichten vom Frickberg bei Frick in Aargau."

Plate XVII, figs. 6 and 7, shows the only specimen of the species which I have seen. It can here be easily compared with forms of *Hyperlioc. discites.*

HYPERLIOCERAS DISCOIDEUM (*Quenstedt*). Plate XIX, figs. 1—4; Plate A, fig. 25.

1886. AMMONITES DISCOIDEUS, *Quenstedt.* Am. Schwäbischen Jura, pl. lviii, fig. 1 only.

a. Discoidal, somewhat compressed, strongly carinate; whorls sloping continuously from the inner margin towards the ventral area, ornamented merely with very fine sigmoidal lines of growth. Ventral area narrow, flat, carrying a

[1] *Loc. cit.*, p. 624.

[2] Zone des *Am. Sowerbyi;* 'Geogn. Pal. Beiträge,' p. 599 (93).

very large, much-raised carina, which occupies in breadth nearly half the ventral area. Inner margin concave and overhanging; umbilicus small and consequently much contracted; aperture triangular.

β. Whorls flatter, sloping from middle only; inner margin concave, sloped; aperture sagittate.

Under the name *Ammonites discoideus*, Quenstedt has united several different forms which I can scarcely agree to place in the same species. Some of them appear to have much greater resemblance to *Hyperlioc. discites;* but no front view is shown us. Selecting, however, his fig. 1 as a very distinct form of the genus *Hyperlioceras*, I notice that there are in my possession certain specimens which approach it very closely; and, though they do not *exactly* tally with it, yet they must come under this name. With the type they may be noticed as follows:

The Type.—Quenstedt's form (restricted as above mentioned): its exact counterpart has not yet been found in England.

α. (Plate XIX, figs. 3 and 4.) Differs from the type in having a more elongated, and more acutely triangular, aperture, and in possessing an overhanging inner margin.

β. (Plate XIX, figs. 1 and 2.) Differs from the type in not having an exactly triangular aperture, and in being compressed on the inner area. It resembles the type in having a slightly sloped inner margin, and in this it differs particularly from α.

The triangular or subtriangular aperture, and the narrow external edge, distinguish this species from the others; and a larger umbilicus separates it from *Hyperlioc. Desori.* Its general shape, and especially its narrow external edge, recall the form of its ancestor *Pseudolioceras compactile.* This external edge carries a carina higher, and also rather narrower, than that of any other species of the genus. The test on the outer edge of the carina is of considerable thickness, and the carina altogether is very prominent; in fact, no species of the solid-keeled Ammonites that I know possesses a larger carina than this one. This interesting fact will be important when we come to deal with certain hollow-carinate forms, which in shape resemble this species very closely, and have a carina as prominent, but hollow.

On account of its peculiar shape, and also because certain specimens possess on the test faint longitudinal striæ and ridges, the form α is frequently labelled "*Am. Truelli.*" This is a very serious mistake, which the slightest study of the suture-lines would detect.

The species occurs in the *Concavum*-beds at Bradford Abbas and Halfway House, Dorset, but is certainly very scarce. I have seen no young specimens which I could refer here with certainty. Incomplete specimens of the form α sometimes measure as much as eight inches in diameter. This form is very frequently crushed out of shape; and, as this rarely, if ever, occurs with any other species in this zone at Bradford Abbas, it may be considered as due to natural weakness in the structure of the shell itself. Its peculiar shape and rather simple sutures suggest such an idea. The form β is far scarcer than the other. Incomplete specimens of six inches in diameter occur. Both forms, α and β, have been found by Mr. E. Witchell in the Gryphite-grit of Frith Quarry, near Painswick, and of Rodborough Hill, near Stroud (see p. 91).

Plate XIX, fig. 3, represents a side view of the form α with a large proportion of the test well preserved; fig. 4 is an exact outline of the front view. The side view of the form β is shown in fig. 1, but only a small amount of test is preserved; fig. 2 exhibits the front view, and the sloping subconcave inner margin can be seen. Both these specimens came from Bradford Abbas, Dorset. Plate A, fig. 25, exhibits the suture-line of this species, taken from the last-mentioned specimen.

Hyperlioceras subdiscoideum, *S. Buckman.* Plate XIX, figs. 5 and 6; Plate XX, figs. 1 and 2; Plate A, fig. 26.

It is not intended to definitely separate the specimens of which these figures exhibit two typical individuals, until more material shows that their peculiar characteristics are fairly constant. The name must therefore be considered as provisional only. Whatever value may be attached to a name, it is useful, if only for purposes of registration; and it can scarcely be denied that these specimens could not be included in any other of the species of *Hyperlioceras* without some distinctive appellation. To me they do not appear a *variety* of any of the foregoing species, but more probably a *fixed mutation* of some species belonging to the *Murchisonæ*-zone, and are therefore cousins to those previously described. This species (as I will call it for the present) appears to unite *Hyperlioceras discites* and *H. discoideum;* or rather (to speak with exactness) it appears to unite *Hyperlioc. discites* ζ and *H. discoideum* β. From the former it differs by showing no trace of the concavity in the inner lateral area, and by the outer portion of the aperture being somewhat more attenuated; from the latter, by possessing a more quadrate aperture and a larger umbilicus; while it differs from both in possessing slight ribs at a later period, and a somewhat differently constructed umbilicus. This feature I will explain as follows: The appearance of the inner whorls indicates a more open, depressed specimen in youth, ornamented with ribs; but a change takes place, and the umbilicus becomes proportionately rather narrower and deeper, with upright, sometimes almost overhanging, inner margin. Yet another difference remains to be noticed, but whether this be constant or otherwise I cannot say, namely, the suture-line (Plate A, fig. 26). This differs in having a longer superior lateral lobe, and a fewer number of auxiliary lobes. The size of the umbilicus in the larger specimens does not give any reason (such as a lessened amount of room on account of the greater width of umbilicus) for the smaller number of auxiliaries; but, when we consider that in youth the specimen is evidently less involute than other species of the genus, we perhaps have an explanation. This evoluteness has lessened the space, and in consequence, perhaps, two of the auxiliary lobes have coalesced, and then this character has been continued in the adult.

This species occurs in the *Concavum*-beds of Bradford Abbas, but is rather scarce.

Plate XIX, fig. 5, represents the side view of a nicely preserved specimen with all its test present except just at the top left-hand corner, where it is broken away, and should have been so depicted. Fig. 6 gives a sectional view, to show the construction of the umbilicus. Plate XX, fig. 1, shows a larger specimen, with some portion of the body-chamber present. Only a thin film of test, a remnant of the under-layer, covers the greater part of the specimen. Fig. 2 gives an outline of the front view. The top is drawn with test on the carina; the other parts of the carina without it. Plate A, fig. 26, gives the suture-line taken from another specimen.

HILDOCERATIDÆ (*continued*).

Genus—LUDWIGIA, *Bayle* (continued).

(See p. 16.)[1]

Since the completion of the first part of this Monograph certain causes, among them the advent of fresh material, have enabled me to work out some additional species belonging to the genus *Ludwigia*. They are especially valuable for the light which they throw upon the descent and development of this genus (pp. 102, 131, &c.); and it is fortunate that I am thus able to continue the description of the species of this genus at a point where it can be again introduced not unsuitably.

[1] Erase the first four lines of heading and substitute: Family—*Hildoceratidæ*. For the reason see p. 125, *et seq.*

Ludwigia costosa (*Quenstedt*). Plate XX, figs. 11, 12.

1886. Ammonites opalinus costosus, *Quenstedt*. Am. Schwäbischen Jura, pl. lv, fig. 20, only.

Discoidal, compressed, carinate; whorls very slightly subconvex, ornamented with a few bifurcating ribs, which are slightly reflexed, and are conspicuous on the inner area; ventral area subacute, smooth, carrying a small carina; inclusion for about one-half of the previous whorl; umbilicus fairly open, slightly ribbed.

The scanty material in my possession remained unnoticed until I observed the same form figured in Quenstedt's work. He has considered it a variety of *Lioc. opalinum;* but with this I cannot agree. Its suture-line, even according to his figure, shows all the characters of the lobe-line of *Ludwigia*, and none of those of *Lioceras;* while its ribs, conspicuous on the inner area, bifurcate and reflexed, agree thoroughly with the definition of the genus *Ludwigia*. I have therefore no hesitation in regarding this form as a species with the name *Ludwigia costosa*.

From the coarsely ornamented forms of *Ludwigia Murchisonæ* this species is separated by being much thinner; and from the compressed forms of that species by being more coarsely ornamented; while from both it differs by its ribs being placed much farther apart, and somewhat irregular. The latter features separate it from the coarser form of *Ludwigia cornu*, to which it has much similarity.

The fact that this species occurs in the *Opalinum*-zone is very important, because it shows that *L. cornu* and *L. rudis* are not in the same genetic series as *L. Murchisonæ*. At one time I was inclined to the opinion, in the absence of evidence to the contrary, that *L. cornu* was descended from some of the more finely ribbed forms of *L. Murchisonæ;* but such evidently is not the case. *Ludwigia costosa* in the *Opalinum*-zone is the parent form of *L. cornu* and *L. rudis* which occur in the *Concavum*-beds.

On the other hand, *L. Murchisonæ* runs on a different line, and does not start from *L. costosa*, because specimens closely resembling *L. Murchisonæ* have been found in the *Opalinum*-zone, as I can testify from recent experience. Such specimens, then, have produced *L. Murchisonæ* in the zone of that name; and the latter has produced *L. Lucyi* in the *Concavum*-beds. One or other, probably the latter, genetic series is the parent-form of the *Hectici*, which continue to the Oxford Clay.

Ludwigia costosa occurs in the *Opalinum*-zone at Burton-Bradstock Cliff, and is probably very scarce.

Plate XX, figs. 11 and 12, show a small specimen in my collection. The example figured by Quenstedt is considerably larger.

Ludwigia rudis, *S. Buckman*. Plate XV, figs. 11—17; Plate A, fig. 7.

Discoidal, somewhat compressed, subcarinate; whorls subconvex, ornamented with coarse, rounded, reflexed, bifurcating ribs, the ends of which slightly project forwards on the ventral area. This area, scarcely defined, is smooth and sloping, and carries a small but distinct carina. The inner margin is scarcely defined, except on the last whorl, when it is sloping and slightly concave. The inclusion is, in young specimens, about a half, and in older two-thirds, of the preceding whorl. The umbilicus is open and somewhat shallow. The convex portions of the whorls exhibited therein, and the coarse ribs which they carry, give a somewhat tumid and knotted appearance to the exposed parts of the umbilical coil. The mouth-border has a lateral process or horn; and on the ventral area it is pointed and slightly projected. The ribs continue to be well marked right up to the mouth-border.

This species, having every characteristic of the genus *Ludwigia*, is evidently descended from *L. costosa*, and is therefore a close relation of *L. cornu*. It differs from *L. costosa* by having a somewhat larger umbilicus, more numerous ribs, and a less distinct carina, besides being somewhat thicker. In the character of its coarse ornamentation this species has some resemblance to certain coarsely-ribbed forms of *L. Murchisonæ*; but it may be distinguished from them by possessing the compressed whorls which appertain only to the more finely ribbed varieties of that species. The more compressed forms (Pl. XV, fig. 13) approach *L. cornu*, but may be separated by their coarser ornamentation, thicker, more convex whorls, larger umbilicus, and less prominent carina.[1] From *Lioceras apertum*, to which it exhibits an extraordinary convergence, this species is separable by the same characters which separate the genera *Ludwigia* and *Lioceras*, namely, the ribs frequently bifurcate, sharply reflexed, and conspicuous on the inner area; the sutures set further apart from one another, simpler, with smaller accessory lobes, fewer auxiliaries, and greater difference in size between superior and inferior lateral lobes. Besides this, the ends of the ribs are bent forwards on the ventral area in *Lud. rudis* and not in *Lioc. apertum;* the carina is more prominent; the whorls are more convex; and the umbilical coil is more tumid and more knotted.

In Dorset *Ludwigia rudis* sometimes occurs at Bradford Abbas; but its chief locality is at Louse-Hill Quarry, near Halfway House. Its horizon is in the *Concavum*-beds. In Somerset the species occurs at Dundry Hill, near Bristol, where it has been obtained by Mr. E. Wilson, F.G.S., who kindly sent me his specimens to examine. Nowhere does it seem to occur of large size (the specimen figured in Plate XV, fig. 13, being the largest with which I am acquainted), and it thus seems to form with *L. cornu* and *L. costosa* a series of dwarf

[1] The carina of *L. cornu*, Pl. IV, fig. 2, is not acute enough; see p. 20.

species of *Ludwigia*. Its characters would certainly cause it to be noticed much sooner than *Lioceras apertum;* and it occurs more frequently than that species. *Lioc. apertum*, in fact, runs more chance of being regarded as a variety of this form or of *Lioc. v-scriptum.*

Plate XV, figs. 11 and 12, represent the type-form of the species, with part of the mouth-border. The test is well preserved on the greater part of this specimen. It was collected by myself at Louse Hill. Plate XV, fig. 13, gives the largest specimen I have seen. It is slightly more compressed, is without test except in the umbilicus, and shows a portion of the mouth-border. This I also collected at Louse Hill. Plate XV, figs. 14 and 15, illustrate a specimen which, together with figs. 7 and 8, was broken, but not irreparably, in transit from the artist. It has the test well preserved, and is a typical young example. It has no portion of the body-chamber present; but it shows the characters of the species very well, especially the nodose ribs on the inner area, and is useful for comparison with figs. 7 and 8. It came from Bradford Abbas. Plate XV, figs. 16 and 17, is a variety with slightly finer ornamentation and a larger umbilicus. The test is well preserved; but the artist has scarcely succeeded in giving a true likeness of the fossil, because he has made the ribs too straight on the outer area, and has not turned the ends sufficiently forwards. They are also too much recurved in the middle.

Ludwigia Lucyi, *S. Buckman*. Plate XXI, figs. 3—11.

Discoidal, somewhat compressed, carinate; whorls broad, flattened (the sides nearly parallel), and ornamented with broad, but obscure, bifurcate ribs, which are recurved on the middle of the lateral area, and project forwards on the outer edge. Ventral area smooth, very slightly convex, carrying a fairly distinct, but narrow, carina. Inner margin deep and rather upright. Inclusion four-fifths of the preceding whorl; umbilicus rather deep, inclining to concave, and with well-marked ribs on the visible portions of the inner whorls.

Although this species seems to be most certainly scarce, yet, by a stroke of good fortune, I have a series commencing with a specimen only 3 lines in diameter. This is probably due to the fact that the fry of this species can be definitely separated from the fry of the various species of *Lioceras* and *Hyperlioceras*. Generally it is almost hopeless to try to decide to which species, or sometimes even to which genus, many of the small fry really belong.[1]

[1] When we remember that the species of these genera possessed a common ancestor, and that the younger the specimen the more we obtain a likeness to that ancestor, there is nothing more than we should expect in not always being able to separate the fry with certainty.

At a diameter of about 2 lines, and at what is about the third whorl, we find the commencement of the ribs, but with no trace even of keel; at 3 lines the ribs are straight, and sometimes joined on the inner margin, the ventral area is a trifle less rotund, the sides of the whorls are divergent, the aperture as broad as it is high, and less than half the preceding whorl is occluded. At a diameter of just under 5 lines the ribs are slightly recurved, the point of bifurcation is a little further from the inner margin, the sides are the least trifle more compressed; but the other characters are about the same. At a diameter of 7 lines the carina begins to be distinct, the sides of the whorls are more compressed, the height of the aperture being about one-and-a-quarter the breadth, and the inclusion is rather more than one-half the preceding whorl. At a diameter of 14 lines the carina is distinctly and strongly formed, the inner margin has just commenced to be distinct, the sides of the whorls are compressed—the height being one-and-a-half times the breadth—the inclusion is three-fifths the preceding whorl, and the ribs are strongly marked and recurved. At a diameter of about $2\frac{1}{2}$ inches the ribs begin to be less strongly marked, the height of the aperture is twice the breadth, and the inclusion is almost four-fifths of the preceding whorl.

The large prominent carina separates the type-form of this species from all forms of *Ludwigia Murchisonæ*. Its broad whorls, and narrow, deep umbilicus distinguish it from the coarse-ribbed *L. obtusa;* its broad, obscure, widely-separated ribs distinguish it from the narrow-centred *L. Baylii.* The young have much resemblance to *L. costosa*, but are far thicker. Although in ribbing this species has perhaps more resemblance to *L. costosa* than to *L. Murchisonæ,* yet I am inclined to think that it is a descendant of the latter rather than the former, on account of its thicker, squarer proportions and more general resemblance in aspect, and also because the series descended from the former are all small species.

What I must for the present class as a variety of this species is depicted on Plate XXI, figs. 10 and 11, and is especially noticeable. It differs most essentially from the type in not having any carina. Even where the test is present there is no distinct carina—nothing more than a small keel formed by the meeting of the two sides of the ventral area. In respect of ribbing the specimen differs in no way from the type; in respect of umbilicus but very little. As it is the only specimen of its kind which I have seen, I cannot say whether this condition of the carina is more than accidental; but no specimens have come under my notice exhibiting anything intermediate between this form and the type with respect to the carina. A prominent carina is one of the easiest characters by which to distinguish the type-form from *Ludwigia Murchisonæ;* but, if the uncarinated specimen be in reality a variety of the type, the value of this character will be diminished. I have not, however, seen the combination of coarse ribs and narrow umbilicus in any varieties of *L. Murchisonæ*. *L. Lucyi* is, of course, a direct descendant of *L. Murchisonæ*, and if it were any advantage it could be written of as *L. Murchisonæ* mut. *Lucyi*; but since *L. Murchisonæ* is, of course, the mutation of something else, the only result would be that the more species, and therefore the more links we obtain, the longer the chain of such names that can be strung together.

The name given to this species is a token of respect to the able President of the Cotteswold Naturalists' Field Club, Mr. W. C. Lucy, F.G.S., &c., to whom I am indebted for the kind present of the specimen shown in Plate XXI, figs. 10, 11.

Ludwigia Lucyi occurs in the *Concavum*-beds, that is to say, in an horizon distinctly above the stage characterised by *L. Murchisonæ* and certain other species peculiar thereto. The type-forms all came from Bradford Abbas; but the species is very scarce. The variety was labelled "Yeovil,"[1] which, judging from its matrix, I interpret as Halfway House (Sherborne), Dorset.

Plate XXI, figs. 3, 4, represent the side and front views of a fine type-specimen with its test fairly preserved; figs. 5, 6, are similar views of a smaller specimen, also with very well-preserved test; fig. 7 is the side view of another but smaller specimen, with test complete, and showing the ribbing characteristic of the genus; fig. 8 illustrates the side view of a very young specimen, with test; and fig. 9, the front view of the same specimen, showing that the carina had not been developed at this stage. All these specimens were collected by myself at Bradford Abbas. Dorset. Fig. 10 gives the side view of the variety; fig. 11 shows the front view. The top and bottom of this figure illustrate the section of the ventral area with the test preserved; but at the point of re-entry, and on the greater part of the ventral area depicted, there is no test.

In Plate A, fig. 5, a tracing of the suture-line is shown. This was taken from a portion (an additional detached piece not placed upon the plate) of the last specimen. It shows the true characters of *Ludwigia*. The small size of the inferior lateral and auxiliary lobes is noticeable, and also the manner in which they are elevated.

[1] Yeovil is a town in the adjoining County of Somerset, and is upon the Middle Lias. Having been for many years the residence of dealers, it is given as the locality to a vast number of Inferior-Oolite fossils scattered over England and the Continent. The error is also preserved in both the London Museums. Many of the fossils so labelled came from as far off as Sherborne in Dorset; but there was in some cases a desire to keep the particulars as to locality as secret as possible; and the effects of untrue information on this head can be traced, both directly as regards localities and indirectly as affecting conclusions, in the literature on the Inferior Oolite of Dorset. Fortunately, the matrix at the different localities varies in so many ways—even on the same horizon—that anyone who has had thorough experience in collecting Dorset-Somerset Inferior-Oolite specimens can generally say at once, and with perfect confidence, from what localities the specimens have been obtained, whatever may be stated upon their labels.

Ludwigia, sp. Plate XXIII, figs. 9, 10.

1874. Ammonites Escheri, *Dumortier* (*non* von Hauer). Études pal. Bassin Rhône, pt. iv, pl. xix, fig. 7.

This is the only specimen of this species which I have seen, and so I refrain from giving it a name, especially as it is not well preserved. Apparently, however, the same species was figured by Dumortier under the name "*Am. Escheri*, von Hauer," and this circumstance directed my attention to this specimen. It differs, however, in many respects from von Hauer's figure of his species, and notably in the absence of all ventral furrows. I fancy that Dumortier's figure does not represent von Hauer's species; but unfortunately, as Dumortier gives no front view of his specimen, there must be some doubt as regards the agreement of our specimen with his as to the ventral area. In the lateral area the resemblance is very complete; and both differ from von Hauer's figure.

To me it seems very probable that this species may be the ancestor of the dwarf *Ludwigiæ* (*L. costosa*, *cornu*, *&c.*). In general shape it resembles them entirely, while it differs only in having obscure knobs on the inner area instead of ribs; and such ornamentation would point to a lower degree of development,[1] which is exactly what might be expected.

Its geological position harmonizes with this theory, since it comes from the base of the Cotteswold Sands (*Variabilis*-subzone) at Nailsworth, Gloucestershire. It was collected by the late Mr. E. Witchell, and has been very kindly lent by his family to be figured in this work. More specimens are desirable.

Ludwigia, sp. Plate XXIII, figs. 2—4.

This species appears to be intermediate between *Lillia* and *Ludwigia*, since it has retained the ventral furrows of the former genus, while its ornamentation is that of the latter.

We must not lay too much stress upon the occurrence of forms, like this and the last, apparently transitional between two genera, especially when they are so small and the material so insufficient. If, when more specimens are obtained, these species are seen to be really transitional, they might be conveniently designated by combining the two generic names, as, for instance, *Lillia-Ludwigia*,[2] sp. (the parent genus first), which would exactly state their relation-

[1] See next page.

[2] If species represent the steps in evolution genera may be likened to the flights of steps. I have no wish to combine the generic names *Ludwigia* and *Lillia*, except in such circumstances as above, nor

ship and their position in the genetic series, and would convey a definite idea with regard to their general appearance, not to be obtained otherwise except by a lengthy description.

This is the only specimen of this species which I have seen. It was in the collection of Mr. T. C. Maggs, F.G.S., and was obtained from Clatcombe, near Sherborne, Dorset. Its geological position is rather uncertain, but I judge it to be either the *Murchisonæ*-zone or the *Concavum*-beds.

HILDOCERATIDÆ (*continued*).

Genus—LILLIA,[1] *Bayle*, emend. *Haug*.

1878. LILLIA, *Bayle*. Explication carte géol. France; explanation of pl. lxxxii, fig. 1.

1885. LILLIA, *Haug*. Beiträge Monog. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 713.

(*Type—Lillia comensis*, von Buch, sp.)

Definition.—Discoidal, carinate; whorls subquadrangular, ornamented with small knobs or protuberances placed at more or less irregular intervals on the inner margin, from which, or from between which, prominences proceed ribs, rather straight on the lateral area, but with a forward sweep on the ventral area. This area is broad and somewhat flattened, carrying two furrows on each side of a small but well-marked solid carina. The suture-line has a rather long and narrow siphonal lobe, a rather wide siphonal saddle, a large superior lateral lobe, a small inferior lateral, and one or two small auxiliaries.

Remarks.—The straight ribs on the lateral area and the knobs or protuberances on the inner edge separate this genus from any of the preceding, as also do its suture-line and the possession of furrows on each side of the carina. The nearest approach to the ornamentation of this genus is seen in young specimens of *Ludwigia Murchisonæ* (Plate II, fig. 3), and especially in young specimens of *L. obtusa*—with their knobs on the inner area, whorls inclined to be quadrangular, and traces of furrows on the ventral area. In fact, it appears to me to be extremely probable (especially since I have had the opportunity to examine

to drop the one for the other. I consider that both terms mark their special stages in Ammonital development—the special features in each stage being for a time very persistent in the species referred thereto.

[1] Hyatt's Genus *Phymatoceras* was probably proposed for the same series of species; but he gave neither a figure nor a reference to any known species, so that we cannot make use of his name.

certain specimens of this genus very kindly sent to me by Dr. Canavari from the Upper Lias of Italy) that *Ludwigia* is descended from *Lillia* through *Lillia comensis* or *Bayani.* One of the greatest differences between the two genera is the narrow siphonal lobe of the latter genus compared with the broad siphonal lobe of the former with its divergent terminal points. The other differences, such as gradual disappearance of furrows, the projection and recurving of the ribs on the lateral area, and the development of more auxiliary lobes, are nothing more than the changes which we ought to expect to find during the gradual evolution of these genera from *Arietites.* Similar changes must have taken place among the ancestors of the genera *Harpoceras, Lioceras,* &c., to evolve them from *Arietites* (see p. 133, *et seq.*).

One species which I have to describe, and which belongs apparently to this genus, is rather interesting and peculiar. The reason for doubting whether this be its correct position is that I have seen but a portion of the suture-line, and that the species occurs so very much later than any other species of the genus. Three or four life-zones, which have hitherto yielded, so far as I am aware, no species of the genus *Lillia,* intervene to isolate *Lillia sulcata* from those species which we meet with in the Upper Lias.

This genus contains the following already-named species, none of which can yet, to my knowledge, be recorded as British: *Am. comensis,*[1] von Buch; *Am. Bayani,* Dumortier; *Am. Escheri,* von Hauer; *Am. erbaensis,* von Hauer; *Am. rheumatisans,* Dumortier; and probably *Am. Lilli,* von Hauer, and *Am. tirolensis,* von Hauer. The last four species are part of the series to which Dumortier gave the name "Podagrosi."

The specimen figured by Bayle as *Lillia Lilli* seems to be rather different to von Hauer's species *Am. Lilli.*

Lillia sulcata, *S. Buckman.* Plate XXII, figs. 32, 33; Plate XXIII, fig. 1.

Discoidal, slightly compressed, carinate, furrowed ventrally; whorls quadrate, with their sides very slightly convex, ornamented on the inner area with small knobs at irregular intervals, from which, generally in pairs, and from between which singly, rather coarse rounded ribs spring. These run rather straight on the lateral area, bend slightly forward on the ventral area, and die away at the furrows. The ventral area is rather flat, carries a small, solid, rather sunken carina, bordered by two conspicuous furrows. The inner margin is convex

[1] *Am. comensis* has been quoted from different places, but, in my experience, incorrectly.

and crenulated on its upper edge by the ends of the knobs or ribs. Inclusion about one-third of the preceding whorl; the outer part of the umbilicus is rather flat, the inner becoming steeper. The inner edge of the body-chamber of this species shows a slight tendency to recede from the regular line of coil, and the body-chamber itself does not continue to increase in breadth at the same proportionate rate that other parts of the shell exhibit; consequently the outer portion of the umbilicus is wider and flatter, but half a whorl back it is smaller and deeper with steep sides.

This species has a great resemblance to *Lillia comensis*, von Buch; but it is altogether squarer in form, is thicker, has a flatter ventral area with more marked furrows, a smaller umbilicus, and a shorter aperture.

Judging from the matrix, the horizon of this species is the *Humphriesianum*-zone. When it is considered that all the other species of *Lillia* occur either in the *Commune*- or the *Jurense*-zone, and that none are known between this latter and the *Humphriesianum*-zone, it is very singular to find a species, with such an evidently close resemblance to those earlier forms, at an horizon so much higher.

There appears to be a very remarkable convergence between *Lillia* and certain degenerate species of *Sonninia*,[1] even if this species should happen to be located in the wrong genus. This latter idea, however, I am not at all prepared to admit. This specimen is well preserved, and shows no signs of rudimentary spines in its inner whorls;[2] while the knobs on its inner area are somewhat different to the prominences seen on the specimen of *Sonninia* (Plate XXIII, fig. 7), which are caused by the coalescing of two ribs on the inner area. The suture-line, so far as can be seen, is also distinct, especially in the disposition of the inner lobes.[3] Therefore I do not think that it belongs to the genus *Sonninia*, and I hold to my original determination. So close is the resemblance, however, that I took the suture-line (Plate XXII, fig. 34) from the *Sonninia* figured in Plate XXIII, figs. 7 and 8, to place it as the suture-line of *Lillia sulcata;* but on further investi-

1 See p. 129. I derive *Sonninia* from some ancestor common also to *Amaltheus* and *Pleuroceras*, while *Lillia* comes from *Arietites*. If we consider that the paths of these two genetic series have been widely different since the time of the Lower Lias, we cannot fail to be surprised at this convergence. It will thus be seen why it is so necessary to insist upon such apparently small differences, and why rudiments are of such importance. How these results have been arrived at, and how the degenerate *Sonninia*, figured Plate XXIII, figs. 7, 8, is linked to *Sonninia Sowerbyi* and to *Pleuroceras*, must be left for the future parts of this Monograph to demonstrate.

2 See explanation of Plate XXIII, fig. 7, concerning rudimentary spines in *Sonninia*.

3 The sutures of larger Ammonites are infallible guides; but among smaller specimens their interpretation becomes difficult. Not only are the peculiar characters in such cases less developed, but the smaller the specimen the nearer the approach to the simple primordial suture-line inherited by all Ammonites in common. Just in the same way we find the fry of the most different adults to be alike.

gation I was not satisfied, and so I removed the test as much as possible from the sutures of the actual *Lillia sulcata*, and the result is given in Plate XXIII, fig. 1. In order to show the specimen from which the former suture-line (Plate XXII, fig. 34) had been taken—and which specimen will be described at a later portion of this work with the other members of its genus, *Sonninia*—I had two views of it inserted where it could be compared with the other specimens, and especially with *Lillia sulcata*.

Plate XXII, figs. 32, 33, give the side and front views of this species. The specimen came from Bradford Abbas, and from its matrix I judge it to be from Bed 3 of the section at page 5 (*Humphriesianum*-zone). It is in my collection. Plate XXIII, fig. 1, exhibits a portion of the suture-line taken from the same specimen.

HILDOCERATIDÆ (*continued*).

Genus—HILDOCERAS,[1] *Hyatt*.

1867. HILDOCERAS, *Hyatt*. Fossil Cephalopoda, Museum Comp. Zoöl. Bull., vol. i, No. 5, p. 99.

(*Type*—HILDOCERAS BIFRONS, *Bruguière* sp.)

Definition.—Discoidal, compressed, carinate, widely umbilicate; whorls subquadrate, ornamented in the type-form with well-marked sigmoidal ribs, which have the genicula close to the inner margin and the outer arc very long.[2] (In some species the ribs are straight on the lateral area.) Ventral area with deep furrows each side of the carina when the test is absent, but sometimes the furrows are inconspicuous when the test is present, more especially in adults. Carina solid. Inner margin subconcave, sloping. Suture-line:[3] Siphonal lobe with two terminal points closely embracing the siphuncle; siphonal saddle very broad, and with a very small accessory lobe; superior lateral lobe broad, inclined to be bulbous and very little branched, with no actual trifurcation; inferior lateral lobe about one-fourth the size of the superior lateral, inferior lateral saddle, auxiliary lobes and saddles sometimes elevated, sometimes hanging down, and varying in this and other respects according to the amount of involution. The general tendency of the genus is to be latisept, but specimens of the same species and even parts of the same individuals vary in this respect.[4]

[1] St. Hilda. [2] Plate A, fig. 30. [3] Plate A, figs. 28, 29.

[4] One specimen of *Hildoceras bifrons* (compressed variety) shows half the whorl latisept, the other half densisept. Other specimens show considerable irregularity in this matter.

Remarks.—In this genus are included species ribbed in two different ways, namely, the straight and the sigmoidal. The former are distinguished from *Lillia* by the absence of knobs on the inner area, and by the concave inner margin; the latter are separable from *Ludwigia* by the ribs being simple (not bifurcate) and inconspicuous on the inner area; while the peculiar suture-line, with its broad siphonal lobe, short and broad superior lateral lobe placed so near the inner margin, and the other lobes undeveloped, fully serves to distinguish the genus from any of those previously mentioned.

The species which are included in this genus may be arranged as follows:

A. With sigmoidal radii:—*Hildoceras bifrons* (Brug.), *H. boreale* (Seebach).

B. With transitional radii:—*Hild. Levisoni* (Simpson).

C. With straight radii:—*Hild. Kiliani*, Haug, *H. Douvillei*, Haug.

Dr. Haug also includes *Am. serpentinus* (Reinecke), and *Am. Frantzi* (Reynès), in the "group of *Am. bifrons*.[1]"

The species of this genus appear to be directly descended from *Am. algovianus*, Oppel, or some form very similar thereto. They seem to show a transitional state of ribbing between the Arietitan and Harpoceratan styles. Their general shape and suture-line are decidedly inclined to the former style.

The species of this genus are characteristic of the Upper Lias, in fact so much so that the presence of a *Hildoceras* may be looked upon as an almost infallible guide regarding the date of the deposit containing it.

Hildoceras bifrons (*Bruguière*), var. Plate XXII, fig. 30, 31; Plate A, fig. 28.

1867. Ammonites bifrons, *Meneghini*. Fossiles calcaire rouge (Lias supérieure), Paléontologie Lombarde, 4[e] série, p. 8, pl. i, figs. 5 *a*, *b*, *c*.

I have thought it unnecessary to enter into the synonyms of this well-known species. The one reference which I have made to Prof. Meneghini's work illustrates a specimen having the greatest resemblance to the varieties to which I wish to draw attention, and showing a considerable difference from the specimens figured by d'Orbigny, Wright, and others. *Hild. bifrons*, like the other species of the genus, is intimately associated with the Upper Lias; and the only reason that I introduce the species here is because I have found this variety in great numbers in an indurated band towards the lower part of the Cotteswold Sands,—strata which, classed as "Midford Sands" on the supposition that they were

[1] "Beiträge Monogr. Harpoceras," 'Neues Jahrbuch f. Min., &c.,' Beil.-Bd. iii, p. 642.

identical in age with the sands at Midford,[1] have been lately replaced by some authors in the Inferior-Oolite Series.[2] Another reason is that since these Sands have been the subject of so much discussion, and since I have to introduce other species which occur in them—species not included in Dr. Wright's 'Lias Monograph'—it is as well that the Ammonite-fauna of this deposit should be fully represented. This genus also seems a good introduction to the next, namely, *Pœcilomorphus*.

The peculiarity about this variety is that it is so much compressed, and that the inclusion of the preceding whorl is much greater than is usual in the species, being up to the longitudinal furrow on the sides, and thus producing a smooth umbilicus. I did not feel it necessary, or consider it justifiable, to take up much room with a figure of this variety; but the larger specimens, which reach 4½ to 5½ inches in diameter, show the same characteristic compression and inclusion.

It is noticeable that these characters seem to be peculiar to those specimens found in the Sands, and practically to be universal among them. The ribbing is frequently very fine, like that shown by the figured specimen; but there is some variation in this respect. The test is usually well preserved, and is very thick on each side of the carina, so that the furrows, which are deeply marked upon the core, are scarcely perceptible on the test.

The manner in which the indurated rock-bed in the Cotteswold Sands is filled with specimens of this variety would seem to indicate that *Hildoceras bifrons*, at any rate, was able to survive the change to conditions necessary to deposit a fine-grained yellow micaceous sand (occasionally hardened into bluish-grey rock) instead of a blue clay.

That *Hildoceras bifrons* had been recorded from the Cotteswold Sands previous to my notice of it last year (p. 45) was unknown to myself and to those to whom I mentioned the subject. Nevertheless just thirty-one years previously, namely, in 1856, the members of the Cotteswold Field Club were much surprised when Dr. Wright announced that he had discovered the species in the Sands at Frocester, and brought it forward as strong evidence for the Liassic character of what were then known as the "Inferior-Oolite Sands." This discovery was alluded to in the President's Address,[3] and in a paper on the Oolites of Gloucestershire[4] the conclusions drawn by Dr. Wright are contested.

[1] See above, p. 50. From further research I find that the Yellow Sands near Midford belong to the *upper part* of the *Striatulum*-beds. The Cotteswold Sands are altogether *below* the *Striatulum*-beds, and contain an Ammonite-fauna different to that of the Sands at Midford. There are no Yellow Sands at Midford below the *Striatulum*-beds.

[2] H. B. Woodward, 'Geol. England and Wales,' 2nd edition, 1886, p. 285. But see this Monograph, p. 50.

[3] Made by my father, as Secretary, at the President's request, January 27th, 1857. See also Dr. Wright on "The Upper Lias Sands," 'Quart. Journ. Geol. Soc.,' vol. xii, 1856, p. 305, &c.

[4] "The Oolites of Gloucestershire and North Wilts," by Prof. J. Buckman, 'Quart. Journ. Geol. Soc.,' vol. xiv, p. 103, 1858.

In his 'Monograph on the Lias Ammonites,'[1] Dr. Wright has recorded *Harpoceras bifrons* from the Cotteswold Sands at Frocester, and he places these Sands in the "zone of *Harpoceras bifrons ;*" but he seems to have been somewhat in doubt upon the matter, since he places the Sands of all the other localities in the "zone of *Lytoceras jurense*," and at p. 140 says that *Harp. bifrons* is a leading fossil of the clay-bed of the Upper Lias, but is not found in the *Jurense*-zone unless as a fossil washed out of an older bed, and redeposited[2] in a newer formation.

It is probable that in making geological divisions we ought not to lay too much stress upon the occurrence of this species, even so plentifully in the Cotteswold Sands, since Dr. Haug[3] remarks that it occurs not infrequently in the *Jurense*-zone, and even comes in the *Opalinum*-zone. What we shall really have to consider in this matter is the other species which accompany it in these Sands. At the same time it is probably preferable to use the term *Commune*-zone to designate the zone in the Upper Lias which succeeds that of *Harp. falciferum,* instead of employing the name of an Ammonite (*bifrons*) which seems to have so wide a vertical range.

About forty feet from the base of the Cotteswold Sands, at Coaley Wood, in a bluish-grey sandstone, reposing upon and followed by bright yellow micaceous sands (Bed 17, section 6, p. 45), is the chief place at which I have obtained this compressed, involute variety. Plate XXII, figs. 30, 31, represent the side and front views of a young specimen of this variety. In Plate A, fig. 28 marks the suture-line, taken from a specimen of the same variety obtained in the Cotteswold Sands. To compare with this is fig. 29, which shows a suture-line taken from a thick, evolute specimen, obtained in the Upper-Lias Clays of Trent, Somerset. The difference of the disposition of the inner part of the two suture-lines will be noticed, as well as the greater length of the part inside the inferior lateral lobe of fig. 28.

[1] Palæontographical Society, vol. xxxiii, p. 138, 1879.

[2] At Coaley Wood, I think, no idea of re-deposition can be entertained. The great number of specimens, the complete manner in which they are preserved, with the test, and in some cases the mouth-border complete, does not admit of this opinion being held.

[3] Op. cit., p. 641, 1885.

HILDOCERATIDÆ (*continued*).

Genus—PŒCILOMORPHUS,[1] *S. Buckman.*

(*Type*—PŒCILOMORPHUS CYCLOIDES, *d'Orbigny* sp.)

Definition.—Discoidal to subglobose, compressed or very thick, widely or very narrowly umbilicate, carinate, furrowed ventrally; whorls subquadrate; ribs sigmoidal, outer arc conspicuous and much longer than the inner, which is inconspicuous. Carina not elevated, solid, bordered by two furrows which are smooth and as deeply marked on the test as on the core. Inner margin convex. Termination plain, with a short, rounded lateral, and a pointed ventral, process. Suture-line:[2]—Siphonal lobe with two terminal points closely embracing the siphuncle; siphonal saddle with a small accessory lobe; superior lateral lobe as long as, or a little longer than, the siphonal, trifurcate; inferior lateral lobe much shorter but similar; one auxiliary lobe. The length of the chambers is variable, apparently being closer together in proportion to the thickness of the specimen.[3]

Remarks.—In thickness and the amount of involution the species of this genus are very variable; but in ornamentation, shape of whorls, suture-line, furrowed ventral area, &c., they show the same peculiar characters. From *Hildoceras* the genus is separable by its possessing a convex, instead of concave, inner margin, a narrower siphonal saddle, a thinner-stemmed trifurcate superior-lateral lobe, and a wider superior-lateral saddle. From *Ludwigia* the absence of bifurcate ribs, the absence of conspicuous ribs on the inner area, the presence of furrows on each side of the carina, the convex inner area, and the absence of more than one auxiliary lobe, easily distinguish it. From *Lillia* the sigmoidal ribs, the absence of knobs or tubercles on the inner margin, the inconspicuous nature of the ribs on the inner area, are the chief distinctions in addition to a narrower siphonal saddle.

I have chosen *Ammonites cycloides*, d'Orbigny, for the type-form of this genus, because it is a species with which workers in the Inferior Oolite of Dorset would soon become familiar. There are two species belonging to this genus in the Inferior Oolite; and their ancestor is *Ammonites Mercati*, von Hauer,[4] which occurs in the Upper Lias. Between this and the *Sauzei*-zone (the position of the first

[1] Ποικίλος, various; μορφή, form.

[2] For suture-lines of this genus see Plate A, figs. 31, 32, 33.

[3] I have not seen the suture-lines of a sufficient number of examples to be able to say if an exact relationship exists between the thickness of the specimen and the closeness of the sutures.

[4] 'Cephalopoden N.-O. Alpen.; Denksch. Akad. Wissensch. mathem.-natur. Cl.,' Bd. xi, pl. xxiii figs. 4—10.

Inferior-Oolite species) is a long interval, during which no species belonging to this genetic series has been recorded. In fact the occurrence of a species in the *Sauzei*-zone is a new find, and helps to decrease what was, and is even now, a very long break in the record. *Ammonites Mercati* differs from these species, because its ribs are not really sigmoidal, but are straighter on the lateral area, and more conspicuous on the inner area, and its inferior lateral lobe is a trifle smaller. *Am. Mercati* could be included in the genus *Pœcilomorphus* under the same conditions as *Hild. Kiliani* and *H. Douvillei* are in *Hildoceras*. The development of the ribs of the one genus is paralleled by that of the other,—the older species possess straight ribs, the younger have sigmoidal ribs; in other words, in these two genera the older species retain the Arietan form of ribbing, the younger possess the Harpoceras mode.

Pœcil. Mercati shows the same involute and evolute varieties as *Pœcil. cycloides;* but apparently it does not vary in thickness in a similar manner. The shape of *Pœcil. macer* is very different from *Pœcil. cycloides;* it is in fact more like that of *Hildoceras*. On the other hand, *Pœcil. Mercati* has considerable similarity to certain species of *Lillia*, while *Pœcil. cycloides,* by its peculiar shape and ornamentation, is easily separable from both *Lillia* and *Hildoceras;* yet we can see how these species of *Pœcilomorphus* are bound up together as the members of one genus or branch. This branch, I take it, is more closely allied to *Hildoceras* than it is to *Lillia;* that is to say, *Lillia* was the first by some time to leave the parent stem, and to assume its own distinctive characters.

In the *Humphriesianum*-zone is found the chief development of *Pœcilomorphus,* namely, in the numerous varieties of *Pœcil. cycloides*. *Pœcil. Mercati*, which is included in the genus somewhat on sufferance, is a very much earlier species, and is outside the scope of this Monograph.

Pœcilomorphus macer, *S. Buckman*. Plate XXII, figs. 23—29; Plate A, fig. 33.

Discoidal, compressed, very evolute, carinate; whorls, subquadrate with slightly convex sides, ornamented with sigmoidal radii, of which the outer arc alone is conspicuous and is longer than the inner. The radii, which become very faint again on the ventral area, are projected forwards to join the carina at an acute angle. The ventral area carries a small solid carina, on each side of which runs a small furrow. Inner margin convex. Inclusion about one third. Umbilicus flat and wide. Termination plain, with a projected, rounded lateral, and a pointed ventral, process. Body-chamber at least 0·60 of a whorl in length.

This small, and, on account of its narrow whorls, thin, compressed species does not present so much variability in shape as *Pœcil. cycloides.* It does not seem to attain a size greater than one inch in diameter, and in appearance is much like a dwarf *Hildoceras;* but it is effectually distinguished by the very different position of its superior and inferior lateral lobes with regard to the rest of the suture-line. From any variety of *Pœcil. cycloides* it is separable by its thinness and great evoluteness. It is much more likely to be passed over among the young forms of *Witchellia*,[1] which occur far more numerously in the same bed, and which, when their test is absent, exhibit furrows along each side of a more or less sunken carina. Our species may, however, be distinguished by possessing a solid carina, sigmoidal ribs, and a more simple suture-line.

The *Sauzei*-zone of Oborne, Dorset (p. 8), and the beds between the Lower Ragstones and "Ironshot" of Dundry (Somerset) are the only localities where I know this very scarce and interesting species to occur.

Plate XXII, fig. 23, shows a side view of a nicely preserved specimen with a complete mouth-border, exhibiting the short, perfect, lateral lappet; the back view, showing the ventral lappet and the furrows on each side of the carina, is given by fig. 24. Figs. 25, 26, 27, and 28 illustrate two more forms of this species. The ventral furrows are, perhaps, scarcely conspicuous enough, especially in fig. 28. Fig. 29 shows the suture-line of a specimen at its natural size, while Plate A, fig. 33, exhibits the same enlarged.

Pœcilomorphus cycloides (*d'Orbigny*). Plate XXII, figs. 1—22; Plate A, figs. 31, 32.

1844. Ammonites cadomensis, *d'Orbigny* (non Defrance). Pal. Franç. Céph Jurass., pl. cxxi, figs. 1—6 (*non* pl. cxxix, figs. 4—6).
1845. — cycloides, *d'Orbigny*. Pal. Franç. Céph. Jurass., p. 370.
1856. — — *Oppel*. Juraformation, p. 370.
1881. Harpoceras cycloides, *S. Buckman*. Inf. Ool. Ammonites; Quart. Journ. Geol. Soc., vol. xxxvii, p. 604.
1885. Hildoceras cycloides, *Haug*. Beiträge Monog. Harpoceras; Neues Jahrbuch f. Min., &c., Beil.-Bd. iii, p. 639.

Discoidal to subglobose, carinate; whorls subquadrate, their sides very slightly

[1] See p. 82.

convex, ornamented with sigmoidal radii, of which the outer arc is longer than the inner—the latter, too, being inconspicuous. The ribs gradually increase in size until they become most pronounced on the edge of the ventral and lateral areas; then, slightly decreasing, they sweep forwards and die away, at the edge of the ventral furrows, to inconspicuous lines of growth. Ventral area slightly subconvex, but interrupted by a small solid carina and two furrows, one on each side. Inner margin convex. Inclusion variable, amount of exposure of preceding whorl being from one half to almost nothing in different specimens. Umbilicus also variable, in some specimens being small and deep, and in others open and flat. Termination plain, sigmoidal, with a rounded lateral, and a pointed ventral, process. The length of the body-chamber is 0·60 of a whorl in fig. 1.

This species is very variable in shape, as an examination of the following Table will show.

	1	2	3	4	5	6	7	8
Diameter	100	100	100	100	100	100	100	100
Height of last whorl	50	50	44	54	48	50	42	50
Breadth of last whorl	67	57	39	39	38	46	31	32
Umbilicus	20	20	25	14	23	24	37	21
Inclusion	25	23	17	21	23	17	10	21

Some individuals are very thick, with the breadth of the whorls considerably more than the height, and with a very small umbilicus; others have a very small umbilicus, but the height of the whorls greater than the breadth; others again have the umbilicus open, even considerably so, and the height of the whorls less than the breadth. At first sight there appear to be three chief varieties of this species, namely, (1) thick with closed umbilicus, (2) medium with open umbilicus, (3) thin with very open umbilicus. An examination, however, of a large number of specimens shows that this will not hold good; for instance, the specimen whose proportionate dimensions I have given under No. 4 shows the smallest umbilicus, but with very narrow whorls.

Dr. Haug appears[1] to be of the opinion that the open-centred, flat forms are the young state of the thick, narrow-centred specimens; but the specimens which I have had figured will clearly indicate that this is not the case. For instance, a young specimen (Plate XXII, figs. 19, 20) of the very thick form shows that the shape is practically the same in youth as in adolescence (Plate XXII, figs. 13, 14); and this is the case with all the different forms of the species.

The following are some of the variations which may be noted:

a. (Plate XXII, figs. 1, 2, 7, 8.) Medium form.

[1] Op. cit., p. 639.

β. (Plate XXII, figs. 3, 4.) Similar, but with coarser ribs.

γ. Similar to a, but thinner (No. 8 on the foregoing Table).

δ. (Plate XXII, figs. 5, 6.) Very small umbilicus; much compressed form.

ε. (Plate XXII, figs. 9, 10.) Similar to a, but smaller umbilicus; ribs more numerous.

ζ. (Plate XXII, figs. 11, 12.) Similar to a, but smaller umbilicus, and only striæ on body-chamber.

η. (Plate XXII, figs. 13—16, 19, 20.) Small umbilicus; very thick whorls. Should probably be considered the type-form.

θ. (Plate XXII, figs. 17, 18.) Slightly thinner than η; ribs irregular in size.

ι. (Plate XXII, figs. 21, 22.) Thin form, very evolute.

Besides these, d'Orbigny has figured a form with large ribs at intervals ('Céph. Jurass.,' plate cxxi, fig. 3), which I do not possess.

Of the above different forms, those marked a and γ are by far the commonest; the forms β, η, θ are rather scarce, while ι is still scarcer, and the others occur only occasionally.

There is no species in the Inferior Oolite for which this ought to be mistaken, if the sigmoidal character of the ribs be observed; but I have noticed that specimens of *Sonninia Boweri* (J. Buckman) are very frequently placed in collections under the name "*Am. cycloides.*" (Their ribs are straighter on the lateral area, and they possess, when perfect, large, well-developed lateral lappets to the mouth-border. Generally they exhibit small spines in the umbilicus; but these are sometimes absent, and it is then when the error is likely to occur. I shall have to allude to these specimens later on; and I hope then to place their differences from the present species in a clear light.)

Dr. Wright ('Monog. Lias Amm.,' p. 429) says: "The Ammonite which most resembles *Phyll. subcarinatum* is the *Phyll. cycloides*, d'Orbigny, from the Inferior Oolite of Moutiers;" but to consider the latter a *Phylloceras* must be a mistake, for it has nothing in common with that genus, neither ribbing, lobes, nor general shape approaching those of the typical *Phylloceras heterophyllum.* It certainly has some resemblance in shape to *Am. subcarinatus*, a species which should not, however, be placed in *Phylloceras*,[1] since its lobes have not the slightest *Phylloceras*-character, though its form of ribbing is somewhat similar, being circular to the whorl; but this character at once separates it from *Pœcilomorphus cycloides.*

This species occurs rather frequently in the true *Humphriesianum*-zone,[2] the

[1] Dr. Haug ('Annuaire géol. universel,' tome iii, 1887, p. 134) states that *Am. subcarinatus* belongs to Hyatt's genus *Pelecoceras;* but Hyatt defined his genus as having an acute abdomen, and his description seems to me to fit *Am. serrodens*, Quenstedt, a very different species.

[2] The lower part. I do not remember to have found it in the upper part, to which Mr. Hudleston gives the name *Cadomensis*-beds.

hard ironshot stone (Bed No. 3, in my section at Oborne, page 8); and in the same zone at Wyke Quarry. It is one of the most distinctive fossils for that zone. Besides these places, it has been obtained at quarries near Sherborne, and at Louse Hill, in Dorset, and Milborne Wick, in Somerset.

Dr. Haug[1] says that this species occurs in the *Parkinsoni*-zone of Normandy. This is very interesting, being contrary to my experience of Dorset. I have found no specimen in the *Parkinsoni*-zone, and probably not even in the upper part of the *Humphriesianum*-zone at any locality. I have always considered it as a most characteristic species for the *Humphriesianum*-zone proper, in which it is associated with innumerable varieties of *Stephanoceras Humphriesianum,* with *St. Braikenridgii, Sphæroceras Gervillii, Sph. Brongniarti, Sph. Wrighti,* &c.

On account of the mistake in the explanation given by d'Orbigny for the plate whereon he figured it, this species was formerly often quoted from Dorset under the name *Am. cadomensis* until I corrected the error in my paper on Inferior-Oolite Ammonites.[2]

Plate XXII, fig. 1, shows the side view of a specimen with the mouth-border from Oborne (third bed of the Section on p. 8); and fig. 2 gives the back view. Figs. 3, 4, illustrate another example from Sherborne. Figs. 5, 6, illustrate a singular variety, with the small umbilicus which is usually peculiar to the inflated forms. This specimen is from Wyke Quarry (second bed of Section, p. 8). Figs. 7, 8, give a smaller example from Sherborne. Figs. 9, 10, mark a specimen with numerous, but unequal, ribs; it is from Sherborne. Fig. 11 shows the side view of a specimen with only finely marked lines of growth on its body-chamber; it has the mouth-border, and came from Oborne. In fig. 12 is given the back view, showing unusually rudimentary furrows. The side view of a thick globose form, with the mouth-border, is exhibited in fig. 13; and a view of this mouth-border, with its ventral process and ventral furrows continued thereon, is shown in fig. 14. This specimen came from Oborne. In figs. 15 and 16 is depicted another thick example, which is also from that peculiar thin development of the *Humphriesianum*-zone at Wyke Quarry. Figs. 17 and 18 are the side and back views of a specimen from Sherborne. Its ribs are somewhat irregular in size. The young specimen delineated in figs. 19 and 20 is very interesting, and shows what is the juvenile stage of the globose forms (figs. 13—16). The specimen of course shows proportionately more umbilicus than they do, and also whorls more inflated; but this is exactly what is found in all other species. This specimen again is from Wyke Quarry. In figs. 21 and 22 are given views of a very umbilicate variety. This variety is scarce, and seems never to have attained a large size; but here it is sufficiently large to show that it could not possibly be the young of any of the

[1] Op. cit., p. 639.

[2] 'Quart. Journ. Geol. Soc.,' vol. xxxvii, 1881, p. 604.

other varieties. It came from Louse Hill, near Sherborne. Plate A, fig. 31, gives the suture-lines of this species copied from d'Orbigny, 'Pal. Franç. Céph. Jurass.,' plate 121, enlarged six times. It differs in several minor details from the drawing I have made from the sutures of a medium specimen in my collection (Plate A, fig. 32), also enlarged six times, in which the accessory lobe in the siphonal saddle is undeveloped, though the saddle itself is larger. Plate A, fig. 31 shows a larger inferior lateral lobe and broader superior lateral, and inferior lateral, saddles; but after all these points are of minor importance compared with the general aspect of the suture-lines, which is practically the same. Considering the difficulty which attends the copying of the sutures of such small specimens, it is not at all unlikely that neither delineation is absolutely exact.

RÉSUMÉ OF THE PRECEDING GENERA.

I have two things to do in this *résumé*, first to notice the suture-lines, &c., figured upon Plate A, so far as they relate to the species already described; and next to put forward certain conclusions which a consideration of them, and of the other characters of the species, have induced me to form concerning these *Ammonites*.

In the first matter I will notice that in Plate A the suture-lines of various species of *Ludwigia*[1] are exhibited in figs. 1—7; and they evidently show the same general characters throughout. These may be briefly recapitulated as—accessory lobe in siphonal saddle slightly developed, inferior lateral lobe very much smaller than the superior lateral, auxiliary lobes feebly developed and few in number. The suture-line of a typical *Ludwigia Murchisonæ* is given in fig. 1, that of *Ludwigia Murchisonæ* var. *obtusa* fig. 2, of a more adult specimen fig. 3, and that of *Lud. Murchisonæ* var. *Baylii* fig. 4. Fig. 3 is noticeable for its very short siphonal lobe; fig. 2 seems to have only two auxiliary lobes; but otherwise their general characters are practically the same. Fig. 5 represents the suture-line of *Ludwigia Lucyi*, which differs only in carrying the inner portion rather higher; but this may not be a persistent feature. Fig. 6 shows the lobe-line of *Lud. cornu*, and indicates the distance at which the lobes are placed one from the other. This latisept character is a special feature in *Ludwigia*, which the less developed forms (*Lud. obtusa*) show in an even more pronounced manner. Fig. 7 gives the suture-line of *Lud. rudis*, and it is placed just above that of *Lioc. apertum* for comparison. The greater difference in size of the two lateral lobes in the former compared to the latter, and the fewer number of less prominent auxiliary lobes, may be noticed.

The suture-lines of the genus *Lioceras*[2] are illustrated by figs. 10—17. They show a more developed accessory lobe in the siphonal saddle, a larger inferior lateral lobe, especially in comparison with the superior lateral, and a greater number of well-developed auxiliary lobes. The ends of the siphonal lobes are less divergent than in *Ludwigia*. Most of the chief lateral lobes decrease in gradually descending order, though sometimes the auxiliaries are a little irregular in this respect. The whole aspect of the lobes shows a more florid style of ornamentation than is met with in *Ludwigia*. Fig. 10 is the lobe-line of a young specimen of

[1] Pages 16—20, 101—108. The sutures of this genus exhibited in Plate II, fig. 5, are not quite trustworthy; the superior lateral lobe is too long, and the inner portion is not finished off.

[2] Pages 21—80.

Lioceras opalinum. Fig. 11 is that of *Lioceras ambiguum* variety *costatum,* and this exhibits differences from the general *Lioceras*-character, in the sutures being farther apart from each other, having a smaller inferior lateral lobe, and partaking more of the *Ludwigia*-type, but with apparently more auxiliaries. The superior lateral saddle is also rather deep. How far these characters may be persistent, the cause of them, and what they signify, can only be found out by a study of a more extended series of specimens (see page 80). In fig. 12 is shown a grand suture-line of *Lioceras bradfordense* variety *giganteum,* especially noteworthy on account of its large size. The second auxiliary lobe seems to be rather smaller than would be expected, and the third on the edge of the inner margin to be rather larger. Fig. 13 is the suture-line of *Lioc. decipiens* variety *simile;* fig. 14 of *Lioc. concavum,* typical form; fig. 15 of *Lioc. concavum* variety *formosum;* and fig. 16 of *Lioc. concavum* variety *v-scriptum.* These are all on the same pattern, but some slight differences in the arrangement of the auxiliary lobes may be seen. Fig. 14 shows how the one lobe here penetrates the preceding in the manner characteristic of *Lioceras;* fig. 15 is chiefly noticeable for the absence of digitations, but I cannot say if this is peculiar to the variety *Lioc. formosum* or if persistent in that form; fig. 16 shows that *Lioc. v-scriptum* is no *Ludwigia,*[1] but possesses an extremely well-developed *Lioceras*-lobe-line; while fig. 17 shows the small lobe-line of *Lioc. apertum* and indicates that, in spite of a wider umbilicus and consequently narrower whorls, yet all the auxiliary lobes are present.

The suture-line of the genus *Pseudolioceras*[2] is given in fig. 22 from a specimen of *Pseudolioc. Beyrichi* var. It is noticeable for its large accessory lobe in the siphonal saddle and its array of auxiliary lobes.

Suture-lines of the genus *Hyperlioceras*[3] are represented in figs. 23—26. They differ from those of *Pseudolioceras* in having a smaller accessory lobe in the siphonal saddle, a somewhat larger inferior lateral lobe compared with the superior lateral, and a still longer array of auxiliary lobes. Otherwise, fig. 23, taken from a specimen of *Hyperlioc. discites,* is very much like the suture-line of *Pseudolioceras,* and its inner lobes hang down on a slight curve in a similar manner. Fig. 24 represents the lobe-line of *Hyperlioc. Walkeri,* which is noticeable for the shallowness of its saddles and the shortness of its lobes; fig. 25 gives the suture of *Hyperlioc. discoideum;* and fig. 26 that of *Hyperlioc. subdiscoideum.* The latter is noticeable for possessing a fewer number of auxiliary lobes, which have also been elevated at the end as if for want of room (I have referred to this at p. 101). The superior lateral lobe is also rather long.

1 The recurved character of the ribs might suggest *Ludwigia;* but the absence of the bifurcate ribs, and the inconspicuous character of the ribs on the inner area show a true *Lioceras.* This determination is fully confirmed by the characteristic suture-line.

2 Pages 81—88.

3 Pages 88—101.

We now come to a very different style of suture, and to find any approach to it at all we must go back to fig. 2 (*Ludwigia obtusa*); but even this is in many ways different. Two figures, 28, 29, illustrate the suture-line of two forms of *Hildoceras*[1] *bifrons*, the latter taken from a thick evolute specimen from the Upper-Lias Clay, Somerset, the former from a compressed involute example from the Cotteswold Sands in Gloucestershire.[2] Both agree in possessing a narrow ventral lobe closely embracing the siphon, a very wide siphonal saddle with an undeveloped accessory lobe, and a broad-stemmed, rather short, superior lateral lobe; but the latter (fig. 29) has its inner lobes elevated as if cramped for room, the former (fig. 28) has the inner lobes in line and stretched as if they could not properly fill up the space; for this purpose, too, it has had to produce some denticulations. Practically only one auxiliary lobe is present in either.

Some lobe-lines of the genus *Pœcilomorphus*[3] are presented in figs. 31, 32, 33, all enlarged about six times the natural size. Fig. 31 is a copy from d'Orbigny 'Céph. Jurass.,' plate 121 (*Am. cycloides*). Fig. 32 I have taken from a medium specimen in my collection. There is a certain amount of difference between the two. The siphonal lobe of fig. 31 is narrower, while the accessory lobe therein is more developed than in fig. 32; the inner part of fig. 31, including the superior lateral saddle, inferior lateral lobe and saddle is broader than in fig. 32 (p. 121). Fig. 33 shows the suture-line of *Pœcil. macer*, which is apparently intermediate between the last two. It exhibits the accessory lobe in the siphonal saddle like fig. 31; but this siphonal saddle is broader, while the superior lateral saddle is narrower, than in that figure. The inferior lateral lobe is also narrower, and except for the accessory lobe in the siphonal saddle the suture agrees more with fig. 32 than with fig. 31 (d'Orbigny's).

The remaining suture-lines must be reserved for discussion until the species to which they belong have been figured and described. It only remains for me to notice the radial lines. These I have taken from the inner edge to the middle of the carina, in contrast with a straight line drawn from the centre of the umbilicus to the tip of the rib upon the carina. The following types of ribbing may be observed:

Fig. 8. *Recurved bifurcate*, taken from the specimen of *Ludwigia Murchisonæ* figured on Plate III, fig. 1. $V =$ middle of ventral lobe.

Fig. 18. *Sigmoidal*, taken from a typical *Lioceras concavum*; $l' =$ middle of superior lateral lobe, $l'' =$ of inferior lateral lobe.

Fig. 19. *V-shaped, changing towards sigmoidal*, taken from a specimen of *Lioceras concavum* var.

[1] Pages 111—114.

[2] In the involute form the whorl overlaps to the lateral sulcus; in the other it leaves as much exposed outside the sulcus as there is inside.

[3] Pages 115—121.

Fig. 20. *V-shaped*, from a specimen of *Lioceras concavum* variety *v-scriptum*.

Fig. 21. *V-shaped;* two examples taken from different places on the same specimen, the larger showing the commencement of the change in shape.

Fig. 30. *Sigmoidal, with long outer arc*, taken from the specimen of *Hildoceras bifrons* which furnished the suture-line fig. 29; $v =$ middle of ventral lobe, $l' =$ of superior lateral lobe, $l'' =$ of inferior lateral lobe, $u =$ junction of ventral and lateral areas. The dotted line through the genicula marks the place of the longitudinal furrow.

Fig. 45. *Subarcuate*, taken from a specimen of *Grammoceras striatulum ;* $v =$ ventral lobe, l' superior lateral, l'' inferior lateral. This kind of ribbing has usually been called sigmoidal, as well as that shown in fig. 18; but I think it desirable to keep a separate term for ribs which have such a long ventral sweep, and have the lateral portion fairly straight. The inside point should have been very slightly turned towards the front.

I now come to the second task of which I purposed to treat in this *résumé*, and which relates chiefly to the vexed subject of classification. In illustration of the subject it becomes necessary for me to demonstrate the descent of the various species as far as possible; and it also becomes necessary for me to make a few corrections in accordance with advancing knowledge. It is some four years since I wrote the first part of this Monograph, and during that time many causes have increased the information in general, and my own knowledge in particular, concerning Ammonites. In the first place, I have been able to examine the strata known as "The Cotteswold Sands" and "Cephalopoda-bed," and have therefrom obtained a large number of species, few of which I formerly possessed, and which, since they belong more exclusively to a somewhat confined series, have given me more insight into the characters of that series than I was able to obtain in any other way. Furthermore, I have had the opportunity of being able to inspect several important collections of Ammonites, which have been sent to me by the great kindness of different correspondents for examination at my leisure. The further inspection of some museum-collections has been of service to me; but the limited time at my disposal, the too frequent paucity of duplicates, the absence of unrecognised species, and sometimes the fact that the specimens cannot leave the building, necessarily restrict the value of such work.

At page 15 of this Monograph I put forward a scheme of grouping. I tried to accomplish the somewhat difficult task of making an old system work in a new fashion with the fewest possible alterations. I also had, as it happens, too great a desire to preserve the names used by other authors, though, while in most instances

I retained the scope of their divisions, I was practically according them a totally different value. For several reasons the arrangement then put forward is objectionable; not the least important of which is that several of the divisions as constructed by older authorities and retained by myself (but with different rank on account of the greater subdivision) are not at all natural. I wish to erase this plan *in toto;* and I consider that it will be more in accordance with scientific requirements to follow the method put forward by Zittel,[1] and to group the genera into *families* (these families would be of about equal scope to what I called "generic groups"). At the same time I do not propose to follow Zittel's nomenclature in all places, but only the method of arrangement. As to what should constitute a family it is not easy to determine; and this will probably be a debateable matter for some time to come. The idea which is proposed for this work is to group in a family those genera which have, besides similarity in character,[2] a common origin, and which therefore realise to the full the meaning of the word family.

It may be advantageous to indicate Zittel's mode of division[3]—as follows:

CEPHALOPODA.

Order—TETRABRANCHIATA.

Sub-order—AMMONOIDEA.

Divided into—
A. RETROSIPHONATA.
B. PROSIPHONATA.

B. divided into—
Group I. LATISELLATI.
Group II. ANGUSTISELLATI.

Group II divided into ten families, of which the eighth is *Harpoceratidæ.*

1 'Handbuch der Palæontologie,' Bd. ii, Abth. i, 1881–85.

2 It must be obvious that those genera which have a common ancestor, such as an *Arietites*, must possess a certain similarity of character, and should differ from those genera whose ancestor is an *Ægoceras* or an *Amaltheus*; but it happens that the matter is complicated in two ways,—(1) by convergence in shape of members of two families advancing towards each other, so to speak, from opposite directions,—(2) by certain species of one family being apparently mimetic of those of another. We must, therefore, in arranging our families, avoid those errors which a consideration of species falling under the above two headings might lead us to commit.

3 Op. cit., pp. 332, 411.

This family contains, according to Zittel, three genera, *Harpoceras*, *Hammatoceras*, *Oppelia;* and these are again subdivided into groups around certain typical *Ammonites*. With the first only of these genera are we concerned at present. This one, *Harpoceras*, is divided into two parts (p. 459):

I. Formenreihen mit *Arieten*-Gepräge.

This included five groups, *a*—*e*.

a. Gruppe des *Am. algovianus*.

b. Gruppe des *H. bifrons* (*Hildoceras*, Hyatt; *Lillia*, Bayle).

c. Gruppe des *Am. hecticus*.

d. Gruppe des *Am. canaliculatus*.

e. Gruppe des *Am. trimarginatus*.

II. Formenreihen der typischen Falciferen.

This contains three groups.

a. Gruppe des *Am. radians* (*Grammoceras*, Hyatt).

b. Gruppe des *Am. complanatus* (*Lioceras*, Hyatt).

c. Gruppe des *Am. aalensis* (*Ludwigia*, Bayle), containing *Am. aalensis*, Ziet., *Am. costula*, Reinecke, *Am. opalinus*, Reinecke, *Am. Murchisonæ*, Sowerby.

Before discussing this scheme, I will give the manner in which Haug[1] arranged these and similar Ammonites, namely, as follows:

I. Harpoceratidæ.

Gekielte Nachkommen der Aegoceratidæ.

a. Harpoceras, Waag. em. Haug.

- α.—α^1. Untergattung *Cycloceras*, Hyatt em. Haug.
  - α^2. „ *Dumortieria*, Haug.
- β. „ *Tropidoceras*, Hyatt em. Haug.
- γ. „ *Grammoceras*, Hyatt.
- δ. *Harpoceras* s. str. Haug = *Leioceras*, Hyatt, p.p.
  - δ^1. Gruppe des *Harpoceras kurrianum*.
  - δ^2. „ „ *falciferum*.
  - δ^3. „ „ *lythense*.
  - δ^4. „ „ *opalinum*.
- ε. Untergattung *Lioceras*, Haytt em. Haug.

[1] "Beiträge Monog. Harpoceras," 'Neues Jahrbuch für Mineralogie,' Beil.-Bd. ii, 1885.

b. Hammatoceras, Hyatt emend. Haug.
  α. Gruppe des *Hammatoceras insigne.*
  β. ,, ,, *Sowerbyi.*
  γ. Untergattung *Sonninia,* Bayle emend. Haug.
c. Oppelia, Waagen.

II. Arietitidæ.

Nachkommen der Arieten mit *Harpoceras*-Gepräge.

Hildoceras, Hyatt emend. Haug.
  α. Untergattung *Lillia,* Bayle em. Haug.
  β. *Hildoceras* s. str.
  γ. Untergattung *Ludwigia,* Bayle em. Haug.
    γ^1 Gruppe des *Ludwigia Murchisonæ.*
    γ^2 ,, ,, *hectica.*
    γ^3 ,, ,, *ignobilis.*

In a later paper,[1] however, Dr. Haug has somewhat modified this arrangement, and has expressed the opinion, formed on an examination of a greater series of specimens, that the groups of *H. radians*, *H. kurrianum*, *H. falciferum*, *H. lythense*, are closely connected with *Arietites*, and have nothing to do with *Ægoceras*.

If the idea be correct that the *Hectici* are derived from *Ludwigia*, and *Ludwigia* from *Lillia* which is closely allied to *Hildoceras*, it follows that the separation of *Ludwigia* from the *Arietites*-like forms, as Zittel has done, will not hold good. Dr. Haug derived *Ludwigia* first from *Hildoceras ;*[2] but he afterwards[3] changed this opinion and derived it from the group of *Harpoceras falciferum*, though at the same time expressing his belief that they are all descendants of *Arietites.*

The question which we have now to answer is, Are all the species of Zittel's two divisions of *Harpoceras* descended from some common ancestor, say *Arietites*, and, if so, what relationship do they bear to one another? Before we can give a correct answer we must examine the groups which Zittel has made. Groups *a*, *b*, *c* of Division I most certainly fall together very naturally, but *d* and *e* do not appear to me to belong to them.[4] In Division II we have a slightly more complicated state of things ; *a* falls, rightly enough, to *Grammoceras ; b* is the genus

[1] "Ueber die genetischen Beziehungen der Gattung *Harpoceras*," 'Neues Jahrbuch für Mineralogie, &c.,' Bd. ii, 1885.

[2] "Beiträge Monog. *Harpoceras.*"

[3] Op. cit.

[4] See p. 133.

Harpoceras in its restricted sense; but *c* contains *Am. aalensis, i. e. Grammoceras, Am. opalinus, i. e. Lioceras, Am. Murchisonæ, i. e. Ludwigia.*

Now, if we were to take *Ludwigia* away and place it in the other group, would the remaining forms fall naturally into another separate group? This must be answered in the negative. *Harpoceras* and *Lioceras* are, in my opinion, separated as widely from *Grammoceras* as they are from the Division I. We have therefore three main divisions to deal with, and their relationship to one another and to *Arietites* is as follows:

Branch A.—*Hildoceras, Lillia, Ludwigia*, &c. This is the branch which bears the most similarity to the form of the parent stem, and whose changes are of recent date so far as the Inferior Oolite is concerned.

Branch B.[1]—*Harpoceras, Lioceras, Pseudolioceras*, &c. A branch from the original stem which has undergone considerable modification prior to the Upper Lias, but has since then been somewhat stationary. In the Upper Lias it is far ahead of the species of Branch A in development; but the latter have managed to become close rivals to it in the Inferior Oolite, and hence we have convergence between *Ludwigia* and *Lioceras*.

Branch C.—*Grammoceras*. A branch which left the parent stem at an early date. It has undergone considerable modification prior to the zone of *Am. Jamesoni;* but since then it has been somewhat stationary. Hence at the top of the Upper Lias the less-developed members of Branch A come to resemble it, leading to convergence between *Hildoceras* and *Grammoceras;* while the higher developed members of that branch have passed it.

Perhaps the simplest form of classification would be to include all these genera in one family, *Hildoceratidæ*,[2] divisible into the Branches A, B, C.[3] To *Harpoceras*, as used by Zittel, the above-constituted family, *Hildoceratidæ*, is probably equal in scope; but in rank it should be equal to his *Harpoceratidæ*, the only difference being that certain genera, which belong more appropriately to other families, have been eliminated. For instance, the Ammonites, which may be grouped around *Am. insignis*, Zieten, and *Am. fallax*, Benecke (*Hammatoceras* pars), are descended from some form allied to *Deroceras*, or *Microderoceras* (*Ægoceras*, Waag. pars), and are therefore more closely allied to *Stephanoceras;* the Ammonites which form the

[1] The groups of *Am. trimarginatus* and *Am. canaliculatus* may be descendants of the forms of this branch.

[2] It is preferable to use Hyatt's name *Hildoceratidæ* in this present case on account of its priority and fitness. In this family he placed the genera *Hildoceras, Grammoceras,* and *Lioceras*, which are the foundations of our present divisions. Thus the family *Hildoceratidæ* closely represents the limits which we wish to assign to the present family, besides having priority over every other in date. The family *Hildoceratidæ* should contain genera descended from *Arietites*, but no others.

[3] The Branches A, B, C are three perfectly distinct, but contemporaneous, genetic series having nothing to do with each other except through their common Lower-Lias ancestor.

group of *Am. Sowerbyi* (*Sonninia*, Bayle, *Hammatoceras* pars, Zittel) are, in my opinion, descended from some form allied to *Amaltheus*, and must, therefore, naturally be kept separate; while as to *Oppelia*, although its descent is not yet clear to me, it is obviously not derived from *Arietites*. In the genus *Harpoceras* have also been included other species besides those which would come under any of the above heads, namely, the species which form the group of *Am. Levesquei* (*Dumortieria*), and which, owing to great convergence in shape towards *Grammoceras*, have been hitherto classed in the genus *Harpoceras*;[1] but Dr. Haug[2] has traced their descent through *Dumortieria Jamesoni*, and *Polymorphites*, to *Agassiceras* of the Lower Lias, and has placed them in his family *Polymorphidæ*.

Now, in order to show at a glance the descent of the *Hildoceratidæ*, which has such an important bearing upon this subject of classification, I append the following Tables II and III. The first is intended to give some idea of the descent of the various species in the first four genera, and so to demonstrate how the material for Table III has been worked up.

In Table II we may notice in passing that the genus *Ludwigia* is composed of two branches—the dwarf *Ludwigiæ* (*L. costosa*, *cornu*, *rudis*), and the larger *Ludwigiæ* (*L. Murchisonæ*, *Lucyi*, *&c.*). The former seems to end with the *Concavum*-beds; the latter, although it disappears temporarily from view above the *Concavum*-beds, without doubt reappears later on—the *Hectici* being the direct descendants of the larger *Ludwigiæ*. *Pseudolioceras* seems to come to an end in the *Opalinum*-zone, but had shortly before given birth to the forms which compose the genus *Hyperlioceras*. A long distance separates the first and second appearance of the genus *Lioceras*; and I imagine that the parent-forms of *Lioceras bradfordense* and *Lioc. fallax*[3] were in existence during that period. *Lioc. ambiguum* I have not put down. It is a species of which the descent is obscure; and it may be a convergence from another series.

These Tables are probably self-explanatory. They are an attempt to show what conjectures may reasonably be formed concerning the relationship of the various species and genera of the *Hildoceratidæ* in accordance with the geological positions in which we find them. They require, of course, to be read together, and also in conjunction with a Table which I shall give presently for Branch C—*Grammoceras*;[4] and if that be done the position of the various species in the same genus with regard to other genera will be seen at a glance.

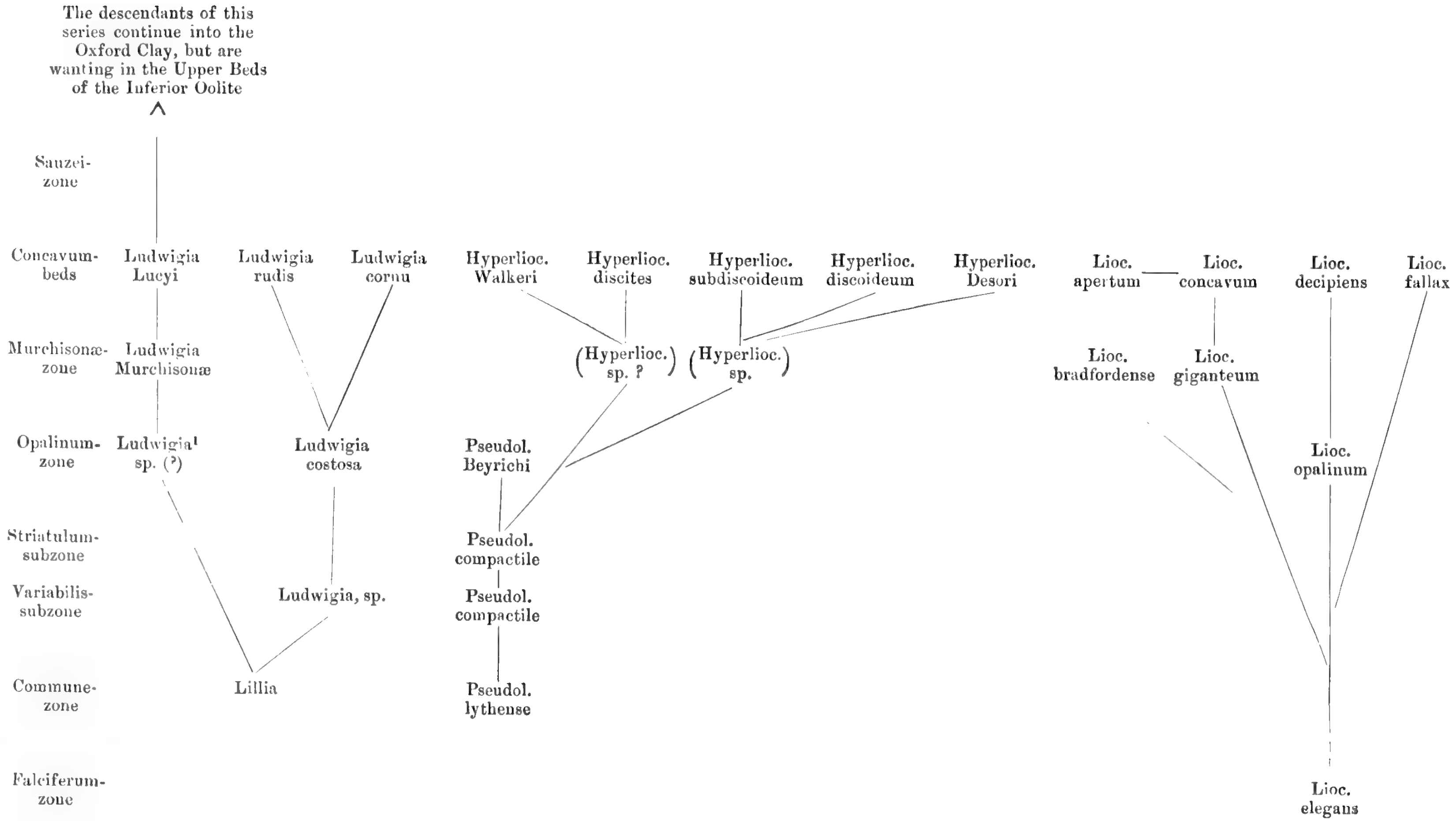
[1] That is before the genus was restricted.

[2] "Ueber die Polymorphidæ," 'Neues Jahrbuch für Mineralogie, &c.,' Bd. ii, 1887.

[3] That is to say, that these species have not come through *Lioc. opalinum*, but from certain forms which had diverged from the parent-stem before *Lioc. opalinum* appeared.

[4] I have thought that the genera *Hildoceras*, *Lillia*, &c., are not sufficiently within the limits of this Monograph to demand a Table.

TABLE II.—*Genealogy of the Species in the first four Genera.*



[1] Found lately at Haresfield Hill.

TABLE III.—*Genealogy of the Inferior Oolite Genera of the* HILDOCERATIDÆ.[1]

				Hectici				Canaliculati		Trimarginati
Parkinsoni-zone										
Humphriesianum-zone			Lillia sulcata			Pœcilomorphus				
Sauzei-zone						Pœcilomorphus				
Concavum-beds				Ludwigia				Lioceras		Hyperlioceras
Murchisonæ-zone		Grammoceras		Ludwigia				Lioceras		Hyperlioceras
Opalinum-zone		Grammoceras		Ludwigia	Hildoceras		Harpoceras	Lioceras	Pseudolioceras	
Striatulum-subzone		Grammoceras	Lillia		Hildoceras				Pseudolioceras	
Variabilis-subzone			Lillia		Hildoceras				Pseudolioceras	
Commune-zone		Grammoceras	Lillia		Hildoceras	Ammonites Mercati	Harpoceras		Pseudolioceras	
Falciferum-zone					Hildoceras		Harpoceras	Lioceras		
Spinatum-zone										
Margaritatus-zone	Ammonites kurrianus	Ammonites Normanianus	Lillia ?		Ammonites algovianus		Am. boscensis, involute var.	Am. Curioni		
Henleyi-zone										
Ibex-zone										
Jamesoni-zone		Ammonites antiquus								
	Branch C.			Branch A.			Branch B.			

[1] The species by which a genus is represented in any one zone may not have been found in England, but the record of its occurrence has been utilised in this Table.

A noticeable feature in Table III is that we can trace *Grammoceras* back further than any of the others in *Am. antiquus*, Wright. Branch A and Branch B are both represented in the *Margaritatus*-zone; but there is a great and sudden inrush of forms in the Upper Lias belonging to these two Branches; and these forms are the parents of the Inferior-Oolite species placed in A and B. Two of them undergo modification—*Lillia* and *Pseudolioceras*, producing *Ludwigia* and *Hyperlioceras;* while only one (not taking account of the solitary *Lillia sulcata*), namely, *Lioceras*, remains constant from the Upper Lias well into the Inferior Oolite. The *Ludwigia*-stem disappears with the *Concavum*-beds so far as our Inferior-Oolite rocks are concerned; but its descendants—the *Hectici*—appear later, several species being found in the Oxford Clay. I do not know if any species likely to be descendants of *Pœcilomorphus* or *Lillia* have been recorded from beds above the *Parkinsoni*-zone; and I cannot at present undertake to say whether in the *Canaliculati* and the *Trimarginati* we should recognise the descendants of *Lioceras* and *Hyperlioceras*, because I have no material to investigate.

In Table III it cannot fail to be noticed how many gaps occur in the sequence of the different genera. More especially is this noticeable below the *Commune*-zone; and again, an examination of the species in Table II reveals that the gaps are really more numerous than would appear from an examination of the generic table. In *Grammoceras* a very long gap, only about twice broken, exists between *Grammoceras antiquum* in the *Jamesoni*-zone and *Grammoceras* in the *Striatulum*-zone. In Branch A a species of *Lillia* occurs after an interval of four life-zones have elapsed without one; and the same number separates *Pœcilomorphus* from *Am. Mercati*. In Branch B the first and second appearance of *Lioceras* is separated by a considerable space which has yielded no species of the genus. Perfection in the geological record we cannot expect, but a constant advance is being made; and in this connection I may notice that *Grammoceras* in the *Murchisonæ*-zone and *Pœcilomorphus* in the *Sauzei*-zone are new facts which tend towards this end.

However, with the material and the facts which have been thus got together, it may be safe to venture a few surmises:

1. The descent of the species comprising Branches A, B, C from a common ancestor in the Lower Lias.

2. That such ancestor had small circular, or subquadrangular, whorls with but little inclusion, had furrows each side of the carina, a simple suture-line with the siphonal lobe as long as or longer than the superior lateral, and ribs fairly straight on the lateral area but slightly projected forwards on the ventral,—that, in fact, it was an *Arietites.*

The changes which have been taking place among the descendants—which appear to have been forced by circumstance or otherwise to work towards the same end, though by different methods, at different times, and with varying degrees of success—would seem to be capable of being reduced to a series of definite laws,[1] like the following:

I. *Towards the attainment of greater involution.*

To attain this end was required—

a. An increase in the breadth of the whorl.

As compensation for the increase in breadth there came—

b. A decrease in comparative thickness,[2] *and a lessened number of whorls.*

In consequence of the decrease in thickness there was—

c. Less space for furrows each side of the carina. And therefore—

d. The furrows were gradually lost, or only reappear sometimes through reversion.

To support the increased side-surface of the whorl we find—

e. More complicated sutures are developed.

In consequence of the decreased width of the ventral area, and to compensate for the increased growth of the lateral lobes—

f. A proportionate decrease of the length and importance of the siphonal lobe in comparison with the superior lateral, and especially in comparison with the whole suture-line.[3]

In consequence of the increased occlusion of the preceding whorl (which meant increased breadth of the side)—

g. An ever larger number of auxiliary lobes is developed.

II. A change from ribs straight on the lateral area to ribs projected forwards on the inner part of the whorl and then recurved, *i. e.* to sigmoidal-shaped ribbing.

Most of the above changes can be summarised in the following:

III. The assumption (by the descendants), at an ever earlier age, of the characters of their adult progenitors.[4]

It is not to be supposed that all these changes occurred in regular and precise

[1] I do not wish to say that these laws will apply to other families. All that I attempt to do at present is to demonstrate that the tracing out of the descent of the *Hildoceratidæ* seems to show that their mode of development is capable of being expressed by these laws.

[2] A quadrangular whorl, like that of *Hildoceras*, has a siphonal area very broad when compared with the lateral area; in *Lioceras*, even if the siphonal area were as broad, it would, when compared with the lateral area, be but insignificant in extent. The increase of the lateral lobes, and decrease of the ventral, may be partly accounted for in the same way; but they were, in addition, influenced by the changes in the whorl-area, and by having to provide support for a different place.

[3] Compare the highly-developed *Hyperlioceras* with the little-developed *Hildoceras*.

[4] Each generation must apparently have not only taken on the characters of its ancestors at a very slightly earlier age, but must have also added something of its own to the process of change; that is to say, that it must have exaggerated, or rather helped to intensify, so far as circumstances

order, or that one could not take place without involving the necessity for the other which I have set down as dependent upon it. We have no reason to be surprised if we found great involution unaccompanied by any addition to the suture-line; but we can perfectly well understand that such a form of shell would not be so well able to resist pressure as an evolute form with the same suture-line, or as an involute form with more complex sutures. In the same way the ventral area may have become very narrow and may yet retain its furrows; but it is obvious that they must decrease in size, and that they will tend to become extinct.[1]

The advance towards involution may not be at all regular in different species. We may find compressed, broadly-whorled forms, with a large spiral angle exposing a large umbilicus; or we may observe the same shaped whorls with a lesser spiral angle and a small umbilicus, and consequently with greater inclusion. At the same time we do not find the auxiliary lobes developed before the inclusion had become great; we may find, and do find, species with great inclusion which have not yet developed the auxiliary lobes to support the extra space—that is a later process. Again, we may find a later, but yet more evolute, form of the same genus possessing the same number of auxiliary lobes as the involute forms. Here, through partial reversion, we have a wider umbilicus—and therefore narrower whorls; but the animal has been unable to get rid of the extra, though it may be useless, auxiliary lobes which it has inherited, and consequently they must be cramped, or the other lobes and saddles must be decreased in size (*Hyperlioceras Walkeri*).

The lessons which the *Hildoceratidæ* and their allies have taught me are what I have tried to set down above. In doing so I have endeavoured to keep in view only the evidence given by the Ammonites themselves, and not put forward anything unless it was a surmise which could fairly be deduced from the sequence of changes observable in them.

It follows from these remarks upon the development of the *Hildoceratidæ* that the further we trace the three branches back the more nearly we should find them alike, and therefore that there would be a great desire to unite, perhaps in one

permitted, each character that it had inherited. Practically speaking the changes from one generation to another would be so small as to be imperceptible; but a series culled from many life-zones shows the various stages of change. In some genetic series the changes appear to have succeeded each other with great rapidity; in others the individuals may pass through several life-zones without any great alteration; the period of activity among the members of one series may be the period of quiescence among those of another; periods of activity and of quiescence will probably be found to alternate in the same series. Alterations in the conditions of life would accelerate or retard these changes, and thus account for such periods.

[1] The adults of *Hildoceras* exhibit less marked furrows than the younger specimens. By Rule 3 the furrows would become extinct in time. The adults of all these species have whorls more compressed in proportion than when younger, and by Rule 1 *c* this would help to cause what is stated in the preceding sentence, while by Rule 3 it would always be becoming more intensified.

genus, the parent-forms of the three stems. But there exists a great check to this desire, namely, the fact that the development or branching-off of the different stems took place at such very different periods. If we look at the *Margaritatus*-zone, we see that the three stems were very fairly distinct, and we can very easily perceive a wide difference between *Am. boscensis* and *Am. algovianus;* but between *Am. boscensis* and *Hildoceras* there is less difference, because they both represent about a similar state of development from the parent-form. This is where the error in regard to grouping is likely to come in, and this is where the greatest difficulties lie. *Ludwigia*, again, is more nearly alike in general aspect to *Lioceras* than to *Hildoceras;* and this is simply because *Lioceras* has been stationary in development, while *Ludwigia* has been gaining upon it until it nearly overtakes it. But if our classification is to be by descent, and not solely by similarity of aspect, we must place *Ludwigia* and *Lioceras* apart into two separate branches in accordance with their descent.

The Branch A is, without doubt, the oldest or least changed of the three. The ventral furrows are retained by *Hildoceras*, *Lillia*, and *Pœcilomorphus;* but they are, on the other hand, rudimentary only in a few forms of *Ludwigia*, and are, in fact, entirely absent from the majority. The quadrangular whorls with evolute form are common to *Hildoceras* and *Lillia;* but in each genus there is a tendency to modify both these features. The simple suture-line, consisting of a large superior-lateral lobe, small inferior-lateral lobe, and about one auxiliary, is common with but little modification to *Hildoceras*, *Lillia*, and even the much later *Pœcilomorphus*. This lobe-line is slightly more developed than that of *Am. algovianus*. In the *Arietitan* parent-form the siphonal lobe was longer than the superior-lateral; in these genera it has decreased somewhat in size, but since they still retain the very broad ventral area, and as they have made but little progress towards inclusion,[1] it is not much affected. In *Am. algovianus* we have ribs straight on the lateral area; but *Hildoceras* shows us a transition state in the matter of ribbing, namely, from the straight ribs of *Hildoceras Douvillei* to the strongly curved ribs of *Hildoceras bifrons*. In the matter of increased inclusion the specimens of the latter species from the Cotteswold Sands show a beginning; they also exhibit a tendency to develop more auxiliary lobes to accompany the change; while they are at the same time more compressed.

Ammonites Mercati still possesses ribs fairly straight on the lateral area; *Pœcilomorphus* shows a complete change, and also has a somewhat more developed suture-line. This genus exhibits very peculiar modes of growth. We have strongly involute forms with great thickness, while the evolute varieties are more compressed—although these rules do not hold good always. In most cases the proportionate height of the whorl remains the same. *Am. Mercati* shows

[1] Except *Pœcil. cycloides:* but see next page.

similar evolute and involute forms; but it is probable that *Pœcilomorphus* is descended from the evolute forms of *Am. Mercati*, otherwise it would most likely have by this time developed a greater number of auxiliary lobes. For some reason or other the evolute forms gradually acquired a small spiral angle; that meant greater inclusion; but greater inclusion meant a contraction of the space of the body-chamber; this has, therefore, been enlarged by expanding the middle of the sides. That the expansion took place in the sides is shown by the increase in the width of the superior lateral saddle, and the decrease of the siphonal saddle in *Pœcil. cycloides.*

Lillia has not abandoned the straight ribs; but it has, for some reason, also developed knobs on the inner area. *Ludwigia* has inherited these knobs, and has lengthened them into stout primary ribs. In order to increase the breadth of the sides in *Ludwigia*, growth has taken place in the inner part of the whorl; and therefore the inner margin has been pushed further towards the centre. Naturally this would cause a lengthening of the ornamentation which adorned the inner part of the whorl, while it affected but little that on the outer part. Hence this change from knobs to ribs is merely the lengthening of the former ;[1] and in the same way an increased number of auxiliary lobes should in time be developed to support this increased breadth of side. The less developed forms of *Ludwigia*,—*L. obtusa* ,&c.—retain some trace of the quadrangular whorls, and the broad siphonal area with rudimentary furrows, and possess at the same time stronger—in the young almost spinous—primary ribs; the more developed forms—*L. Baylii*, *cornu*, &c.—have compressed whorls, have entirely lost the ventral furrows, have less pronounced primary ribs, and are more involute,—so that they show a decided convergence towards *Lioceras*. The next step which they would take in development would be to increase the number of their auxiliary lobes, when they would be almost indistinguishable from *Lioceras*. However, it appears that these forms died out. The dwarf *Ludwigiæ* (*L. costosa, cornu*, &c.) became more highly developed at an earlier date than the others, and it is possible that they may have sprung from an earlier-modified species of *Lillia*.

Whether the Branch B or the Branch C left the parent-stem first is not, with our present knowledge, easy to say. The latter have changed less altogether; and although they are already more developed in the *Jamesoni*-zone than is *Hildoceras* in the *Commune*-zone, yet they undergo little further modification from that time,—so there exists a convergence in shape between them and *Hildoceras* in the Lias-Oolite border-region.

[1] It is perhaps worth while to notice in passing how convergence may be brought about. If upon the inner area two ribs happened to become joined they would thus produce a strong rib, similar in appearance to the primary rib of *Ludwigia*. This is what sometimes happens in *Grammoceras;* and consequently we have at that time convergence in shape towards *Ludwigia*, but at other times convergence towards *Hildoceras* or *Lioceras*.

The species of Branch B, on the other hand, are more developed in the *Margaritatus*-zone than is *Hildoceras* in the *Commune*-zone; while in the *Falciferum*-zone they are more developed than are the highest forms of the Branch A (*Ludwigia*) in the *Murchisonæ*-zone. At the same time they may have left the parent-stem later than the Branch C, but may have developed quicker. The first forms of Branch B which I have been able to recognise are *Am. boscensis* and *Am. Curioni*, which both exhibit the commencement of the falciform or sigmoidal ribbing, and have a suture-line which is more developed than that of the earlier forms of Branch A. The forms from which these two Ammonites are descended ought to be something very nearly like *Am. algovianus*. Although the involute variety of *Am. boscensis* (Meneghini, 'Foss. du Medolo,' pl. ii, fig. 18) bears marks of its descent in the furrowed ventral area, yet its ornamentation and sutures lead us on at once to the genus *Harpoceras* in which we meet with only very rudimentary furrows in one or two species. But in *Harpoceras* the curvature of the ribs is more highly developed; the suture-line is more complicated and produces larger, more branched lateral lobes; the involution is variable, as if in a transition state, as, for example, from the evolute *Harp. Strangewaysi*[1] to the involute *Harp. subplanatum;* while, probably from this cause, the auxiliary lobes are not much more developed. We, however, meet with a large accessory lobe in the siphonal saddle, and it is not difficult to see the probable reason for its development. In *Arietites* and in the less developed *Hildoceratidæ*, that part of the whorl which is least supported by the sutures is between the siphonal and superior-lateral lobes; but in these quadrangular-whorled forms, this part is in the shape of an arch whose bases rest upon these said lobes. In consequence, the crown of the arch would not require much support; but, as compression proceeded, this part would become flatter and flatter, therefore less able to stand pressure, and consequently an accessory lobe would be introduced to aid in its support.

The theory which Dr. Haug puts forward, that *Ludwigia* is derived from *Harpoceras falciferum*,[2] seems to me untenable. It leaves the coarse primary ribs unaccounted for; it means that, as the descendant of *Harpoceras*, *Ludwigia* is developed in a less degree as regards suture-line, and that in place of the strongly falciform ribs, it has taken on recurved, somewhat angular ribs. (The shape of these ribs is explained if we imagine its descent from *Lillia;* the difference in the ribbing of *Ludwigia* and *Lillia* is that the ribs in the former spring from a coarse primary rib instead of from a small knob on the inner margin, as in the latter.)[3]

[1] Non *Am. falcifer*, Sowerby; non *Am. serpentinus*, Reinecke. The original specimen is in the British Museum, and was badly figured by Sowerby,—the umbilicus is quite one-fourth too large, the inner margin being exhibited concave instead of almost upright and straight.

[2] "Ueber die genetischen Beziehungen der Gattung Harpoceras," 'Neues Jahrbuch für Mineralogie, &c.,' Bd. ii, p. 174, 1885.

[3] The coalescing of two ribs on the inner area of *Harpoceras* might produce something similar in

Am. Curioni may possibly be the ancestor of *Lioceras* and *Pseudolioceras.* Both these genera have their ribs less curved—and therefore less developed—than *Harpoceras; Lioceras* does not possess such complicated lateral lobes as that genus, but shows more auxiliaries, which probably owe their origin to the fact that, while *Harpoceras* was in a transition state as regards the size of its umbilicus, this genus had become fixed to the involute form. *Lioceras* shows ribs which are not strikingly peculiar, except in one instance, namely, the V-shape. Whether that shape is due to atavism, or whether it is the result of a developed accidental peculiarity, I cannot say.[1] The recession of the inner margin, and consequently of the whorl, when the body-chamber is present, is a characteristic probably due to descent from more evolute forms; and so is the fact that the very young specimens—not only in this genus, however, though it shows it the most, but in many other genera—are extremely evolute, especially compared to the adults, and that great inclusion does not commence in early youth. In several places I have noticed these facts in the course of my remarks upon the genus.

Pseudolioceras is another well-developed genus. It is highly involute, and has evidently obtained that as a settled character. Dr. Haug says[2] that *Pseudolioc. compactile* has more auxiliary lobes than *Pseudolioc. lythense* (none of my specimens of the latter species show the lobes); but this fact might indicate that the development of the auxiliaries to fill the lately-acquired increased breadth of the side was actually in progress. This development of auxiliaries attains its maximum in the next genus, *Hyperlioceras*, the descendant of this one. Here, with one slight exception, we meet with highly involute forms; but they have gone a step further in the matter of development—producing more auxiliary lobes to support the increased side-breadth—and they have enlarged the inferior lateral saddle for the same purpose. Such species are *Hyperlioc. discites* and *discoideum*, and probably *Desori*. But *Hyperlioc. subdiscoideum* is an instance either of reversion or of less development in this matter of sutures (see p. 101); while *Hyperlioc. Walkeri* has the full number of auxiliary lobes, but is an instance of reversion in the matter of a wider umbilicus. That *Hyperlioc. Walkeri* is descended from an involute *Hyperlioceras* is certain, because otherwise it would not have inherited the extra number of auxiliary lobes. This parent *Hyperlioceras*-species (which we do not know at present) must have developed more auxiliary lobes than its ancestor *Pseudolioceras*, and must have thereby given to the increased side the necessary support. These lobes it has transmitted to its descendants, *Hyperlioc. discites*, *discoideum*, and *Walkeri*. The last has, how-

appearance to the primary ribs in *Ludwigia*, but yet would, I think, be distinguishable. This would not explain the small spines.

[1] Probably the former. Compare the recurved ribbing of the young of *Ludwigia Murchisonæ*, a species standing lower in the scale of development.

[2] *Op. cit.*, p. 623.

ever, no actual need for them on account of having obtained, for some reason or other, less side-breadth to support; and, in order to accommodate them, it would appear that it has had to decrease the size of its other lobes.

All the species of *Hyperlioceras* show a most decided tendency in adult age to suddenly become, when the body-chamber is present, widely umbilicate.[1] This character is also found in *Lioceras* in a less degree, but is almost absent, I believe, in *Pseudolioceras*.

Before proceeding to notice the species of the next group, I may remark that the very small fry of the foregoing genera (in all cases, I believe) not only differ from the adults by being evolute, with rounded whorls, but commence their ribbing in the first instance as straight folds on the sides of the whorls. So far as their shape and ribbing go, the development from youth into adult of a highly-developed species follows about the same rules as those which, as I have been trying to show, hold good in connection with the evolution of these species from *Arietites*. In fact, they fully illustrate the truth of my Rule III, p. 134.

The species which belong to Branch C show, as far as the Inferior Oolite is concerned, a much wider gap between themselves and the Inferior-Oolite representatives of Branches A and B. In fact, the representatives of Branch C are found at a much earlier period, namely, in the *Jamesoni*-zone, where they have already obtained a thoroughly distinctive appearance. A development somewhat similar to what they have reached at this early date is only attained by the representatives of Branch B during the Middle-Lias period, and by the representatives of Branch A during the Upper Lias. At the same time Branch C has developed but very little since the *Jamesoni*-zone, so that the species which we meet with at the end of the Upper Lias exhibit characters very similar to those of the early species. As a consequence of what is practically a cessation of development, few generic divisions are required in this branch when compared with the others.

The earliest species is *Grammoceras antiquum* (Wright) in the *Jamesoni*-zone; and this exhibits already considerable development, namely, compressed, broad whorls, and the absence of the ventral furrows. Excepting some species in the *Margaritatus*-zone, we do not, in reality, meet with any quantity of forms until we reach the borderland between Lias and Oolite. One of the species which is found at this point, namely, *Grammoceras striatulum*, appears to be far less developed than the older *Grammoceras antiquum;* but it will probably be better to defer a detailed criticism until I have described the various species.

It is interesting to notice that certain species of this branch exhibit marks of their descent. A variety of *Gramm. Normannianum* has ventral furrows; so has *Gramm. ovatum;* while certain other species exhibit rudiments of the same.

[1] This character is also shown by *Œcotraustes* and some species of *Oppelia;* while *Hammatoceras fallax*, and *Sphæroceras*, add to it a contraction of the thickness of the body-chamber.

The branches A, B, C of the family *Hildoceratidæ* seem to be fairly well characterised; but I intend, in the text and plates, to place between the second and third branches a series of species, which appear to combine in themselves certain of the characters of all three branches in union with their own especial features. I refer to the genus *Haugia*. By courtesy, I propose to include it in the *Hildoceratidæ*, but it cannot apparently be placed in either of the divisions A, B, C, nor does it come in the order of descent into any of these branches.[1] So far as its characters are concerned it apparently connects A and B with C, and has the ribbing of *Lillia* with a suture-line between *Harpoceras* and *Grammoceras;* and so I have, for better comparison, placed it here instead of at the end of the *Hildoceratidæ*. Concerning its descent, I cannot speak definitely, nor can I trace the steps by which it has arrived at its present development. In breadth and compression of whorl and absence of furrows it shows high development; in involution it is in a transitional state, and also in the matter of its ribbing; its sutures show development in the lateral lobes, but not in the size or number of the auxiliaries. One character it has carried to great perfection, namely, the large hollow-carina. In this it certainly distances all rivals—the genus *Harpoceras* being the only one which at all approaches it.

[1] Unless it be a descendant of the earliest forms of *Lillia*. If so the changes must have taken place very rapidly; it will, also, in that case, be but little out of its right order.

HILDOCERATIDÆ (*continued*).

Genus—HAUGIA, *S. Buckman*, 1888.[1]

(*Type*—HAUGIA VARIABILIS, *d'Orbigny*, sp.)

Definition.—Discoidal, with a strong hollow-carina; whorls ornamented with arcuate,[2] or subsigmoidal, ribs, and sometimes with knobs on the inner marginal edge; from these knobs two, three, or more ribs spring. Ventral area not actually defined; it is rounded when the test is absent, but otherwise furnished with a strong hollow-carina (Plate A, fig. 38). Inclusion variable; inner margin convex. Suture-line (Plate A, figs. 34—37) possesses a large, somewhat branched, superior lateral lobe, a narrow, deep, superior lateral saddle divided by a medium-sized accessory lobe, an inferior lateral lobe about half the size of the superior lateral, inferior lateral saddle not nearly so deep as superior lateral causing the inferior lateral lobe to appear one-sided, auxiliary lobes more or less drooping.

Remarks.—The species which are included in this genus show a very obvious relationship, and yet exhibit a certain amount of progress in development. The following features are the most characteristic: 1st, the strong, very large hollow-carina; 2nd, the high, but much compressed, whorls; 3rd, the broad, much ornamented, and therefore highly-developed, superior and inferior lateral lobes—which, too, occupy nearly the whole side, and the small, unimportant, and therefore undeveloped, auxiliary lobes, which are cramped up at one end as if of no account.

The members of this genus belong apparently to two more or less parallel series, both of which become more involute as they develop. The first are characterised by possessing arcuate ribs generally, and knobs on the inner margin; the second—probably the younger and more developed branch—do not possess any knobs, and their ribs are inclined to become subsigmoidal. Thus these latter apparently possess the characters of the adults of the first (whose knobs disappear in the last whorls), combined with greater involution generally.

The following species belong to the first class:—*Haugia variabilis* (d'Orbigny), *H. Ogerieni* (Dumortier), *H. navis* (Dum.), *H. malagma* (Dum.), *H. illustris* (Denckmann). To the second belong:—*Haugia Eseri* (Oppel), *H. occidentalis* (Haug).

[1] See p. 45.

[2] Ribs which run nearly straight across the lateral area, and are only slightly projected on the ventral area. Thus they are arched like a half-expanded bow, each end projecting towards the front about equally.

The first are distinguished by their ornamentation from all genera hitherto mentioned, except *Lillia;* but from that the high hollow-carina and the acute, unfurrowed, ventral area at once distinguish them.

The second exhibit, in outward aspect, convergence to *Pseudolioceras*, thus exemplifying my statement that the gradual progress of the forms of the various genetic series is towards a similar shape (p. 133). They may be distinguished from *Pseudolioceras* by a much larger hollow-carina, a ventral area more completely rounded where the test is absent, and by a very different suture-line (compare Plate A, figs. 37 and 22). The superior and inferior lateral lobes are more developed, and take up more lateral space than in *Pseudolioceras;* while the auxiliary lobes are fewer in number but larger, and yet are cramped into a smaller space. The ribs also are less truly sigmoidal. The agreement of this branch in the matter of lobes, and practically in every character except knobs, with the type of the genus, shows that there is a close relationship between them.

Am. variabilis was placed by Hyatt[1] in his genus *Hammatoceras*, merely, I presume, on account of its resemblance in ornamentation—especially the knobs on the inner margin—to *Hammatoceras insigne*. Wright, and other authors, who did not recognise *Hammatoceras*, kept the species in Waagen's later genus *Harpoceras*. Haug[2] placed it to *Hammatoceras* with a query, but included it, not in the *Insigne*-group, but in the *Sowerbyi*-group; while he placed *Am. Ogerieni*, *Am. navis*, and *Am. malagma* in a group with *Am. propinquans* and others (*Sonninia*, Bayle). The entirely different character of the lobes separates *Haugia* from *Hammatoceras;* while a study of the other members of the genus shows that the knobs on the inner margin were an inconstant character, and, in the case of *Haugia variabilis*, merely an example of deceptive outward similarity. The same remarks apply concerning *Haugia* and *Sonninia*; the latter possesses a far more florid, very much branched suture-line.

Dumortier[3] placed *Am. navis* and *Am. malagma* in his section "*Podagrosi*" (*Lillia*, pars, see p. 109); but the large hollow-carina and the unfurrowed ventral area show that they do not belong there. Haug[4] placed *Am. Eseri* in "the group of *Am. lythensis*" (*Pseudolioceras*, p. 81); but I have just previously pointed out the differences between *Haugia Eseri* and *Pseudolioceras*. Quenstedt,[5] by giving the same form the name *Am. radians compressus*, regarded it as a variety of *Am.* (that is, *Grammoceras*) *radians;* but though it certainly shows a very great

[1] 'Ceph. Mus. Comp. Zool. Bulletin,' p. 89. His description applies to *Hammatoceras insigne*, but not to *Am. variabilis*.

[2] "Beiträge Monog. Harpoceras," 'Neues Jahrbuch für Mineralogie, &c.,' Beil.-Bd. iii, p. 656.

[3] 'Études pal. Bassin Rhône,' pt. iv, p. 82.

[4] *Op. cit.*, p. 628.

[5] 'Cephalopoden,' p. 112.

convergence towards some of the narrow-umbilicate species of that genus, yet its suture-line is more developed—the ornamentation being more florid; and its ribs do not show the strong sweep on the ventral area which is characteristic of *Grammoceras*. Haug[1] placed *Am. occidentalis* in "the group of *Am. Kurrianus*" with *Am. fallaciosus* (*Grammoceras*, pars); but the above remarks will apply to this determination also.

The lobe-line of this genus agrees with the lobe-line of the family *Hildoceratidæ* generally (see Plate A). The superior and inferior lateral lobes are as much, or more, developed than in the most developed genera, namely *Lioceras*, *Pseudolioceras*, and *Hyperlioceras;* but the auxiliary lobes, in consequence of the involute shape being only a lately-acquired character, are much less developed. The lobe-line resembles that of *Harpoceras* most closely, but may be distinguished by the much smaller accessory lobe in the siphonal saddle, the broader superior-lateral lobe with much more prominent trifurcation, and the different disposition of the auxiliary lobes. (The strong, distinctive, falciform character of the ribs in *Harpoceras*, especially the sweeping curve on the outer lateral and ventral areas, is absent altogether from *Haugia*.) The lobe-line also resembles that of *Grammoceras*, to which I have already alluded.

A consideration of the above remarks will show that there is every reason to regard the inclusion of *Haugia* in the family *Hildoceratidæ* as correct. At the same time the very divergent opinions which different authors have held, concerning the proper position of various members of this genus, show in how many different genera the species may be placed, if only one character at a time be taken account of.

The points of resemblance and difference between this and other genera may be shown in a Table thus:

Features.	Genera with similar features.	Differences which these genera present.
Knobs and ribs.	*Hammatoceras.*	Lobe-line.
Do.	*Sonninia.*	Do.
Do.	*Lillia.*	Lobe-line; solid carina and furrowed ventral area.
Without knobs; involute.	*Pseudolioceras.*	Lobe-line; sigmoidal ribbing.
Without knobs; evolute.	*Grammoceras.*	Lobe-line; subarcuate ribbing with long ventral sweep.
Lobe-line.	*Harpoceras.*	Falciform ribbing.

It is noticeable that, notwithstanding the similiarity of lobe-line, no author has put any species of *Haugia* in *Harpoceras*, that is, in the *Harpoceras falciferum*-group, the difference in ribbing being such a striking feature.

It is very singular that two other species with very similar ornamentation, but

[1] *Op. cit.*, p. 617.

PLATE XV.

Sowerbyi-zone (Concavum-beds) ?

Figs. 1, 2.—Lioceras decipiens, var. simile, *S. Buckman.*

Fig. 1.—Side view of a specimen with well-preserved test. Locality unrecorded; probably from near Sherborne. Collected by my father. (Page 32.)

Fig. 2.—Front view of the same specimen.

Concavum-beds.

Figs. 3, 4.—Lioceras apertum, *S. Buckman.*

Fig. 3.—Side view of a specimen with greater portion of body-chamber, showing V-shaped ribs scarcely perceptible on the inner area. Bradford Abbas, Dorset. My Collection. (Page 76.)

Fig. 4.—Front view of the same specimen.

Figs. 5, 6.—Lioceras concavum (*Sowerby*) variety.

Fig. 5.—Side view of a specimen showing the whorl receding from the regular coil because of the presence of a large portion of the body-chamber, and thus causing it to somewhat resemble *Lioc. apertum,* to compare with which it is here figured. Bradford Abbas. Collected by my father. (Page 72.)

Fig. 6.—Front view of the same specimen, to compare with fig. 4.

Figs. 7—10.—Lioceras apertum, *S. Buckman.*

Fig. 7.—Side view of a young specimen, showing the shape of the ribs. To compare with fig. 14. Bradford Abbas, Dorset. (Page 76.)

Fig. 8.—Front view of the same specimen, to compare with fig. 15.

Fig. 9.—A slight variety. Side view, showing part of the lateral process of the mouth-border. Bradford Abbas, Dorset. My collection. (Page 76.)

Fig. 10.—Back view of the same specimen.

Figs. 11—17.—Ludwigia rudis, *S. Buckman.*

Fig. 11.—Side view of the type specimen, showing bifurcating ribs conspicuous on inner area and slightly produced on ventral area, and the commencement of the lateral process of the mouth border. The × shows the position of the last suture-line. Louse Hill, near Sherborne, Dorset. My Collection. (Page 103.)

Fig. 12.—Front view of the same specimen.

Fig. 13.—Side view of a somewhat more compressed specimen, with a larger umbilicus, showing part of the termination. Louse Hill. My collection.

Fig. 14.—Side view of a young typical specimen, showing the coarse bifurcating ribs conspicuous on the inner area. To compare with fig. 7. Bradford Abbas, Dorset.

Fig. 15.—Front view of the same specimen, to compare with fig. 8.

Fig. 16.—Side view of a wide-centred variety. The ends of the ribs are not turned sufficiently towards the front, and the ribs are too much V-shaped. Locality not recorded; probably from Half-way House, near Sherborne. Collected by my father.

Fig. 17.—Front view of the same specimen.

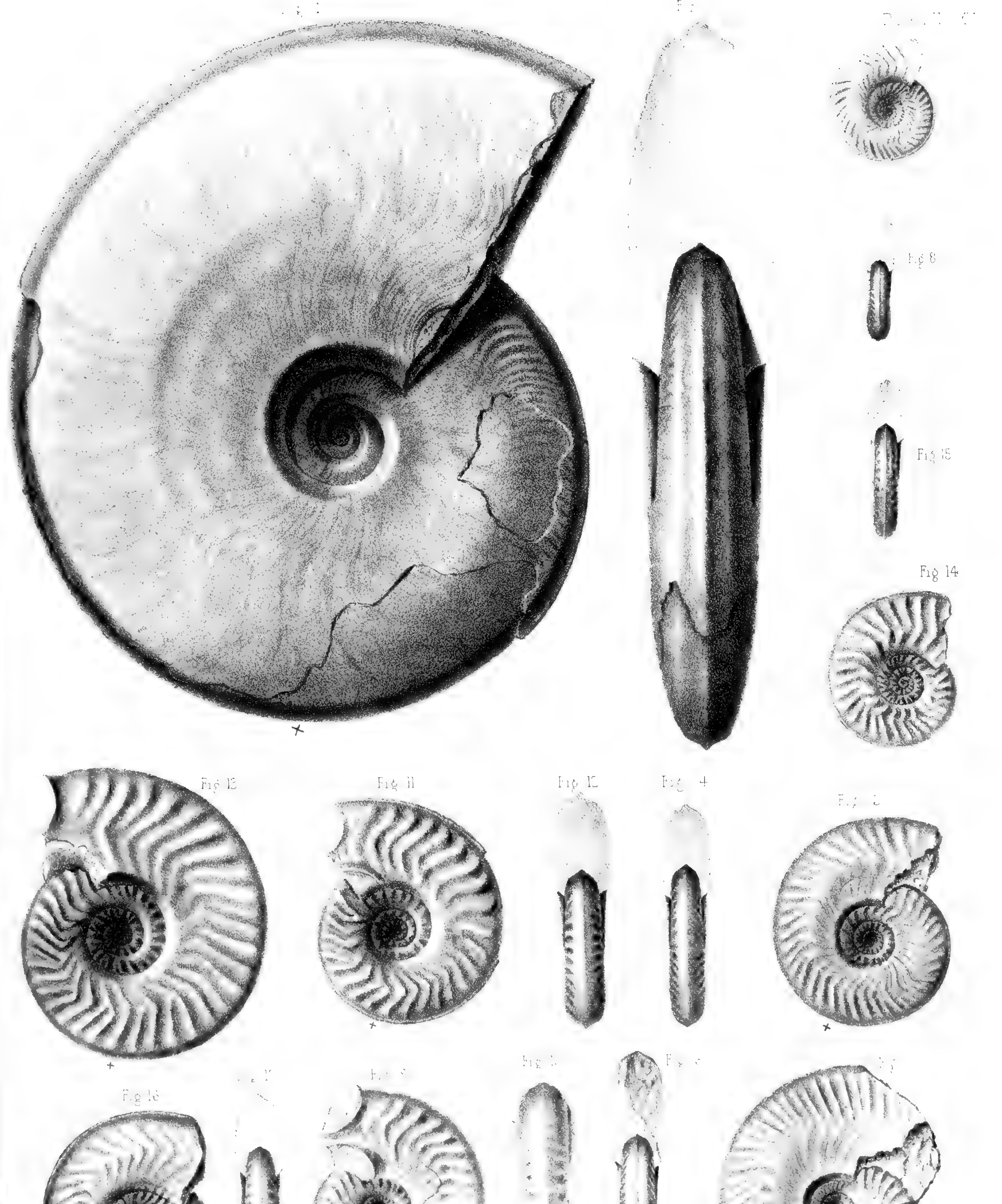


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PLATE XVI.

Concavum-beds.

Figs. 1—11.—HYPERLIOCERAS WALKERI, *S. Buckman.*

Fig. 1.—Side view of a very well-preserved type specimen, exhibiting the fine lines of growth. Bradford Abbas, Dorset. Collected by my father. On account of the strong recession of the inner margin the breadth of the whorl actually decreases during the last half turn exhibited in the figure. (Page 92.)

Fig. 2.—Front view of the same specimen, showing its compressed sides, and the prominent carina characteristic of the genus.

Fig. 3.—Side view of a smaller typical specimen, showing the period of change from ribs to lines of growth only. Bradford Abbas, Dorset. Collected by my father.

Fig. 4.—Front view of the same specimen.

Fig. 5.—Side view of a slightly more compressed specimen, with larger umbilicus. Bradford Abbas.

Fig. 6.—Front view of the same specimen. (Figs. 3—6 are to compare with Plate XI, figs. 2—7.)

Fig. 7.—Side view of a young specimen of this variety, showing the ribbing and the commencement of the termination. Bradford Abbas.

Fig. 8.—Back view of the same specimen.

Fig. 9.—Side view of a smaller specimen, showing the gradual development of the ribs from the almost straight single ones; also a breakage in the she which had healed over.

Fig. 10.—Side view of a young specimen of a narrow-centred variety. Bradford Abbas, Dorset.

Fig. 11.—Front view of the same specimen.

Figs. 12, 13.—HYPERLIOCERAS DISCITES (*Waagen*).

Fig. 12.—Side view of a young specimen. Bradford Abbas. My Collection. (Page 94.)

Fig. 13.—Front view of the same specimen.

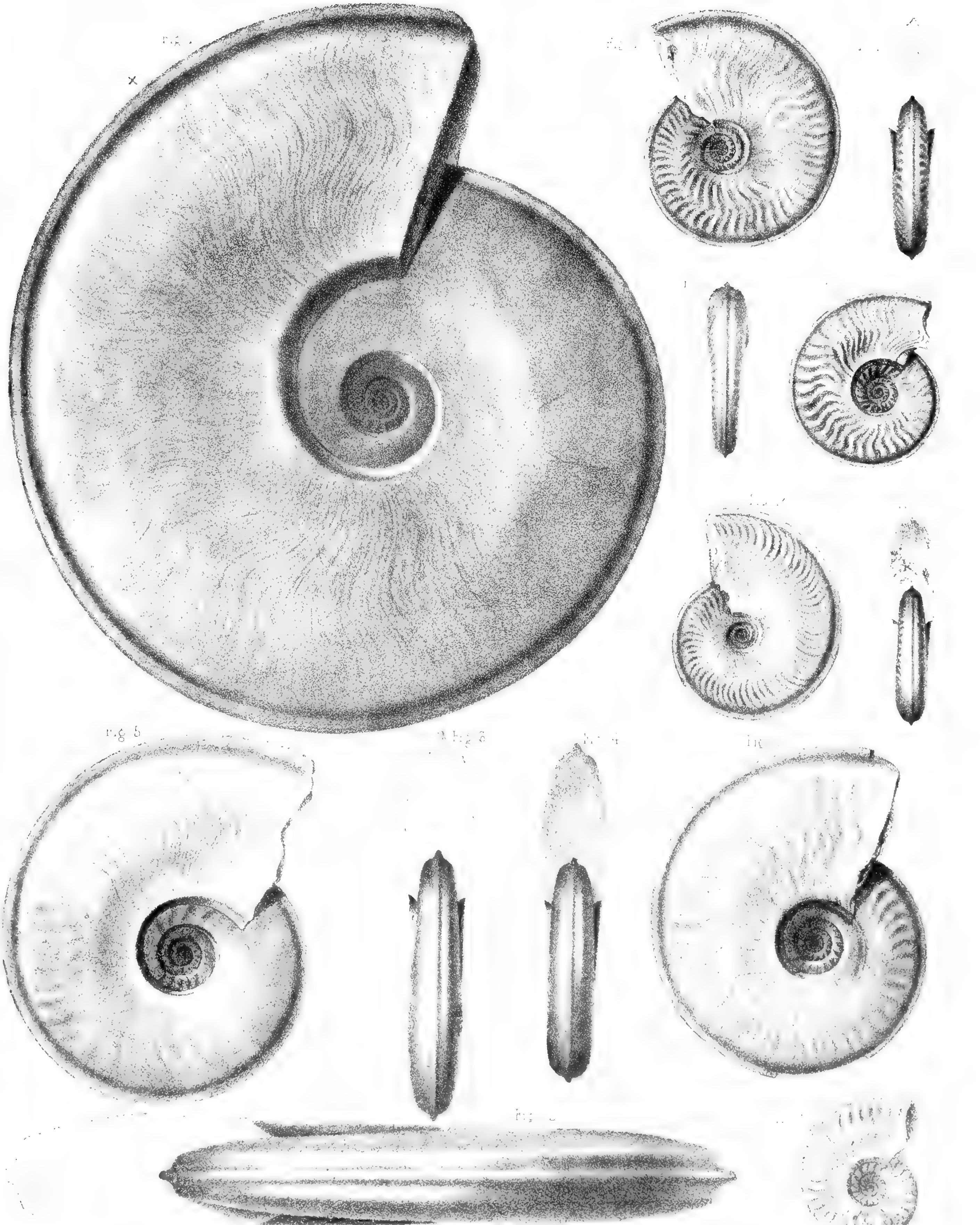


Fig. 5
Fig. 6

PLATE XVII.

Concavum-beds.

Figs. 1—5.—Hyperlioceras discites (*Waagen*).

Fig. 1.—Side view of a smooth example (var. *a*). All the test present and well-preserved, but no part of the body-chamber. Bradford Abbas, Dorset. My Collection. (Page 94.)

Fig. 2.—Front view of the same specimen.

Fig. 3.—Side view of another specimen showing the termination to the mouth border. Bradford Abbas, Dorset. Collected by my father.

Fig. 4.—Front view (in outline) of the same specimen.

Fig. 5.—Side view of another specimen (var. ζ). No part of the body-chamber is present. Bradford Abbas, Dorset. Collected by my father.

Figs. 6, 7.—Hyperlioceras Desori (*Moesch*).

Fig. 6.—Side view of a specimen with small portion of the test preserved. Bradford Abbas, Dorset. My Collection. (Page 97.)

Fig. 7.—Front view of the same showing the sub-triangular aperture, and overhanging inner margin.

PLATE XVII

Fig 3.

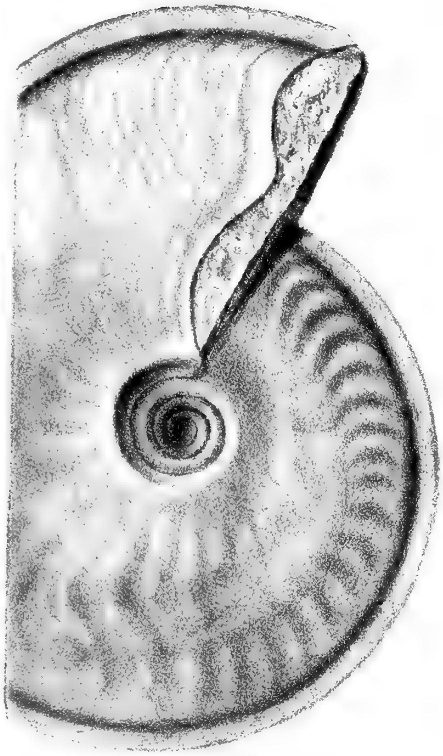


Fig 2

Fig. 1

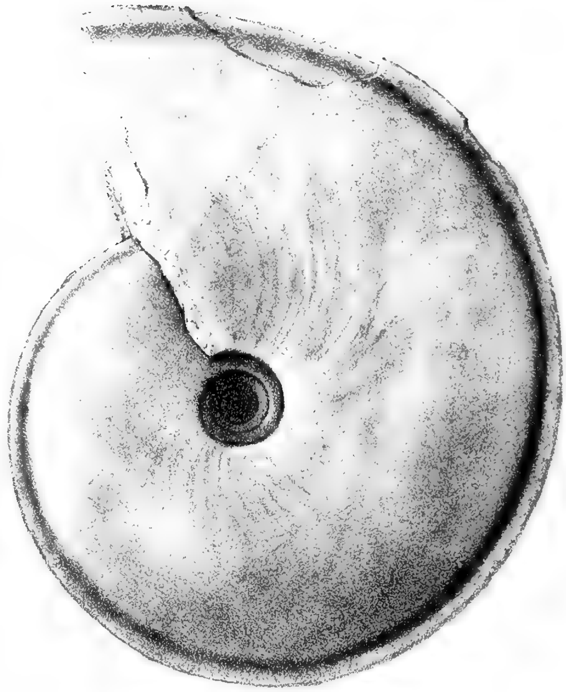


Fig 4.

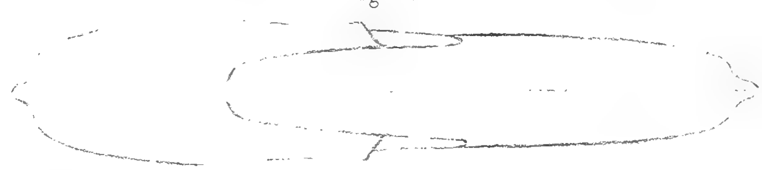


Fig. 5.

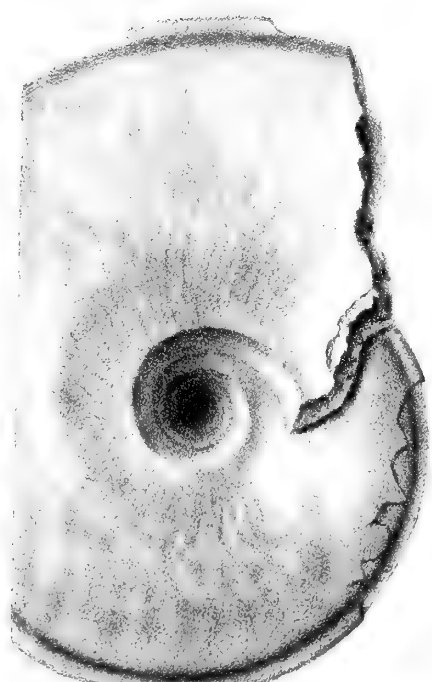


Fig. 7

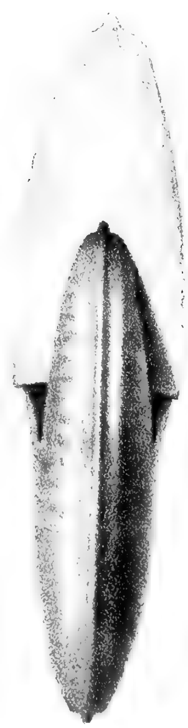
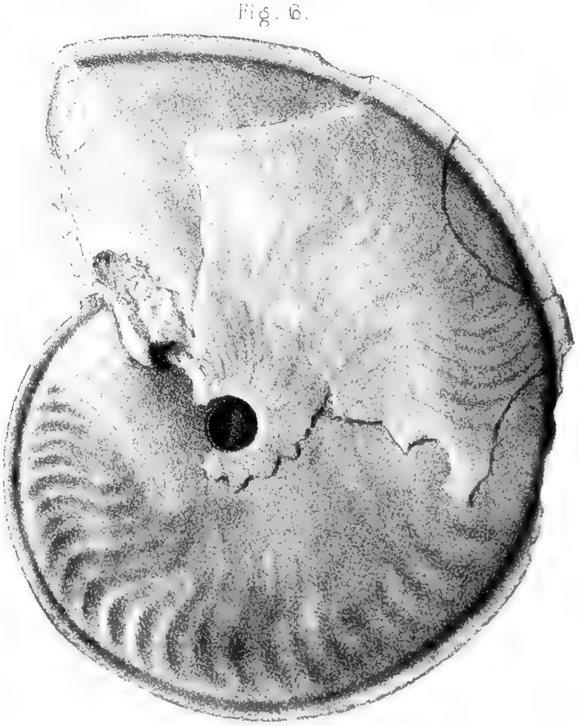


Fig. 6.



Gawan del et lith

Mintern Bros. imp

PLATE XVIII.

Concavum-beds.

Hyperlioceras discites (*Waagen*).

Fig. 1.—Fine adult specimen. The test is excellently preserved. The lower part of the figure shows longitudinal lines—the indications of the further overlapping of the whorl. Half a whorl from the last piece of inner margin must be added to imagine this specimen complete. No portion of the body-chamber is present. Bradford Abbas (Anbury Quarry). My Collection. Obtained by Mr. F. Stubbington. (Page 94.)

Fig. 2.—Front view of the same specimen. (The section of the aperture is taken from the top point of whorl to centre, leaving the projecting piece out.)

Fig. 3.—Front view (in outline) of the specimen figured Plate XVII, fig. 5 (var. ζ).

Fig. 4.—Side view of a young specimen (var. ζ). Bradford Abbas, Dorset. My Collection.

Fig. 5.—Front view of the same (in outline). Only the top of the aperture has the test present on the carina.

Fig 1

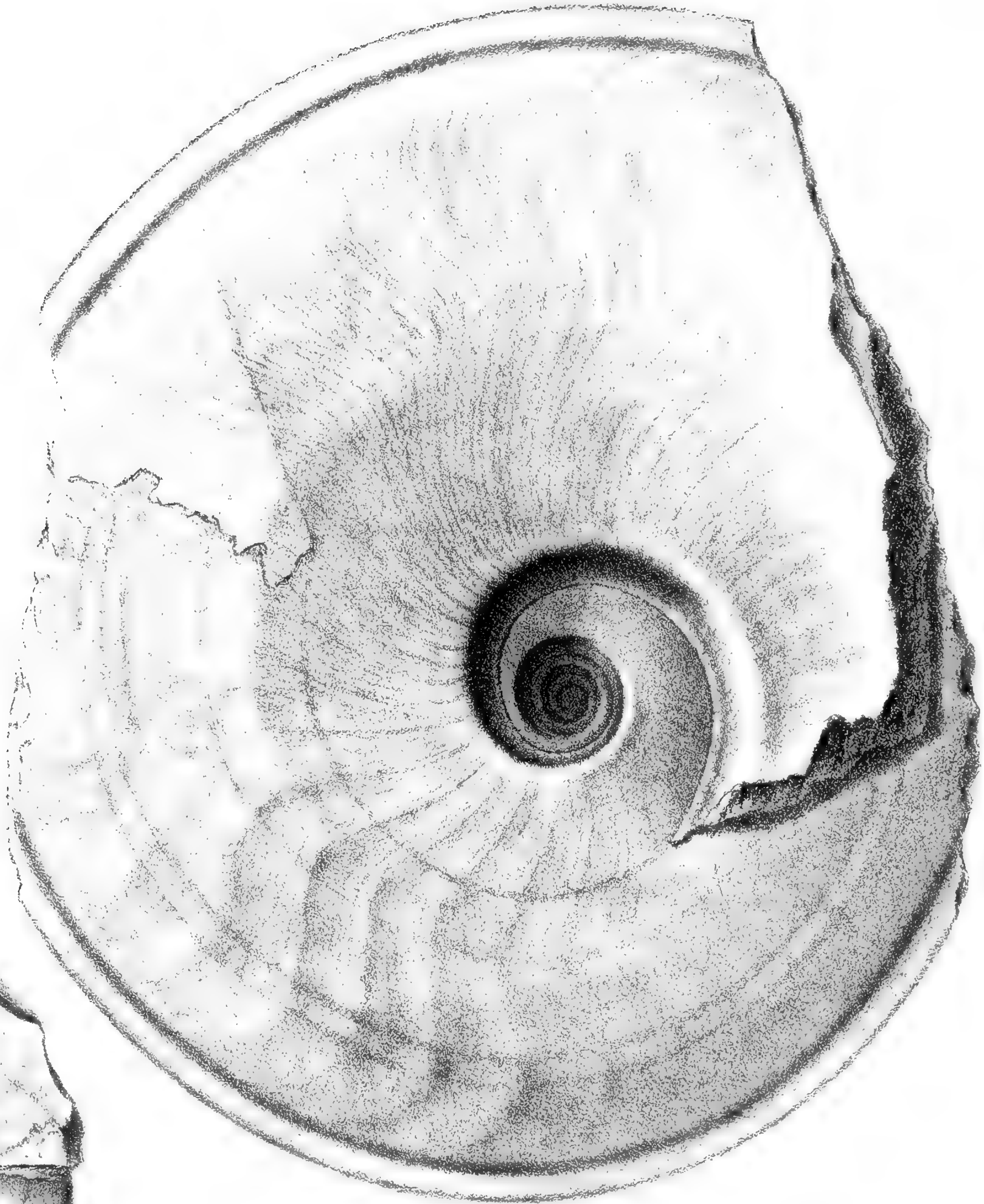


Fig 4

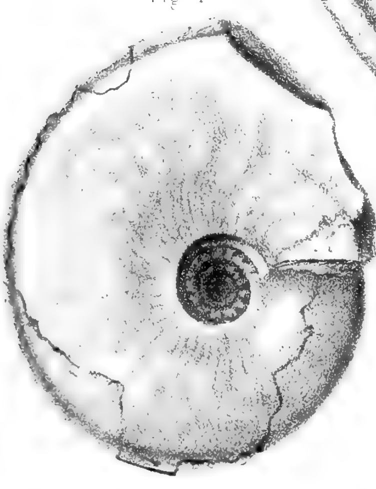


Fig 5

Fig 2

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PLATE XIX.

Concavum-beds.

Figs. 1—4.—Hyperlioceras discoideum (*Quenstedt*).

Fig. 1.—Side view of a large adult specimen (var. β). Bradford Abbas, Dorset. My Collection. (Page 98.)

Fig. 2.—Front view of the same specimen.

Fig. 3.—Side view of another form (var. α). Bradford Abbas, Dorset. My Collection.

Fig. 4.—Outline of the front view of the same specimen, showing triangular aperture, and concave inner margin with the upper edge overhanging the lower.

Figs. 5, 6.—Hyperlioceras subdiscoideum, *S. Buckman.*

Fig. 5.—Side view of a specimen with all its test well-preserved. (At the top left-hand corner the carina and ventral area have been broken away; but, as depicted in the figure, it might be thought the carina were hollow, which is not the case.) Bradford Abbas, Dorset. My Collection. (Page 100.)

Fig. 6.—Sectional view through the same specimen, showing the umbilicus contracted by the last turn.

Fig. 2 Fig. 4 PLATE X

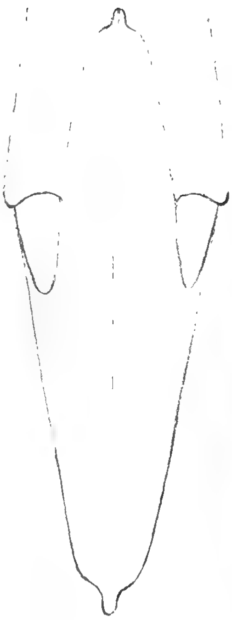

Fig. 6

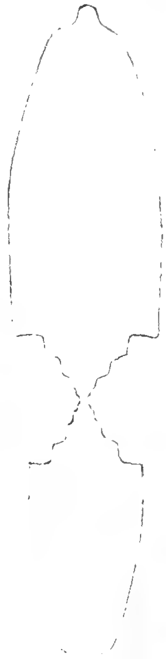

Fig. 5

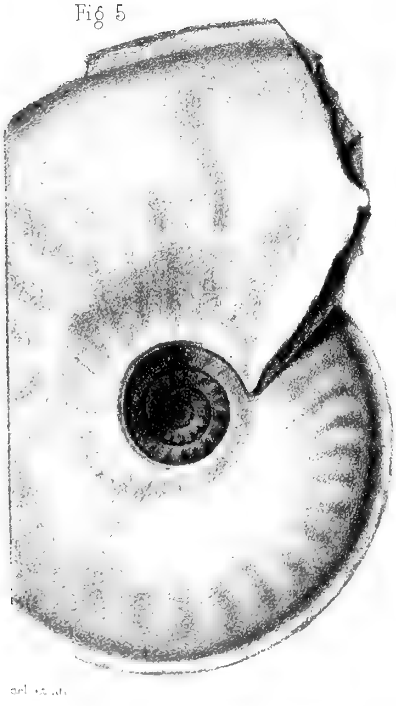

Fig. 3.

del. et lith. Mintern Bros. imp.

PLATE XX.

Concavum-beds.

Figs. 1, 2.—HYPERLIOCERAS SUBDISCOIDEUM, *S. Buckman.*

Fig. 1.—Side view of a large specimen with only a thin film of test preserved. Only a portion of the specimen has been drawn. Railway cutting, Bradford Abbas, Dorset. My Collection. (Page 100.)

Fig. 2.—Outline of the front view. The carina at the top with the test entire, at bottom and point of re-entry without test.

Variabilis-subzone.

Figs. 3—6.—PSEUDOLIOCERAS COMPACTILE (*Simpson*).

Fig. 3.—Side view of a specimen with test completely preserved. Bed 17, Coaley Wood, Gloucestershire. My Collection. (Page 85.)

Fig. 4.—Front view of the same specimen. The hollow carina is filled with crystal, but the aperture with sandy stone.

Fig. 5.—Side view of a young specimen with quite half a whorl of body-chamber present. The carina is solid upon the body-chamber. *a*, indicates carina with test; *b*, without. North Nibley, Gloucestershire. My Collection.

Fig. 6.—Back view of the same specimen showing broader, flattened, ventral area of body-chamber. *a*, ventral area and carina with test; *b*, without.

Opalinum-zone.

Figs. 7—9.—PSEUDOLIOCERAS BEYRICHI (*Schloenbach*) variety.

Fig. 7.—Side view of a specimen with the inner coat of the test well preserved. No part of the body-chamber present. Coaley Wood. My Collection. (Page 87.)

Fig. 8.—Front view of the same specimen. *a*, ventral area and carina, test present; *b*, rounded ventral area without carina, test absent.

Fig. 9.—Side view of a variety with larger umbilicus. North Nibley. My Collection.

Fig. 10.—Outline of the back view of the same specimen. *a*, ventral area and carina with test present; *b*, rounded ventral area without test.

Figs. 11, 12.—LUDWIGIA COSTOSA (*Quenstedt*).

Fig. 11.—Side view showing the bifurcate reflexed ribs. Burton Bradstock, Dorset. My Collection. (Page 102.)

Fig. 12.—Front view of the same specimen.

Parkinsoni-zone.

Figs. 13—17.—ŒCOTRAUSTES CONJUNGENS (*K. Mayer*).

(Inserted here by mistake.)

Fig. 13.—Side view of a specimen with test preserved. About half of the body-chamber is probably present according to the knobs. Bradford Abbas, Dorset (Bed No. 1). My Collection.

Fig. 14.—Back view of the same specimen showing the tubercles on each side of a small keel. (The figure is drawn too long.)

Fig. 15.—Side view of a specimen without test. The whole of the body-chamber is present. The cross marks the position of the last suture. Bradford Abbas, Dorset. Collected by my father.

Fig. 16.—Front view of the same specimen, showing the rounded ventral area at the end of the body-chamber.

Fig. 17.—The mouth border, showing part of the lateral process, from another specimen. Bradford Abbas. My Collection.

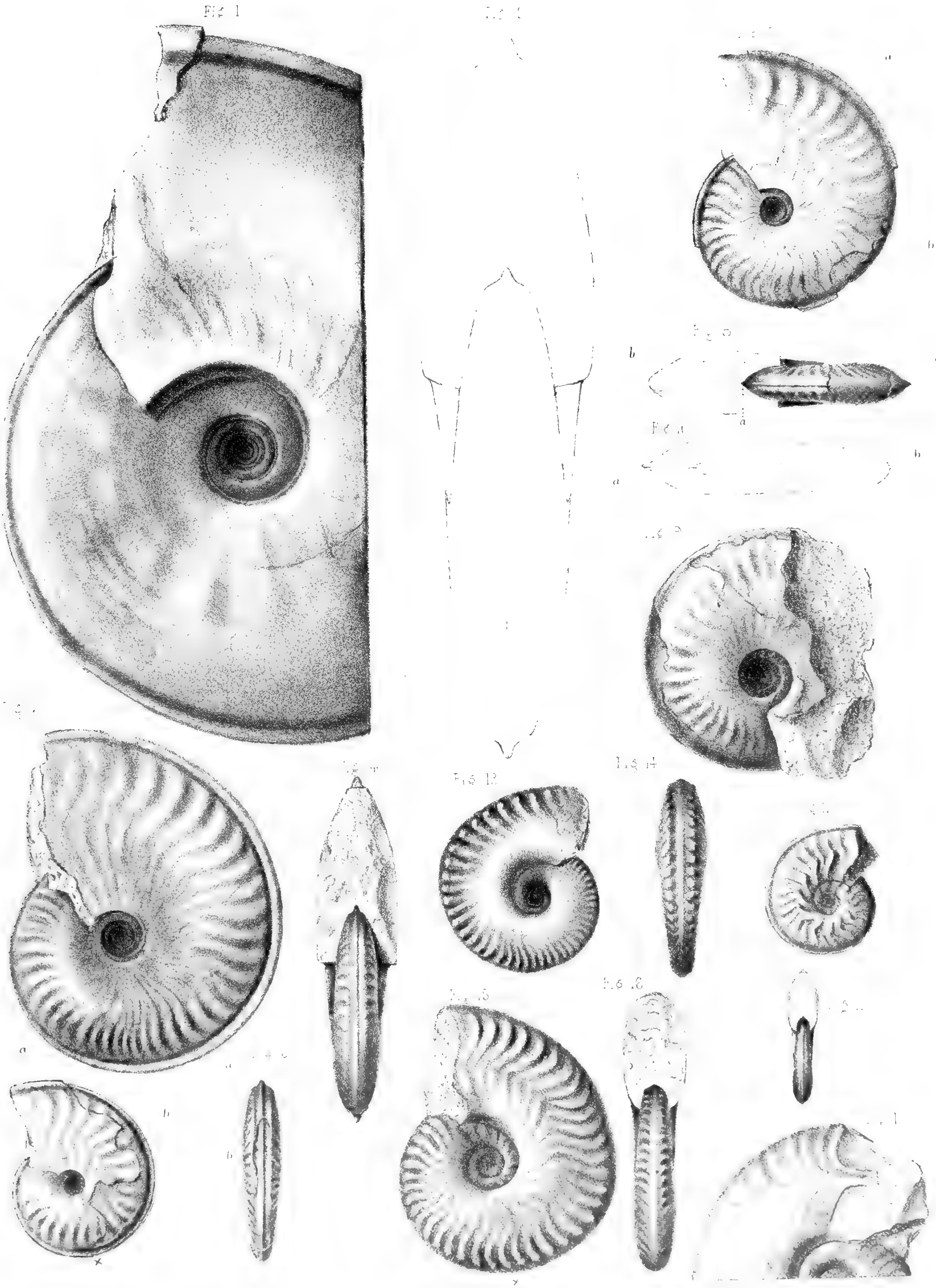
Fig. 1
Fig. 12
Fig. 14
Fig. 16

PLATE XXI.

Parkinsoni-zone.

Figs. 1, 2.—Œcotraustes rugosus, *S. Buckman.*

Fig. 1.—Side view. The ribs on the inner area are scarcely coarse enough. East Coker, near Yeovil, Somerset. My Collection.

Fig. 2.—Front view of the same specimen. The inner margin is depicted too abrupt; it should be subconvex.

Concavum-beds.

Figs. 3—9.—Ludwigia Lucyi, *S. Buckman.*

Fig. 3.—Side view of a specimen with no part of the body-chamber present. Bradford Abbas, Dorset. My Collection. (Page 104.)

Fig. 4.—Front view of the same specimen showing the strong carina. The inner margin is concave.

Fig. 5.—Side view of a smaller example. Bradford Abbas, Dorset. My Collection.

Fig. 6.—Front view of the same specimen, showing a peculiarly flattened ventral area.

Fig. 7.—Side view of a smaller example, showing the bifurcate, reflexed ribs characteristic of the genus. Bradford Abbas, Dorset. My Collection.

Fig. 8.—Side view of a young example. Bradford Abbas, Dorset. My Collection.

Fig. 9.—Front view of the same specimen, showing the inflated sides, and the rounded ventral area destitute of keel.

Figs. 10, 11.—Ludwigia Lucyi, *S. Buckman*, variety.

Fig. 10.—Side view of a specimen without any carina. Probably from Halfway House, near Sherborne, Dorset. Very kindly presented to me by Mr. W. C. Lucy, F.G.S. (Page 105.)

Fig. 11.—Front view of the same specimen, showing the almost complete absence of the carina even where the test is present.

PLATE IV.

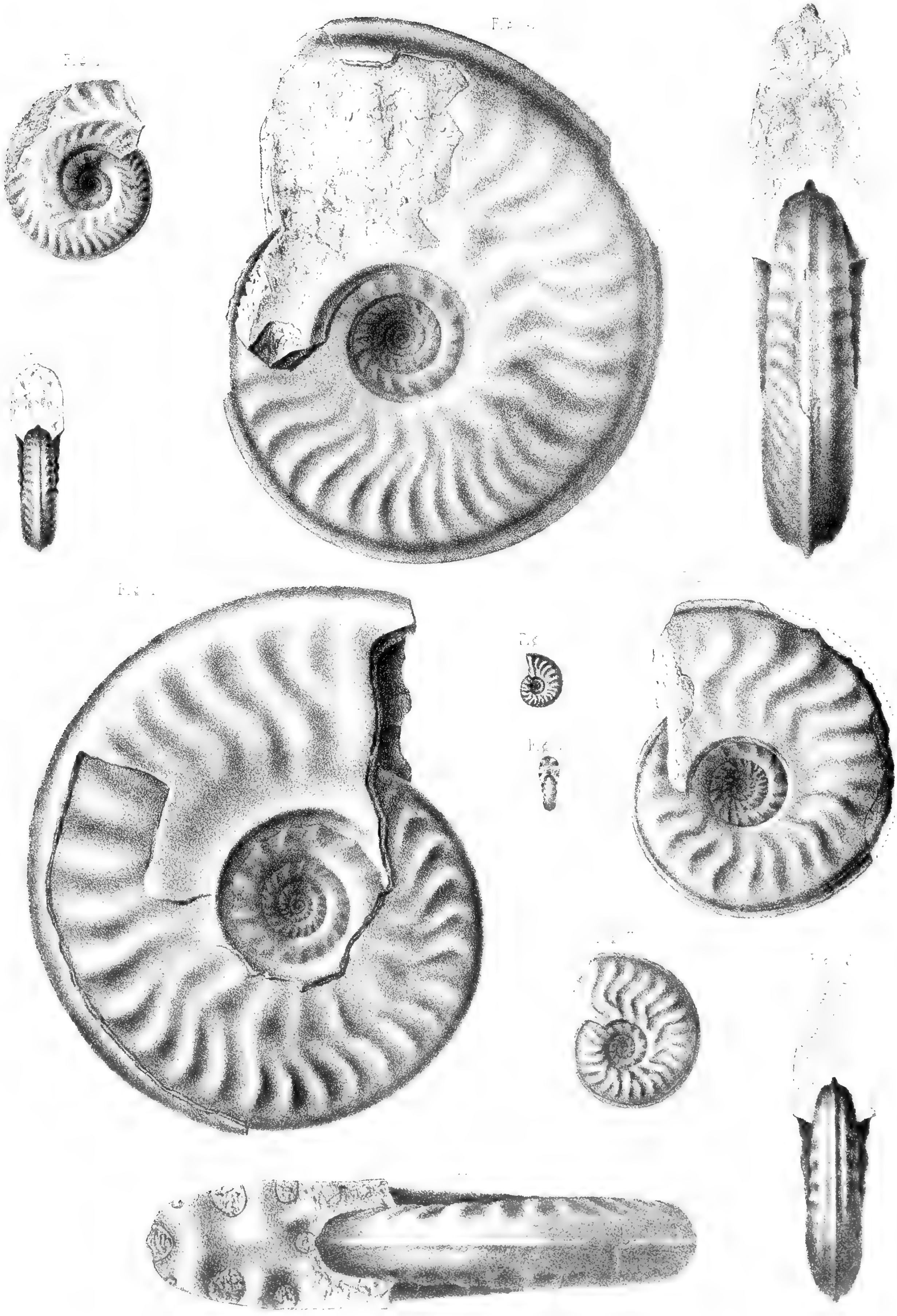

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PLATE XXII.

Humphriesianum-zone.

Figs. 1—22.—PŒCILOMORPHUS CYCLOIDES (*d'Orbigny*).

Fig. 1.—Side view of a somewhat compressed form with moderately large umbilicus. The sigmoidal termination is shown; and the cross marks the last suture. Test extremely well preserved. Oborne, near Sherborne, Dorset. My Collection. (Page 117.)

Fig. 2.—Back view of the same specimen, showing the furrowed ventral area.

Fig. 3.—Side view of a less compressed form with smaller umbilicus. Nearly all the body-chamber present (the cross indicating the position of the last suture). Sherborne, Dorset. Collected by my father.

Fig. 4.—Front view of the same specimen.

Fig. 5.—Side view of a compressed form with very small umbilicus. This variety is very scarce. The specimen is not too well preserved. From the lower part of the hard irony band, Wyke Quarry, Sherborne, Dorset. My Collection.

Fig. 6.—Front view of the same specimen.

Fig. 7.—Side view of a specimen with about half a whorl of body-chamber present. Sherborne, Dorset. Collected by my father.

Fig. 8.—Front view of the same specimen.

Fig. 9.—Side view of a specimen with unequal-sized ribs. Half a whorl at least of body-chamber present, and possibly more. Sherborne, Dorset. Collected by my father. (Page 119.)

Fig. 10.—Front view of the same specimen.

Fig. 11.—Side view of another variety with small umbilicus. The mouth-border is shown, and the change of the ribs into fine lines of growth on the body-chamber. Oborne, Dorset. My Collection.

Fig. 12.—Back view of the same specimen, illustrating a more rounded ventral area and nearly absent furrows. (The carina on the upper part is shown too clearly.)

Fig. 13.—Side view of a very thick variety with small umbilicus. The mouth-border is preserved completely. Sherborne, Dorset. Collected by my father. (Page 119.)

Fig. 14.—View of the top part of the mouth-border, to show the bluntly-pointed ventral process retaining the carina and furrows.

Fig. 15.—Side view of a very thick variety. Test very poorly preserved. The iron band, Wyke Quarry, near Sherborne, Dorset. My Collection.

Fig. 16.—Front view of the same specimen.

Fig. 17.—Side view of a thick variety with small umbilicus and coarse, irregular-sized ribs. Oborne, Dorset. My Collection.

Fig. 18.—Back view of the same specimen.

Fig. 19.—Side view of a young specimen of the thick form. Wyke Quarry, Sherborne. My Collection. (Page 119.)

Fig. 20.—Front view of the same specimen. (Figs. 19 and 20 are inserted to show that the young specimens of the thick forms are themselves thick and fairly involute.)

Fig. 21.—Side view of an evolute, compressed variety. Louse Hill, near Sherborne, Dorset. My Collection. (Page 119.)

Fig. 22.—Front view of the same specimen. (Figs. 21 and 22 are introduced to demonstrate that this variety is distinct in itself, and is not the young state of any of the others.)

Sauzei-zone.

Figs. 23—29.—PŒCILOMORPHUS MACER, *S. Buckman.*

Fig. 23.—Side view of a very nicely preserved specimen with a perfect mouth-border. The last suture is not visible, but the portion of test absent reveals that the body-chamber is over 0·60 of a whorl in length. Oborne, Dorset. My Collection. (Page 116.)

Fig. 24.—Front view of the same specimen.

Fig. 25.—Side view of another specimen a trifle thicker. Oborne. My Collection.

Fig. 26.—Front view of the same specimen.

Fig. 27.—Side view of a thicker specimen with coarser ribs, and a deeper umbilicus. Oborne. My Collection.

Fig. 28.—Front view of the same specimen. The aperture is drawn rather too narrow.

Fig. 29.—Suture-line taken from another specimen.

Variabilis-subzone.

Figs. 30, 31.—HILDOCERAS BIFRONS (*Bruguière*) variety.

Fig. 30.—Side view of a compressed, involute variety. A young specimen with very fine ribs on the outer area and a smooth middle. Bed No. 17, Coaley Wood, Gloucestershire. My Collection. (Page 112.)

Fig. 31.—Front view of the same specimen, to show the compression.

Humphriesianum-zone.

Figs. 32, 33.—LILLIA SULCATA, *S. Buckman.*

Fig. 32.—Side view of well-preserved specimen. Bradford Abbas, Dorset. My Collection. See Plate XXIII, fig. 1. (Page 109.)

Fig. 33.—Front view of the same specimen, showing the quadrangular aperture and the furrowed ventral area.

Fig. 34.—SONNINIA, sp.

Fig. 34.—Suture-line, taken from a specimen in the Bristol Museum. Obtained at Dundry Hill, Somerset. At first thought to belong to the species above. See Plate XXIII, figs. 7, 8. (Page 110.)

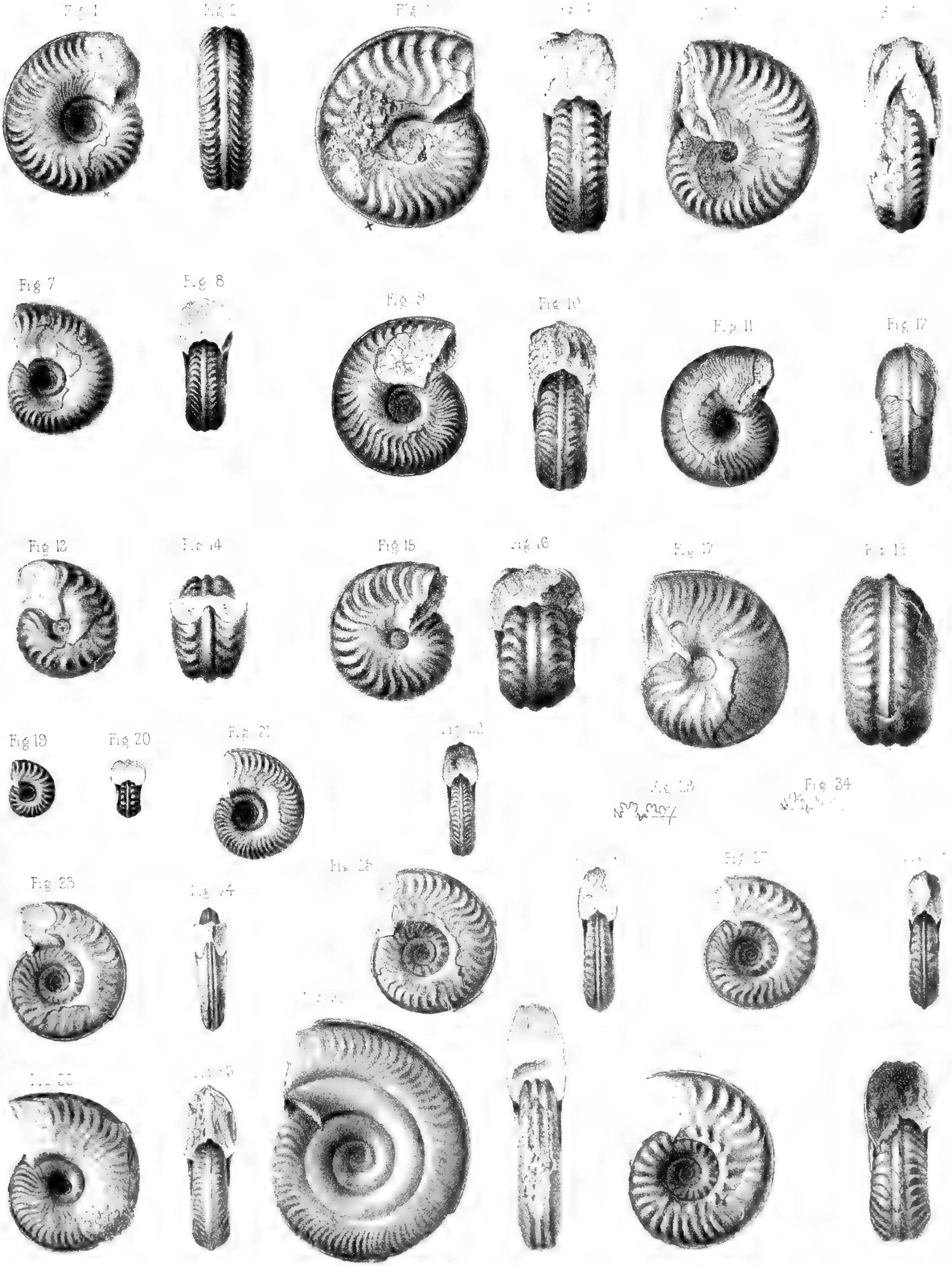
Variabilis-subzone.

Figs. 35, 36.—INCERTÆ SEDIS.

Fig. 35.—Side view. The test present on the greater portion, but the sandy matrix has destroyed its sharpness. The absence of ventral furrows shows that this is not a *Pœcilomorphus;* and this deficiency, together with the sigmoidal ribs, that it is not a *Lillia.* It has very great resemblance to *Haugia Ogerieni,* (Plate XXIII, figs. 16, 17), but has a small solid carina. We must await more specimens before coming to a decided conclusion. North Nibbley, Gloucestershire. My Collection.

Fig. 36.—Front view, showing sharpened ventral area without any trace of furrows.

PLATE



A. Gawan del et lith

PLATE XXIII.

Fig. 1.—Lillia sulcata, *S. Buckman*.

Fig. 1.—Part of the suture-line taken from the specimen depicted in Plate XXII, figs. 32, 33. (Page 109.)

Murchisonæ-zone or *Concavum-beds.*

Figs. 2—4.—Ludwigia (?) sp.

Fig. 2.—Side view of a specimen from Clatcombe, near Sherborne, Dorset. In the Collection of Mr. T. C. Maggs, F.G.S. (Page 107.)

Fig. 3.—Front view of the same shell, showing slight ventral furrows.

Fig. 4.—Suture-line, taken from the same specimen.

Humphriesianum-zone.

Figs. 5, 6.—Sonninia (?) sp.

Fig. 5.—Side view of a small specimen, differing in its ornamentation from the above and placed here for comparison. From the "Ironshot" Oolite, Dundry Hill, Somerset. In the Collection of the Bristol Museum.

Fig. 6.—Front view of the same specimen.

Figs. 7, 8.—Sonninia sp.

Fig. 7.—Side view of the specimen from which the suture-line, Plate XXII, fig. 34, was taken. Springing from the middle of the sides of the inner whorls, and pressed tightly into, and almost hidden by, the succeeding whorls, are small rudimentary spines. As they are not well preserved they are easily overlooked, but such rudiments point to the probability of this specimen being a poorly-developed form of the genus *Sonninia.* It is here figured because its suture-line was depicted where that of *Lillia sulcata* should have been, and so that it may be compared with the other figures of that species. From the "Ironshot" Oolite, Dundry Hill, Somerset. In the Collection of the Bristol Museum.

Fig. 8.—Front view of the same specimen.

Variabilis-subzone.

Figs. 9, 10.—Ludwigia sp.

Fig. 9.—Side view of a specimen, without test. It is, in fact, little more than a cast in sand. From bottom of Cotteswold Sands, Nailsworth, Gloucestershire. In the Collection of the late Mr. E. Witchell. (Page 107.)

Fig. 10.—Front view of the same specimen.

Figs. 11—15.—Haugia variabilis (*d'Orbigny*).

Fig. 11.—Side view, showing arcuate ribs. From White Lackington Park, near Ilminster, Somerset. In the Collection of the Natural History Museum, South Kensington. This is the original specimen of *Ammonites jugosus*, Sowerby, 'Min. Conch.,' pl. 92, fig. 1. But as neither Sowerby's figure nor his description could possibly cause his species to be correctly identified, I deem it only an act of justice not to supersede d'Orbigny's well-known name. (Page 146.)

Fig. 12.—Front view of the same specimen.

Fig. 13.—Suture-line taken from the same specimen. This was rather obscure, and the artist experienced considerable difficulty in tracing it.

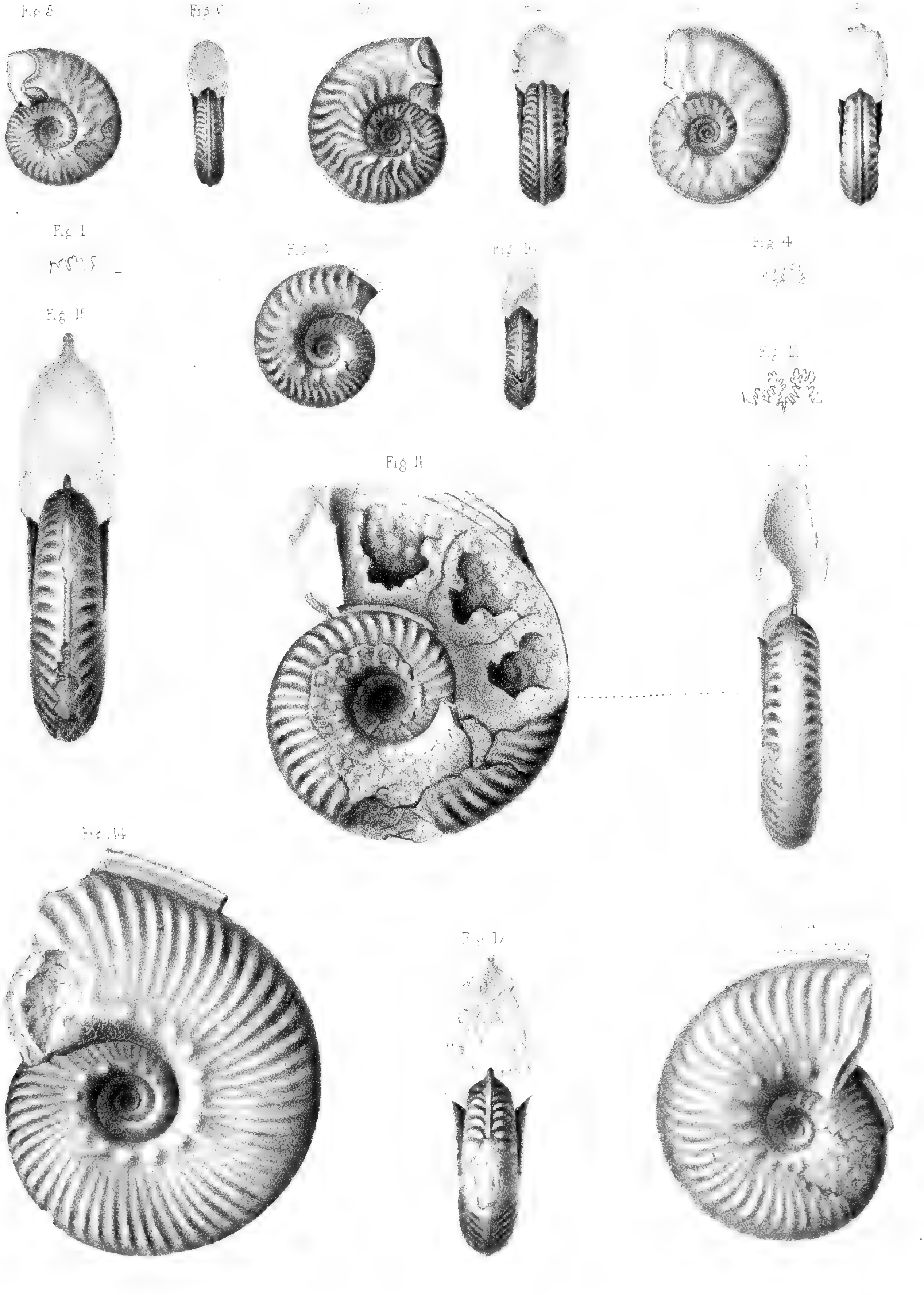
Fig. 14.—Side view of a young specimen, showing the small umbilicus and the arcuate ribs. Cotteswold Sands, Coaley Wood, Gloucestershire (Bed 16).

Fig. 15.—Front view of the same specimen.

Figs. 16, 17.—Haugia Ogerieni (*Dumortier*).

Fig. 16.—Side view of a specimen with its thin test partly preserved, showing subsigmoidal ribs. Cotteswold Sands, North Nibley (Bed 18).

Fig. 17.—Front view of the same specimen, showing much smaller carina (compare fig. 15).



A Gawan del et lith

PLATE A.

[I have taken the figures in this plate from specimens in my own Collection, except where otherwise stated.]

Genus—LUDWIGIA, *Bayle.*

Fig. 1.—Suture-line of *Lud. Murchisonæ* (Sow.), from a specimen (obtained at Combe, near Sherborne, Dorset) in the Collection of Mr. W. H. Hudleston, F.R.S., &c. (Page 122.)

Fig. 2.—Suture-line of *Lud. Murchisonæ*, var. *obtusa* (Quenst.), from a specimen in my Collection obtained at Haselbury, Somerset. (Page 122.)

Fig. 3.—Suture-line of *Lud. Murchisonæ* (variety allied to, or adult of, *Lud. obtusa*), taken from a specimen in Mr. Hudleston's Collection labelled "Pea-grit, Cheltenham." (Page 122.)

Fig. 4.—Suture-line of *Lud. Murchisonæ*, var. *Baylii*, S. Buckm., from a specimen in Mr. Hudleston's Collection obtained at Bradford Abbas, Dorset. (Page 122.)

Fig. 5.—Suture-line of *Lud. Lucyi*, S. Buckm., var., from the specimen depicted Plate XXI, figs. 10, 11. (Page 122.)

Fig. 6.—Suture-line of *Lud. cornu*, S. Buckm. (Page 122.)

Fig. 7.—Suture-line of *Lud. rudis*, S. Buckm., taken from the specimen figured Plate XV, fig. 13. (Page 122.)

Fig. 8.—Outline of the radial curve of *Lud. Murchisonæ* (Sow.), from the specimen figured Plate III, fig. 1. The straight line in this and the other figures is drawn from the tip of the radius on the carina to the centre. v = the middle of the siphonal lobe; the dotted line marks the upper edge of the inner margin; the thick line the point of contact with the next whorl. (Page 124.)

Genus—ŒCOTRAUSTES, *Waagen.*

Fig. 9.—Suture-line of *Œc. conjungens*, K. Mayer, from the specimen figured Plate XX, figs. 15, 16. The similarity which this suture-line exhibits to those of *Ludwigia* and also to *Pseudolioceras* (fig. 22) is striking. Still this is not the correct place for this genus.

Genus—LIOCERAS, *Hyatt*, emend.

Fig. 10.—Suture-line of *Lioc. opalinum* (Reinecke) from a young specimen. (Page 122.)

Fig. 11.—Suture-lines of *Lioc. ambiguum*, var. *costatum*, S. Buckm., from the specimen figured Plate VII, fig. 7. Part of the succeeding suture is here given in order to exhibit the length of the chamber. Although the difference in this respect from that of *Lioc. concavum* (fig. 14) appears small, yet when the suture-lines are observed upon a specimen in a long series the difference is marked, while it is heightened by the smaller auxiliary lobes. (Pages 29, 123.)

Fig. 12.—Suture-line of *Lioc. bradfordense*, var. *giganteum*, S. Buckm., from the specimen figured Plate XI, fig. 1. (Page 123.)

Fig. 13.—Suture-line of *Lioc. decipiens*, var. *simile*, S. Buckm., from the specimen figured Plate XV, figs. 1, 2. (Page 123.)

Fig. 14.—Suture-line of *Lioc. concavum* (Sow.), from a typical specimen. (Page 123.)

Fig. 15.—Suture-line of *Lioc. concavum*, var. *formosum*, S. Buckm. (Page 123.)

Fig. 16.—Suture-line of *Lioc. concavum*, var. *v-scriptum*, S. Buckm., from the specimen depicted Plate X, figs. 5, 6. (Pages 72, 123.)

Fig. 17.—Suture-line of *Lioc. apertum*, S. Buckm., from the specimen figured Plate XV, figs. 3, 4. (Page 122.)

Fig. 18.—Outline of the radial curve of *Lioc. concavum* (Sow.), from the specimen which furnished the suture-line depicted in fig. 14. v = middle of siphonal lobe; l' = middle of superior lateral lobe; l'' = inferior lateral lobe. (Page 124.)

Fig. 19.—Outline of the radial curve of *Lioc. concavum* variety, from the specimen exhibited in Plate X, fig. 9. (Page 124.)

Fig. 20.—Outline of the radial curve of *Lioc. concavum*, θ. (Page 125.)

Fig. 21.—Outlines of the radial curves of *Lioc. concavum*, var. *v-scriptum*. The outlines are taken from two different places, the larger curves being about two thirds of a whorl beyond the other. (Page 125.)

Genus—PSEUDOLIOCERAS, *S. Buckm.*

Fig. 22.—Suture-line of *Pseudolioceras Beyrichi* (Schloenb.), var., from the specimen figured Plate XX, figs. 7, 8. (Page 123.)

Genus—HYPERLIOCERAS, *S. Buckm.*

Fig. 23.—Suture-line of *Hyperlioc. discites* (Waagen), var. ε. (Page 123.)

Fig. 24.—Suture-line of *Hyperlioc. Walkeri*, S. Buckm., from the specimen figured Plate XVI, fig. 1. (Page 123.)

Fig. 25.—Suture-line of *Hyperlioc. discoideum* (Quenstedt), from the specimen figured Plate XIX, figs. 1, 2. (Page 123.)

Fig. 26.—Suture-line of *Hyperlioc. subdiscoideum*, S. Buckm. (Pages 101, 123.)

Fig. 27.—Section of the ventral area and carina of *Hyperlioc. discoideum* (in outline), showing the solid carina. a = core; b = test; s = position of siphuncle. (Pages 81, 88.)

Genus—HILDOCERAS, *Hyatt.*

Fig. 28.—Suture-line of *Hild. bifrons* (Brug.) (compressed, involute variety), from a specimen found in the Cotteswold Sands of Coaley Wood. (Page 124.)

Fig. 29.—Suture-line of *Hild. bifrons* (thick, evolute variety), from a specimen obtained in the Upper Lias Clay (Commune-zone), Trent, near Yeovil, Somerset. (Page 124.)

Fig. 30.—Outline of the radial curve of *Hild. bifrons*, from the same specimen. v = middle of siphonal lobe; l', of superior lateral; l'', of inferior lateral; u = edge of ventral and lateral areas; dotted line between l' and l'' = sulcus in lateral area; dotted line below = upper edge of inner margin. (Page 124.)

Genus—PŒCILOMORPHUS, *S. Buckm.*

Fig. 31.—Suture-line of *Pœcil. cycloides* (d'Orb.), copied from his 'Céph. jurass.,' pl. 121. Enlarged six times. (Page 124.)

Fig. 32.—Suture-line of *Pœcil. cycloides* (d'Orb.), from a specimen in my Collection. Enlarged six times. (Page 124.)

Fig. 33.—Suture-line of *Pœcil. macer*, S. Buckm. Enlarged six times. (Page 124.)

Genus—HAUGIA, *S. Buckm.*

Fig. 34.—Suture-line of *Haugia variabilis* (d'Orb.), copied from his 'Céph. jurass.,' pl. 113.

Fig. 35.—Suture-line of *Haugia variabilis*, from a specimen in the Collection of the late Mr. E. Witchell, F.G.S.

Fig. 36.—Suture-line of *Haugia Ogerieni* (Dum.).

Fig. 37.—Suture-line of *Haugia Eseri* (Oppel).

Fig. 38.—Section of the ventral area and carina (in outline) of *Haugia variabilis*, with the test present, showing the structure of the hollow carina. a, a = core; b = test; c = hollow tube in carina; s = position of siphuncle; between c and s lies the partition-band. This figure is enlarged twice. (Page 81.)

Genus—GRAMMOCERAS, *Hyatt.*

Fig. 39.—Suture-line of *Gramm. fallaciosum*, Bayle.

Fig. 40.—Suture-line of *Gramm. sp.*

Fig. 41.—Suture-line of *Gramm. dispansum* (Lycett).

Fig. 42.—Ditto, from another specimen.

Fig. 43.—Suture-line of *Gramm. striatulum* (Sow.).

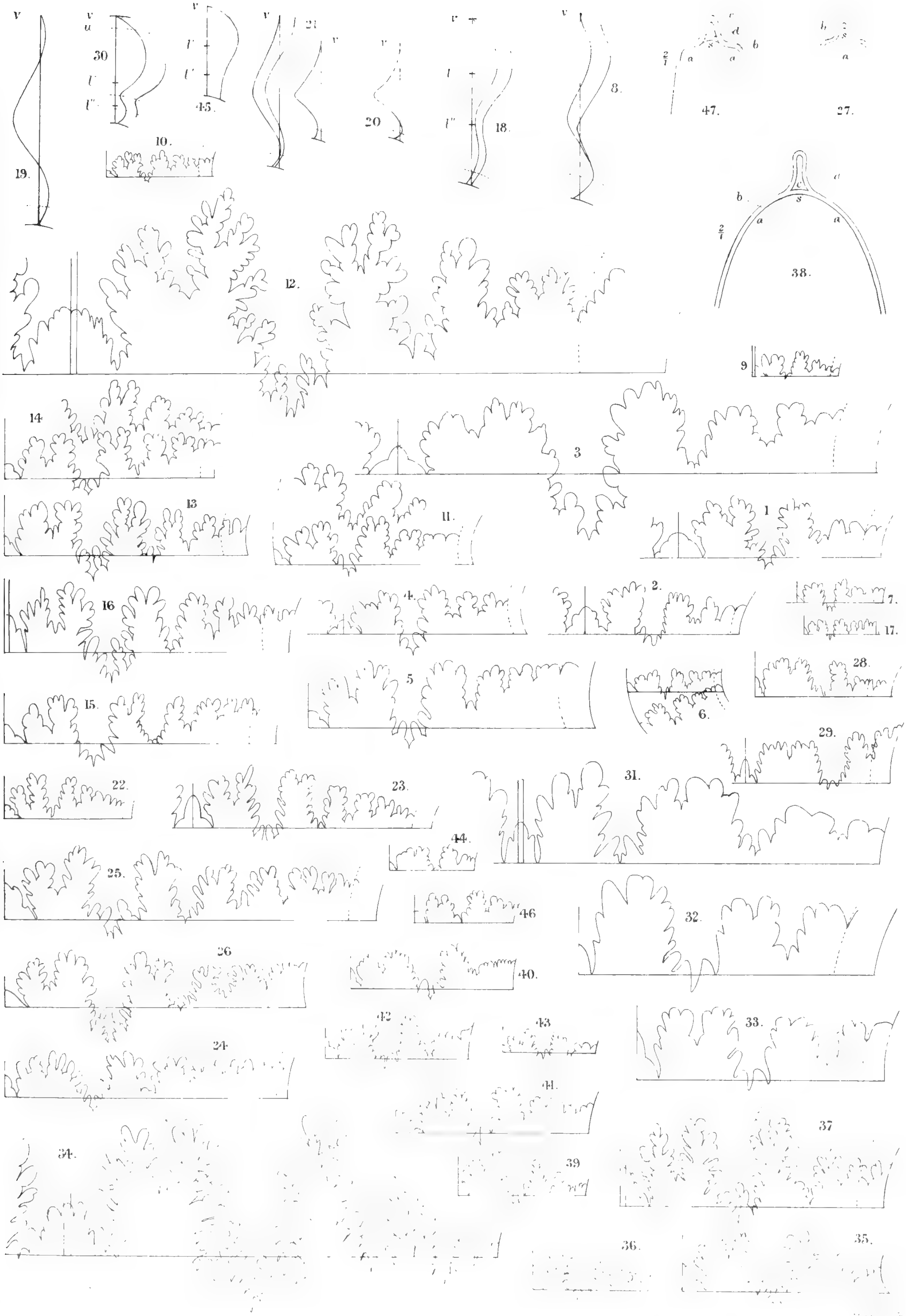
Fig. 44.—Ditto, from another specimen.

Fig. 45.—Outline of the radial curve of *Gramm. striatulum*.

Fig. 46.—Suture-line of *Gramm. Moorei* (Lycett).

Genus—WITCHELLIA, *S. Buckm.*

Fig. 47.—Section of the ventral area and carina of *Witchellia læviuscula* (Sow.). a, a = core furrowed and slightly carinated; b = test; c = hollow tube in carina; d = partition band; s = position of siphuncle. The figure is enlarged twice natural size. The test on the carina is perhaps somewhat too thick. The sulci on each side of s are not distinct enough. (See pages 81, 82.)



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THE

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LONDON:

MDCCCLXXXIX.

A MONOGRAPH

OF THE

DEVONIAN FAUNA

OF THE

SOUTH OF ENGLAND.

BY

G. F. WHIDBORNE, M.A., F.G.S.

PART I.

THE FAUNA OF THE LIMESTONES

OF

LUMMATON, WOLBOROUGH, CHIRCOMBE BRIDGE, AND CHUDLEIGH.

Pages i, ii; 1—46; Plates I—IV.

LONDON:

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PREFACE.

Since the time of the publication of Prof. Phillips's 'Palæozoic Fossils of Devon and Cornwall,' the knowledge of both the stratigraphy and the palæontology of the Devonian System in England has very greatly increased. Of late years many able observers have done much towards clearing up various of the intricate problems that are presented. At the present time the Geological Survey, having finished the mapping of North Devon, is engaged on that of the South, and from it we may expect a great advance of our knowledge. Nevertheless, the intricacy of the sequence is so great, and the data for interpreting it so small, that we can hardly hope that it will be rapidly cleared up; and certainly at present even the correlation of the different parts of the system with the major divisions in America and the Continent is still a matter of discussion.

Among the reasons for this, at least as regards South Devon, are the following:

1. The metamorphism, from whatever cause, of many of the beds.

2. The great twisting and flattening, as well as actual contortion and reversal of large portions of the strata.

3. The general absence or bad preservation of fossils (except Corals and Amorphozoa) in most localities.

4. The frequent discontinuity of the beds, and especially of the Limestones, which sometimes appear, expand, and vanish in very short distances, owing, at least in part, to their accretionary and organic origin.

5. The constant obscuration of the bedding, which is often difficult and sometimes almost impossible to trace.

On the other hand, there are various localities which yield a very good series of organic remains in a fair state of preservation. When these have been thoroughly examined and compared with the Devonian Fauna of other countries, we shall be possessed of landmarks by which the other strata may be grouped.

During a residence at Torquay some years ago I collected very largely from one of the most fossiliferous of these localities, Lummaton Quarries, just to the west of St. Mary Church. These were reopened about fifteen years ago when the

1

adjacent Barton Quarries were closed. My attention was at first chiefly directed to the Brachiopoda in special reference to Dr. Davidson's 'Supplement to the Devonian Brachiopoda' then in progress. From Lummaton I was able to supply him with a large series of interesting species. This search, moreover, proved that there were many other unrecognised British Devonian fossils outside the class of Brachiopoda, and these, by Dr. Davidson's suggestion, I attempted to work out. By the kindness of Mr. Vicary and Mr. Pengelly I was enabled to study the Fauna of the equally rich locality of Wolborough, as well as some fossils from Chudleigh and Chircombe Bridge. Before long, however, other duties obliged me to lay aside the task uncompleted, and it remained in abeyance till last spring, when Prof. Hughes brought his party of Cambridge geologists to Torquay. Having had occasion during this visit to show him my notes, he strongly advised me to resume the subject, and under his kind guidance my present task is undertaken.

From these circumstances it has appeared to me that the best course to pursue will be in the first instance to describe the fossils of the four localities mentioned above, and then if possible to go on to those of other places. A view will thus be presented of a typical Middle Devonian Fauna, gathered almost entirely from the two localities of Wolborough and Lummaton, which are in all probability almost exactly upon the same horizon. Uppercot Quarry, near Chudleigh, lies most likely higher in the series, and Chircombe Bridge, in the Bradley Woods, near Newton, lower; but as Mr. Vicary has placed in my hands a small but very remarkable series of fossils from these places I am tempted to include them in the present list.

Besides the Woodwardian Professor I have to thank many kind friends for their invaluable assistance. To Mr. T. Roberts, M.A., F.G.S., of the Woodwardian Museum, I am under especial obligation for the constant supervision he has given to my work. In most of the more doubtful points I have had the advantage of consulting him, and in those cases have rarely felt satisfied till he and I have come to an agreement. My thanks are also due to Prof. Rupert Jones, F.R.S., who has examined the Ostracods and given me such great help as to enable me to identify and describe them. To Mr. Vicary, F.G.S., I am under the greatest obligation for the liberal way in which he has placed his splendid collection entirely at my disposal. To Mr. Pengelly, F.R.S., and the Committee of the Torquay Natural History Society, Dr. Woodward, F.R.S., Dr. Geikie, F.R.S., and Prof. Hughes, M.A., F.G.S., I am indebted for the permission to examine and describe the specimens in the Museums under their direction; and I have cause for gratitude to many other friends whose names will be mentioned in the body of the work. Lastly, it is my sad pleasure to record the kind help that my two honoured and lamented friends, Mr. Lee and Mr. Champernowne, gave me by the loan of interesting fossils, and to commemorate the care and enthusiasm which Dr. Davidson bestowed in his failing health upon the Brachiopoda of these localities.

A MONOGRAPH

OF THE

DEVONIAN FAUNA OF THE SOUTH OF ENGLAND.

Vertebrata.

Fish Remains. Pl. I, fig. 1.

The traces of Vertebrates in the Limestones of Devonshire are scant in the extreme. From the localities under consideration, the only indication of the existence of Fishes known to me are two small fragments of bone obtained from the Lummaton shell-bed, which are far too fragmentary for identification. Apparently their surface is decayed, and the only mark on them is a long straight furrow, which Mr. Smith Woodward, who has kindly examined them, considers possibly to indicate a mucus-groove.

The coarse texture of the bone, which is much greater on one side than the other, indicates that they belonged to an animal of considerable size. He believes them to be probably part of some large Placoid, which might have been allied to the genus Homosteus.

Though they are quite unidentifiable, I have thought their presence worth recording, as they prove that large fish were inhabitants of the waters that contains so prolific an Invertebrate Fauna. Fish-remains also occur in the Lower Devonian beds at Kilmorie, and some fine fragments were discovered last spring at Goodrington by members of Professor Hughes's party of Cambridge geologists.

Crustacea.

The Crustacea of these Limestones are sufficiently numerous, but for the most part of small size. No less than seven families of Trilobites are represented, and these include about twenty species belonging to the genera Phacops (2), Cheirurus (2), Acidaspis (2), Lichas, Cyphaspis, Proëtus (4), Dechenella, Harpes, and Bronteus (6). Of these, Proëtus, Cyphaspis, and Bronteus yield by far the greatest number of specimens. Moreover, there are probably two Phyllocarids, of the genera Bactropus and Tropidocaris (?); and Ostracods of the genera Entomis, Cyprosina, Polycope, Cypridina (?), Cypridella, and Cypridinella (?), of which the Cyprosina is at once the largest and the most abundant. Lummaton seems to be far more prolific in Crustacea than Wolborough; but this may have been due to the greater preserving power of its sediment, that of Wolborough having been unsuitable to retain such delicate organisms as Trilobites in a sufficiently perfect state to attract the collector's eye. Neither has this latter place been specially searched for Ostracods, and such small fossils would almost certainly escape notice unless attention were especially turned to them. Finally, most of the Crustacea at Lummaton have occurred in the bed at the top of the quarry, which is apparently little else than a shell-heap, and which was probably a local and littoral deposit. This would explain the fact that the Trilobites are almost always found there in a fragmentary condition; for most likely they had decayed and fallen asunder before they reached the place of deposition.

Order—TRILOBITA.

I. *Family.*—Phacopidæ, *Salter*, 1864.

1. *Genus.*—Phacops,[1] *Emmerich*, 1839.

The Trilobites now included in this genus were formerly classed with Calymene. It is defined by the shape of the facial suture, the large and conical faceted eye, the eleven segments of the thorax with grooved pleuræ, and the large glabella broadest in front. *Ph. latifrons*, Bronn, is the typical species. The restricted genus extends from the Upper Silurian to the Upper Devonian, but the neighbouring genera, which have been usually regarded as sub-genera of Phacops, begin at the base of the Lower Silurian.

1. Phacops batracheus, *Whidborne*. Pl. I, figs. 2—7.

? 1841. Calymene granulata, *Phil.* Pal. Foss., p. 128, pl. lvi, figs. 248 *g, h, i*, only.
1864. Phacops granulatus, *Salt.* Mon. Brit. Tril., p. 18, pl. i, fig. 1, only.
1889. — batracheus, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 28.

Description.—Head wide, convex, flattened above. Glabella pentangular, roughly equilateral, bluntly pointed in front, slightly convex above, curving

[1] Though ὤψ is feminine, its derivative Cyclops is masculine. Goldfuss having used the names of Brontes and Arges (two Cyclopes), Emmerich seems to have referred to this in the word Phacops. It would therefore be masculine.

suddenly over the two front sides to the border, which it constantly overhangs, and marked with two indistinct scars indicating frontal furrows. Basal lobe narrow, distinct, arched and granulated centrally; flat, smooth, and expanding laterally; separated from the front part of glabella by a furrow, deep on the sides, shallow and curving in centre. Neck-furrow similar to the basal furrow but straighter. Neck-lobe narrow, arched, smooth. Lateral processes straight, separated very indistinctly from cheek by a slight furrow, and ornamented with a row of tubercles. Cheeks oblique, receding, widely rounded at the latero-posterior corner. Border wide, defined within by a slight concavity. Surface behind the eye narrow, slightly swollen. Eye very large, occupying more than half the cheek, semicircular, with straight sides almost, but not quite, as high as the glabella. Lenses very large and convex, in eighteen perpendicular rows of from four to six lenses each, between eighty and ninety in all. Lobe of the eye smooth, swollen, connected with the basal lobe. Facial sutures obscure.

Thorax with eleven segments. Axis narrow, much arched. Pleuræ flat and grooved at first, then bending suddenly down at the fulcrum where the groove disappears; extremities rounded.

Tail wide. Axis narrow, convex, conical, reaching close to the hind border, with nine segments divided by eight grooves, the posterior ones indistinct. Limb separated from axis by strong concavities, convex, with eight segments vanishing at the border.

Size of Head.—15 mm. long, 30 mm. wide, and 9 mm. deep.

Size of Thorax and Tail.—Length, 32 mm.; width, 22 mm.; depth, 6 mm. (about).

Localities.—This handsome Trilobite is by no means uncommon at Lummaton. I have obtained eight examples of the head from that locality. There is another in the Battersby Collection in the Torquay Museum, and one in the Bristol Museum. There are two specimens of the tail in the Woodwardian, and I have three or four more, as well as one united to the thorax. There is a specimen of the head in Mr. Vicary's collection from Wolborough, and another, in Mr. Pengelly's collection, which was figured by Salter.

Remarks.—This species is widely different from *Phacops latifrons*, (Bronn),[1] and from *Ph. Schlotheimi* (Bronn),[2] but it comes very much nearer to *Ph. granulatus* (Münst.),[3] with which, in fact, it seems to have been united by some authors. A careful examination, however, has convinced Mr. Roberts, Mr. Marr, and myself that it is really to be regarded as distinct. Judging from Münster's figures there is at first sight small reason for doubting its identity, but, in his description, he

[1] 1825, Bronn, in Leonhard's 'Zeitsch.' (afterwards 'Jahrb.'), pt. 1, p. 318, pl. ii, figs. 1, 2, 3.

[2] Ibid., p. 319, pl. ii, figs. 5, 6, 7, 8.

[3] 1840, Münster, 'Beiträge,' pt. 3, p. 36, pl. v, fig. 3.

lays great stress on the granulations on the cheeks, which he describes as coarser than those on the glabella, but which are altogether absent in our fossils. He also mentions a deep groove running round within the border, whereas in our form this groove is only slight. In the Woodwardian Museum are three German specimens, believed to have been presented to it by Count Münster himself, and these bear out these distinctions, and also show that the eye was situated much further forward, so as to have a large portion of the cheek behind it. It may be observed that one of these specimens, wanting the test, goes to prove that his *Calymene lævis*[1] belongs to the same species.

In the same Museum are the four type-specimens from Petherwin, figured by Sowerby[2] as two species of Calymene, and identified by M'Coy[3] as *Portlockia granulata* (Münst.). These agree in the position of the eye, in size, and other respects with the German specimens, and evidently belong to that species. The reason Sowerby regarded them as two species, is that one of them is smooth, but this only arises from its being a cast; the other is very coarsely granulated. It is to be noted that these Woodwardian specimens (both German and English) agree in having only about twelve longitudinal rows of facets in the eye, and in the number of lenses themselves being very small.

Turning now to Phillips's 'Palæozoic Fossils'[4] we find *C. granulata* described both from Petherwin and Hope's Nose, though unfortunately the localities of the figured specimens are not distinguished. It appears likely that more than one species is included here; the three tails (*m*, *o*, *p*) may belong to the genus Proëtus; the heads (*a*, *b*, *c*, *d*, *e*) agree with Münster's species, showing the granulated cheeks (which he notes) and the anterior position of the eye, and probably came from Petherwin; while the heads (*g*, *h*, *i*) look more like the Lummaton species, but are too slightly drawn for certain identification. I have not myself observed these fossils at Hope's Nose.

Salter, in his 'British Trilobites,'[5] describes *Ph. granulatus* in terms which agree with that species, and his figures of the Petherwin fossils clearly represent it; but his largest figure is from a specimen, in Mr. Pengelly's cabinet, from Newton, and evidently belongs not to *Ph. granulatus* but to our Lummaton species.

As occurring at Lummaton *Phacops batracheus* seems very definite and well marked; it is a Trilobite with a pentangular, pointed, and finely granulated glabella overhanging the border, and with large low funnel-shaped eyes, almost filling the cheeks, which were smooth and scarcely furrowed.

From *Calymene latifrons*, Bronn, as seen in German and English specimens, it is

[1] 1840, Münst., 'Beitr.,' pt. 3, p. 36, pl. v, fig. 4.

[2] 1840, Sow., 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liv, figs. 23, 24.

[3] 1851, M'Coy, 'Synops. Pal. Foss. Woodw.,' p. 177.

[4] 1841, Phil., 'Pal. Foss.,' p. 128, pl. lvi, figs. 248 *a*—*p*.

[5] 1864, Salter, 'Brit. Trilob.,' p. 18, pl. i, figs. 1—4.

easily distinguished by its more regular and overhanging glabella, finer granules, and smoother cheeks, and from *C. Schlotheimi* by its less elevated eyes, shorter glabella, and the narrower axis of its tail.

It comes strikingly near to *Phacops fecundus*, Barr.,[1] and especially to some of its varieties from Bohemia. It may, however, be distinguished from them by the more pointed, flatter, and overhanging frontal lobe, the smooth cheek, and the different position of the eye, which in the Bohemian species has usually a considerable expanse of cheek behind it. It agrees with *Ph. latifrons* as against *Ph. fecundus* in having eighteen and not nineteen perpendicular rows of lenses, and with *Ph. fecundus* as against *Ph. latifrons* in the eye not reaching the highest level of the glabella. *Ph. fecundus*, on the other hand, differs from *Ph. granulatus* in the much greater number of rows of facets in the eye.

Dr. Kayser[2] describes a German variety of *Ph. fecundus*, and points out several distinctions between it and *Ph. latifrons*, which still further show that *Ph. batracheus* is not to be ranked with either. He also proves that the fossil described by F. A. Römer[3] as *Ph. granulatus* belongs really to *Ph. fecundus*.

In a paper on the zoology of *Cabrières* (Languedoc) Dr. F. Frech[4] describes "*Ph. fecundus mut. nov. supra-devonica*," and this seems to come still nearer to *Ph. batracheus*. Apparently, however, it differs from it in the cheeks being finely granulated, the cheek-groove deep, the neck- and basal lobes narrower, the glabella more rounded in front, and the cheeks narrower near the posterior angle. The head would seem to be rather longer, and the furrows of the glabella less distinct.

No other German or Bohemian species resembles it. In *Ph. signatus*, Corda,[5] the eye is much more forward; in *Ph. trapeziceps*, Barr.,[6] the neck is much wider, and the glabella slopes to the front border; in *Ph. Hœninghausi*, Barr.,[7] the head is more elongate and the eye more forward. In *Ph. cephalotes*, Barr.,[8] the glabella is much larger and more protuberant; and in *Ph. Boecki*, Corda,[9] the basal lobe is linear and the glabella more rounded.

Ph. breviceps (?), Barr., is described by Barrois[10] from a pygidium, which seems wider than that of our species, and this distinction is fully borne out by Barrande's own description of that species.[11]

1 1852, Barrande, 'Syst. Sil.,' vol. i, p. 514, pl. xxi, figs. 1—27; pl. xxii, figs. 32, 33; and Supplement, pl. xiii, figs. 1—14.

2 1878, 'Abhandlungen zur geol. Specialkarte von Preuss.,' Band 2, pt. 4, p. 19, pl. ii, figs. 1—12.

3 1866, F. A. Römer, 'Beitr.,' pt. 5, p. 8, pl. 34, fig. 7.

4 1887, Frech, 'Zeitsch. deutsch. geol. Gesell.,' p. 469.

5 1852, Barr., 'Syst. Sil.,' vol. i, p. 521, pl. xxiii, figs. 1—4, Étage F.

6 Ibid., vol. i, p. 526, pl. xxii, figs. 19—23, Étage E.

7 Ibid., vol. i, p. 522, pl. xxi, figs. 28—31, Ét. G. 8 Ibid., vol. i, p. 509, pl. xx, figs. 1—14, Ét. G.

9 Ibid., vol. i, p. 513, pl. xx, figs. 30—32, Étages F and G.

10 1886, Barrois, 'Ann. Soc. Géol. du Nord,' vol. xiii, p. 137, pl. ii, fig. 4.

11 1852, Barrande, 'Syst. Sil.,' vol. i, p. 518, pl. xxii, figs. 24—31, Ét. F.

Of American species, *Ph. Logani*, Hall[1], has the central part of the basal furrow wider, the head is more rounded, and the tuberculation more distant. The eyelid is also coarsely spotted, and there is a tendency to spines on the neck-lobe and the angles. *Ph. cristata*, Hall,[2] has a more anterior eye and spinous angles. *Ph. rana*, Hall,[3] is finely and evenly granulated on the glabella and cheeks, and the glabella does not overhang the border. The other species described by Hall appear to be without granulations.

2. Phacops latifrons (*Bronn*). Pl. I, figs. 8, 8 *a*, 9.

1825.	Calymene macrophthalma, *Brongn.* Pars. Crust. Foss., pl. i, fig. 5, a—c.
1825.	— latifrons, *Bronn.* Leonh. Zeitschr., p. 317, pl. ii, figs. 1, 2, 3.
1833.	— Latreillii, *Stein.* Mém. Soc. Géol. Fr., vol. i, pt. 2, p. 351.
1835.	— macrophthalma, *Bronn.* Leth. Geog., p. 111, pl. ix, fig. 4.
1840.	— Latreillii, *Phill.* Pal. Foss., p. 129, pl. lvi, fig. 249.
1840.	— accipbina, — Ibid., p. 128.
1843.	— ? Jordani, *F. A. Röm.* Verst. Harz, p. 37, pl. xi, fig. 4.
1843.	Phacops macrophthalmus, *Goldf.* Neues Jahrb., p. 564.
1846.	— latifrons, *Burm.* Trilobites, Ray Soc., p. 88, pl. ii, figs. 4—6.
1850.	— — *Sandb.* Verst. Rhein., p. 16, pl. i, fig. 7.
? 1850.	— — *F. A. Röm.* Beitr., pt. 1, p. 24, pl. ix, fig. 24 (= *Ph. fecundus* fide Kayser).
1852.	— — *Quenstd.* Handb., p. 289, pl. xxii, figs. 10—14.
1853.	— latreillii, *Stein.* Geog. Beschr. Eifel, p. 87.
1855.	Portlockia latifrons, *M'Coy.* Desc. Brit. Pal. Foss., p. 177.
1864.	Phacops — *Salter.* Brit. Trilob., p. 18, pl. i, figs. 9—16.
1864.	— cryptophthalmus, *Salter.* Brit. Trilob., p. 17, pl. 1, fig. 8.
1876.	— latifrons, *F. Röm.* Leth. Pal., pl. xxxi, fig. 2.
1877.	— — *Barrois.* Ann. Soc. Géol. du Nord, vol. iv, p. 86.
1882.	— — — Recherches Ter. Anc. Asturies, p. 284.
1884.	— — *Beushausen.* Abhandlung. zur geol. Specialk. von Preuss., Band vi, pt. 1, p. 37.
1885.	— — *Zittel.* Handb., p. 614, fig. 811.
1885.	— — *Riemann.* Neues Jahrb., pt. 3, Beil.-Band, p. 146.
1885.	— — *Barrois.* Ann. Soc. Géol. du Nord, vol. xiii, p. 75.
1887.	— — *Frech.* Zeitsch. der deut. geol. Gesell., p. 470.
1888.	— — *Etheridge.* Brit. Foss., pt. 1, p. 146.

This well-known species was quoted by Phillips from Barton, and by Salter from Newton, but in the first of these places it appears very rare, and it is possible

[1] 1861, Hall, 'Pal. New York,' vol. iii, p. 353, pl. lxxiii, figs. 15—25; and 1888, Hall, vol. vii, pl. viii a, figs. 19, 20.

[2] 1861, Hall, 'Description of New Species, &c.,' p. 67; and 1888, Hall, 'Pal. New York,' vol. vii, p. 14, pl. vi, figs. 1—13, 16—29, and pl. viii a, figs. 1—4.

[3] 1861, Hall, 'Desc. New Species,' p. 55; and 1888, Hall, 'Pal. New York,' vol. vii, p. 19, pl. vii, figs. 1—11, pl. viii, figs. 1—18, and pl. viii a, figs. 21—23.

that specimens of *Ph. batracheus* have been mistaken for it. In the Torquay Museum is a specimen (Plate I, fig. 9) which exactly agrees with the German fossils, but it is without a locality, and, though it looks as if it might have come from Newton, the nature of the matrix is not such as to fix it definitely. Mr. Vicary informs me that he has seven specimens, all tails, from Wolborough, one of which is figured on page 20 of Salter's Monograph. Possibly, however, some of these may belong to *Ph. batracheus*, as also in all probability does the one given by the same author as a variety of *Ph. latifrons* (loc. cit, Plate I, fig. 16). On the other hand, I can see no likeness to *Ph. cryptophthalmus* in the fossil Salter describes from Newton under that name. The authorities of the Museum of Practical Geology have, at my suggestion, cleared it from the matrix as far as possible, and I can therefore give a slightly better figure of it than before (Plate I, figs. 8, 8 *a*). The result is that I am confirmed in my opinion that *Ph. cryptophthalmus* must be removed from the English lists, and the specimen be regarded as in all probability belonging to *Ph. latifrons.* From Barton the only specimen I know is one in the Lee Collection in the British Museum, which is of rather small size and preserves the test. *Phacops latifrons*, however, occurs plentifully in the shales above the limestones at Hope's Nose, where its eye forms one of the most conspicuous fossils; and it is also found in great profusion in the Upper Devonians at Baggy Point in North Devon. From this locality a magnificent series of specimens of all sizes were collected by Prof. Hughes and his Cambridge party in 1887, and are now in the Woodwardian Museum.

Phacops latifrons is very common in the Eifel; but, although distinguished by Bronn in 1825, it has often been confused by later authors with another common species, *Ph. Schlotheimi* (Bronn), which has a much more elongated form, a larger eye, and a differently shaped glabella. I have examined large numbers of the two species in the British Museum, and feel quite convinced that Dr. Kayser and others are right in restoring Bronn's species, and that therefore the references to the latter must be removed from its synonymy. I would also follow Dr. Kayser in believing that the *P. latifrons* and *P. Bronni* of F. A. Römer are really synonyms of *P. fecundus* of Barrande, and that they too must, therefore, be removed from the list.

II. *Family.*—CHEIRURIDÆ, *Salter*, 1864.

1. *Genus.*—CHEIRURUS, *Beyrich*, 1845.

With its prominent and peculiar glabella, its indented cheeks, its small faceted eye, and its facial suture severing a large and almost right-angled free cheek, this genus is peculiarly distinctive. Including its subgenera, it contains nearly 100 species, and extends from the top of the Cambrian to the Middle Devonian.

1. CHEIRURUS PENGELLII, *Whidborne.* Pl. I, figs. 10—13, 15, 16.

1841.	CALYMENE STERNBERGII, *Phil.*	(Not *Boeck* nor *Münster.*) Pal. Foss., p. 128, pl. lvi, fig. 247.
1853.	CHEIRURUS ARTICULATUS, *Salter.*	Geol. Surv., dec. 7, pl. i, Art. 1, p. 10.
1864.	— — —	Mon. Brit. Tril., p. 61, pl. vi, figs. 7, 8.
1885.	— GIBBUS, *Rieman.*	(Pars.) Neues Jahrb., pt. 3, Beil.-Band, p. 147.
1886.	— — *Barrois.*	(Pars.) Ann. Soc. Géol. du Nord, vol. xiii, p. 172.
1888.	— ARTICULATUS, *Eth.*	Brit. Foss., pt. 1, p. 144.
1889.	— PENGELLII, *Whidb.*	Geol. Mag., dec. iii, vol. vi, p. 29.

Description.—Head large, somewhat convex, rather elongate, semioval. Glabella subquadrilateral, rather flattened, wider in front, sides diverging at an angle of about 18°, straight in profile. Front lobe short, depressed, wider than the others, the segment of a sphere; upper lobe straight, narrow; second lobe expanding into an escutcheon in the middle; basal lobes triangular, with apices *vis-à-vis*, and about one-fifth the width of the glabella asunder. Neck-lobe narrow, expanding upwards in the centre. Furrows quite crossing the glabella, broad and distinct, and of uniform depth both on the glabella and round the cheeks. Border covered and hidden by the frontal lobe, forming a curve greater than a semicircle, met at the posterior angle by the hind border of the cheeks, which runs straight across from the neck-lobe, and terminated by a short stout spine tending rather outwards and downwards. Cheeks flatly convex, bordered by steep furrows. Eye situated centrally in the anterior part of the cheek. Facial suture cutting the border close beside the frontal lobe, running straight down to the eye, and turning horizontally outwards to cut the side border at a short distance above the angle. Surface of the glabella and border bearing small, distant, sharp pustules; cheek covered with larger close pustules and punctations; furrows smooth.

Hypostome large, flattish, convex, consisting of an ovoid central portion with a lunate constriction separating its smaller end, and surrounded anteriorly by a very narrow flat ring, expanding into sharply pointed triangles at the side. The posterior half bounded by an elevated rounded border, having straight oblique sides, and being squared and bevelled behind. Surface with numerous fine and irregular granules.

Tail convex, small, short. Axis elevated, conical, of about five segments; limb with three or four large, rounded, bifurcated (?) ribs reaching to the border.

Margins spinous at the sides, inclining rapidly to each other, but turning before they meet to form two spines at the posterior end.

Size of head.—23 mm. in length, 38 mm. in width (excluding spine), and 8 mm. in depth.

Localities.—From Lummaton there are nine specimens of the head in my collection, one in the Bristol Museum, two in the Lee Collection in the British Museum, three or four in the Torquay Museum, and three in the Woodwardian Museum, in which also there is a poor but unique specimen of the tail and a small hypostome. There are also two examples of the hypostome in my collection. From Wolborough there is a single head in Mr. Vicary's Collection.

Remarks.—The specimens at our disposal have for the most part lost both their outer surface and their free cheeks, and in no case has the eye been fully preserved, though its loss seems generally due to accidental fracture. Nevertheless, these fossils are very distinctive, and present much detail, and, judging from them, this species, which has been admirably and minutely described by Salter, is subject to very little variability, and therefore minute distinctions must be considered of importance. Thus the profile of the head and the proportions of the frontal lobe seem always to remain much the same, and to give slight but constant specific characters. The single known specimen of the tail is in a far less satisfactory condition than could be desired. At first sight it appears perfectly distinct from that of any kindred species, but the margin is imperfect, and the traces of lateral spines have been obliterated. Nevertheless, even thus it affords important help.

There appears to exist much confusion with regard to the naming of this species.

Münster, in his 'Beiträge,' Pt. 3, pl. v, figures three species of *Cheirurus* under the names of *Calymene Sternbergii*,[1] *C. propinqua*,[2] and *C. articulata*.[3] With the first of these Phillips identified our Devonshire fossil. This identification Salter rejected, because in that species the furrows vanish in the centre of the glabella; but he in turn identified it with *C. articulata*, at the same time remarking that Münster's figures are evidently inaccurate, and that if accurate this identification could not stand. Neither in the 'Decades'[4] nor in his Monograph[4] does he give any indirect reason for supposing it to belong to this species. The only argument in favour of it appears to be that Barrande[5] states that he has examined the originals of Münster's figures and finds that the *C. Sternbergii* and *propinqua* of that author are probably one species, and approach his own *Ch. Hawlei*, while *C. articulata* is distinct, and belongs to the group of *Ch. gibbus;* and that Sandberger[6] identifies *Ch. gibbus* with Phillips's figure. We shall, however, show

[1] Loc. cit., p. 37, pl. v, fig. 5. [2] Loc. cit., p. 38, pl. v, fig. 6. [3] Loc. cit., p. 38, pl. v, fig. 7.

[4] See above, p. 8 (synonymy). [5] Barr., 'Syst. Sil.,' vol. i, p. 754.

[6] Sandb., 'Verst. Nassau,' p. 19, pl. ii, fig. 2.

that the two latter are distinct; and, moreover, Münster's figure of *Ch. articulata* is much more like the German, than the English fossil. From the latter it differs in the much greater length of the frontal lobe, the width of the glabella and the angle of its sides, the absence of cheek-spines, and other features. After a very careful comparison of it, Mr. T. Roberts agrees with me that in view of these differences it is best to regard it as distinct, and to adopt the alternative name which Salter suggested (*op. cit.*, p. 62), and this I have the more pleasure in doing, as it is after my old and honoured friend Mr. Pengelly, F.R.S., of Torquay.

When, however, we come to compare this with the Bohemian species, we find much greater grounds for hesitation. To two of these, *Ch. Sternbergii*[1] (Boeck) and *Ch. gibbus*, Beyr.,[2] it bears a very close likeness. Of these species there are fine examples in the British Museum, and a careful examination of them, and of Barrande's figures, shows that it stands exactly midway between. *Ch. gibbus* is a much narrower and more convex form, and has a much more distinctive appearance when judged from the whole fossil than from the head alone. In it the frontal lobe is very large and prominent, and consequently the profile of the glabella is concave instead of as in ours, roughly speaking, straight. The cheeks are also decidedly shorter and narrower. *Ch. Sternbergii*, on the other hand, has the frontal lobe still shorter and more depressed than *Ch. Pengellii*, and the profile of the glabella is definitely convex instead of straight. The eyes also appear to be situated further from the glabella, the furrows of the glabella are more oblique and shallower in the centre, the apices of the basal lobes come much closer to each other, the cheeks appear to be decidedly wider and less convex, and the margins of the hypostome are smooth. The tail appears shorter but generally very like the English fossil, which differs distinctly from that of *Ch. gibbus*. Thus, though it is quite possible that *Ch. Pengellii* may ultimately prove to be only a local variation of *Ch. Sternbergii*, the points of difference are so numerous and persistent that it could not safely be classed with it at present.

Ch. Quenstedti,[3] Barr., differs in having more oblique and less continuous furrows, and in the shape of the second lobe of the glabella and of the tail. *Ch. myops*, F. A. Römer,[4] has a much more triangulated head, a much squarer glabella, and a smaller eye. Its hypostome also seems differently shaped. *Ch. gibbus*, as figured by Sandberger, also differs in several respects; the front lobe is longer, the sides of the glabella more oblique, the lobes of the glabella more arched, and the basal lobes much nearer together.

[1] 1852, Barr., 'Syst. Sil.,' vol. i, p. 795, pl. xli, figs. 29—39, and Supplement, p. 94, pl. xii, figs. 8—15, Étages E—H.

[2] 1852, Barr., 'Syst. Sil.,' vol. i, p. 792, pl. xl, figs. 35—39; pl. xli, figs. 17—27; and pl. xlii, figs. 12—15, Étages F and G.

[3] 1852, Barr., 'Syst. Sil.,' vol. i, p. 790, pl. xl, fig. 13; and pl. xlii, figs. 2, 3, 4, Ét. E.

[4] 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 65, pl. x, fig. 8; and pt. 3, p. 24, pl. 20, fig. 6.

2. CHEIRURUS STERNBERGII ? *Boeck*, Pl. I, figs. 14, 14 *a*.

1825.	PARADOXIDES ?, *Sternberg*.			Verhandl. Gesell. vaterl. Mus. Böhmen, p. 85, pl. i, fig. 5.
1828.	TRILOBITES STERNBERGII, *Boeck*.			Mag. Naturvid., vol. viii, p. 37.
1843.	—	—	*Burm.*	Org. Tril., Ray Soc., p. 115, pl. iii, figs. 7, 8.
1845.	CHEIRURUS	—	*Beyr.*	Ueb. böhm. Trilob., p. 15, fig. 4.
1846.	—	—	*Barr.*	Notice prelim., p. 86.
1846.	—	GIBBUS,	*Beyr.*	Unters. üb. Trilob., pt. 2, p. 3, pl. iv, fig. 5.
1847.	—	STERNBERGII,	*Hawle and Corda.*	Abhand. Böhm. Gesell., Band 5, p. 251.
	—	AFFINIS,	—	Ibid., p. 252.
1852.	—	STERNBERGII,	*Barr.*	Syst. Sil. Bohèm., vol. i, p. 795, pl. xli, figs. 29—39, Étages E—H.
1872.	—	—	—	Syst. Sil. Bohèm., vol. i; Supplement, p. 94, pl. xii, figs. 8—15.

A fragmentary specimen from Lummaton in my collection is, in the opinion of Mr. Roberts, probably different from the Cheirurus commonly found there. In this opinion I coincide; and, on the other hand, I can see no difference, as far as the evidence goes, between it and *Ch. Sternbergii* (Boeck), as figured and described by Barrande.

The specimen consists of the upper part of a glabella. The frontal lobe is short and receding, and somewhat flattened at the sides; the frontal and median furrows are oblique and shallow in the centre, and the profile is convex. In all these points it differs from *Ch. Pengellii*, and it is, moreover, very much larger than the largest known specimens of that species.

The evidence is, however, too slight for positive identification, and it will be interesting to see whether it is borne out by any specimens that may be found in future.

Cheirurus Sternbergii is the type species of the genus. It was originally figured and described by Count Sternberg in 1825 from a Bohemian fossil, and the name was attached to it by Boeck in 1827. It is very different from the species figured under this name by Münster in 1840, and very much more like *Ch. Pengellii*, although it disagrees with that species in numerous details.

III. *Family.*—ACIDASPIDÆ, *Barrande*, 1852.

1. *Genus.*—ACIDASPIS, *Murchison*, 1839.

This genus, the only one in its family, was established by Murchison, but not fully defined by him, and foreign authors have occasionally adopted the alternative name of *Odontopleura*, Emmrich. The trilobation of the head is rendered obscure by the presence of longitudinal markings giving with the transverse furrows a very complicated pattern. The head is generally very wide, and the tail small. The profusion of long fine spines on the borders, the ribs, the neck, and other parts of the body, renders it a remarkably conspicuous genus.

1. Acidaspis Robertsii, *Whidborne.* Pl. I, figs. 17, 17*a*.

1889. Acidaspis Robertsii, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Head-shield small, wide, rather flat. Glabella long, depressed, almost quadrilateral, rather wider behind, reaching to the border in front, and extending half as far again as the cheeks behind; crossed by three straight, shallow constrictions, apparently representing the frontal, ocular, and neck furrows, the first of which is barely visible, and is close to the front margin. Immediately in front of each of these constrictions, a pair of warts appear near the sides of the glabella, which might have borne small spines. On each side of the rear of the neck-lobe, two slender, flatly set spines, which are longer than the glabella, and in the centre just in front of them a tubercle which apparently bore a spine set more perpendicularly. Border raised, rather straight and oblique in the front part, turning suddenly midway, and becoming almost concave just before the angle; in outline slightly sinking on each side. Cheeks irregularly convex, divided into two nearly equal parts by a raised curved line, running from the front of glabella, and terminated at the hind margin apparently by an elevated spine; the part of the cheek on each side of this being concave; the part beyond it becoming a groove at the angle, which seems also to have borne a spine; and the part within it joined to the glabella by three rounded processes sloping obliquely backwards to it, and leaving deep pits between them. Hind margin of cheeks defined by the last of these processes, assuming the shape of an inverted W.

Size.—Length of glabella 12 mm., length of cheek 8 mm., width of head to base of cheek-spine 20 mm.

Locality.—A single specimen was found at Lummaton by Mr. Thomas Roberts, F.G.S., and was presented by him to the Woodwardian Museum.

Remarks.—Mr. Roberts' specimen is very far from perfect, and indeed, but for the careful way in which he has developed it, would have been impossible to identify. The outside edge of the border is gone, so that it gives no evidence whether, like *A. lacerata,* it carried spines. There is no trace of the position of the eye, but probably it was borne on the end of the long spine or stalk at the base of the central line of the cheek, as in that species. The hind border of the cheek or lateral process of the neck-lobe is also invisible or absent.

The only foreign species which seems to approach it at all closely is *Acidaspis lacerata* of Barrande,[1] which, indeed, comes so near to it that I was at first in much doubt whether the latter ought not to be regarded as a variety. The chief difference appears to be in the greater width of the head in our species, and the angularity of the border, though it is possible that these points may be accentuated by the defective character of the specimen. The slight groove at the latero-posterior angle is also not seen in Barrande's figure, and would at once be a good distinctive mark were it not possible that the upper layer of the test, which appears to be wanting in our fossil, might not reproduce it. This also might account for the greater rotundity of several of the protuberances in the foreign fossil, but not, I think, for the constrictions and much greater flatness of the glabella; nor does it seem to me that the contour of the posterior part of the cheek could have agreed with it had it been present. The median line of the cheek is much more elevated and longer, the rear spines seem much greater, and the specimen is more than twice the size of Barrande's. I have therefore little hesitation in regarding it as a distinct species, and I have much pleasure in giving it the name of its discoverer, to whose kindness and acuteness I owe so much in my effort to work out the fauna of these beds.

From most of the other species of Acidaspis it is at once distinguished by the forked spines of the neck-lobe. Of those that possess them *A. mira*,[2] Barr., has a much more tumid and sloping glabella, and a more squared cheek, the angularity noticed in our fossil being present, but much more to the rear. *A. Prevosti*,[3] Barr., has no other large tubercles or spines on the glabella, and the cheeks are altogether deeper and rounder. In *A. Dufrenoyi*,[4] Barr., the cephalic shield is much more elongate and elliptic. *A. Verneuili*,[5] Barr., and *A. vesiculosa*,[6] Beyr., have margins swollen at the sides, so as to give quite a different contour to the head.

2. Acidaspis pilata, *Whidborne*. Pl. I, fig. 18.

1889. Acidaspis Hughesii,[7] *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Pygidium small, flat, semicircular. Axis broad, last segment forming an ovoid, shallow depresssion filled with two small spherical knobs nearly

[1] 1852, Barr., 'Syst. Sil.,' vol. i, p. 746, pl. xxxix, figs. 18, 19, Ét. F.

[2] Ibid., p. 735, pl. xxxix, figs. 1—11, Ét. E.

[3] Ibid., p. 739, pl. xxxix, figs. 33—41, Ét. E.

[4] Ibid., p. 741, pl. xxxviii, figs. 25, 26, Ét. E.

[5] Ibid., p. 710, pl. xxxviii, figs. 1—9, Ét. E.

[6] Ibid., p. 715, pl. xxxviii, figs. 13—21, Ét. F.

[7] Mr. Marr points out that Salter has catalogued, without description, a widespread Lower-Silurian Trilobite under this name. In order, therefore, to avoid confusion, I have renamed the Devonian species, although a merely catalogued name has no rightful validity.

touching and with short necks behind, surrounded by a flat limb, very narrow at the back, but dilate at the sides, which is slightly excavate and reaches some distance in front of the spheres. Anterior side straight, bearing a spine pointing forward at the corner. Border bearing sixteen large, and apparently very long spines.

Size of Pygidium.—14 mm. in width, 7 mm. in length.

Locality.—Lummaton. A single specimen in my collection.

Remarks.—This little fossil for a long time caused me much perplexity. It is in an imperfect and obscure condition, and it was only by reference to foreign species that its true character could be made out. However, it has proved to be extremely similar to *Arges radiatus*, Goldf.,[1] differing, nevertheless, as far as can be ascertained, in various particulars. It is decidedly narrower, the excavate sides come at least twice as far forward as the two spheres, leading to the impression that the latter are comparatively smaller in the English species; the spines too, in our fossil, seem decidedly stouter and longer, and though they are in all cases broken, so that it is impossible to say how much longer they were, probably the difference was great, as they show no signs of tapering; lastly, there seems to be a spine situate on the front margin, close to the lateral angle. The German species is also described by Barrande[2] from his Étages E. and F. of Bohemia, where he states it to be very rare. His figure exactly corresponds with that of Goldfuss, except that he gives the first segment of the axis, which is not seen in our, or the German, fossil.

Acidaspis radiata is the only fossil that could be mistaken for our species, the tails of Acidaspis generally being formed on a very different plan. But it is pointed out by Barrande, and it is interesting to notice, that there are approximations to the bilobed form in one or two other species. In *Acidaspis Portlocki*,[3] Barr., from Étage E, are two large and definite swellings behind the last segment. In *A. vesiculosa*,[4] Beyr., Étage F, similar swellings are visible, but of a much smaller size; in *A. minuta*,[5] Barr., Étage E, they are reduced to two large tubercles upon the last segment; and in *A. Leonhardi*, Barr.,[6] Étage E, and *A. Dufrenoyi*,[7] Barr., Étage E, they become merely small granules or dots. Under these circumstances it becomes a question how far these variations are to be regarded as specific only, and, if a distinct genus is to be formed, how many adjacent species it should conclude. This question can be ultimately decided only when the perfect animal is found, but in the meantime we may consider *A. pilata*, *A. radiata*, and *A. Portlocki* to belong to a single group.

[1] 1843, Goldf., 'Neues Jahrb. für Min.,' 1843, p. 544, pl. iv, fig. 1.

[2] 1852, Barr., 'Syst. Sil. Boh.,' vol. i, p. 749, pl. xxxix, fig. 24.

[3] Ibid., p. 744, pl. xxxviii, fig. 10—12.

[4] Ibid., p. 715, pl. xxxviii, fig. 13—21.

[5] Ibid., p. 729, pl. xxxvii, figs. 18—22.

[6] Ibid., p. 720, pl. xxxvii, figs. 1—11.

[7] Ibid., p. 741, pl. xxxviii, fig. 25, 26.

There is, of course, a possibility of this species, of which only the tail is known, proving to be the same as *A. Robertsii*, of which only the head has been found; but, as there is nothing to indicate their identity except the occurrence of single specimens of each in the same locality, and as the genus is a very large one, it seems safest to follow Barrande in his treatment of the kindred species *A. lacerata* and *A. radiata*, and to regard them as being, as in all probability they are, separate species.

IV. *Family.*—Lichadæ, *Barrande.*

1. *Genus.*—Lichas, *Dalman*, 1826.

While this genus presents many points of likeness to *Acidaspis* it is very easily distinguished therefrom. It is notable for the complicated furrows of the glabella, the frontal pair of which become longitudinal, for its large expanded tail, and for the leaf-like character of its ribs and spines. It belongs chiefly to the Lower Silurian or Ordovician system, only a few species occurring in the Devonian.

1. Lichas Devonianus, *Whidborne.* Pl. I, figs. 19, 19 *a*, 19 *b*.

1889. Lichas Devonianus, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Head very wide, short, and swollen, depth as great as its length, ornamented with distant rounded tubercles irregular in size. Glabella oblately spheroidal, very abnormal in the arrangement of the lobes; frontal furrow becoming two parallel straight lines separating a long, narrow, longitudinally and transversely convex frontal lobe, except close to the front border, where they arch rapidly outwards so that the front lobe ends in two horn-like points. The second furrow running from the neck to the border at an angle of about 45°, so that the median ring of the glabella becomes two large convex lobes almost equal in size to the front lobe, and in shape spherical triangles. Basal ring represented by two small transverse tubercles at the base of the median lobes. Cheek rather larger and flatter than the median lobe, widely triangular in shape, and bearing near its front a large and very elevated and oblique eye, which is surrounded by a smooth concavity followed by a circle of large tubercles. Facial suture cutting the border obliquely just outside the median lobe of the glabella, and proceeding on a smooth raised ridge of the same obliquity up to the eye, after which it tends more outwards, and, running almost horizontally, cuts the hind border close behind the cheek-spine.

Free cheek small, bearing the short, thick cheek-spine. Border prominent, deep, circular in section, preceded by a furrow where not actually overhung by the glabella, and ornamented by three strong grooves between sharpish ridges. Neck-lobe very broad and arched, extending half-way behind the fixed cheek. Lateral processes of the neck bent rather forward. Outer layer of test thick.

Size of Head.—10 mm. in length, 32 mm. in breadth, 8 mm. in depth.

Locality.—Lummaton. I have obtained three specimens, and there is another in the Lee Collection in the British Museum.

Remarks.—The specimen figured is the only one that shows the characters well. It originally retained the eye, but this was accidentally destroyed before it was figured, and that part has therefore been restored from a rough drawing I had made. This fossil had been a little distorted by pressure, and consequently may appear to be rather wider than it actually is. The extremity of the cheek is also very much obscured, and is consequently difficult to understand exactly.

The only Bohemian species which at all resembles it is *Lichas Haueri*, Barr.,[1] but it differs from that species in most of its details. For instance, the border is stronger, and is grooved instead of punctated, the head is much wider, the frontal lobe ends suddenly at the deep suture instead of sloping evenly to it, the lateral processes of the neck-lobe are oblique instead of horizontal, the eye seems larger and bordered by tubercles, the median lobes come much nearer the neck, and the inner points of the cheeks are attenuated instead of blunt. But though clearly distinct, the two species are analogous, and it is interesting to note that *Lichas Haueri* is the only species which Barrande describes from his zone F, which is regarded by Prof. Hughes, Mr. Roberts, Mr. Marr, and others as belonging to the Devonian epoch. No part of either the body or tail is known.

Lichas granulosus, F. A. Römer,[2] belongs to the same group, but in it the glabella is much larger and more elevated, the cheeks smaller, and the head much less transverse. *L. meridionalis*, Frech,[3] appears, as far as can be judged from the description, to have a shorter glabella, more angulated profile, and smaller side-lobes; these Languedoc specimens, however, seem to have been very fragmentary, and no figure is given by the author.

Some American species seem to approach *Lichas Devonianus* more nearly than the Continental. *Lichas* (*Arges*) *contusus*, Hall,[4] agrees with it in the shape of its frontal lobe, but it is a flatter and much less transverse species and the fixed cheeks are situate more in the rear of the side-lobes of the glabella. In *L. hylæus*,

[1] 1852, Barr., 'Syst. Sil.,' vol. i, p. 604, pl. xxviii, figs. 38—44, Ét. F.

[2] 1852, F. A. Röm., 'Beitr.,' pt. 2, p, 85, pl. xiii, fig. 3, and pt. iii, p. 24, pl. v, figs. 8, 9.

[3] 1887, "Palæoz. Bildungen von Cabrières," 'Zeitsch. der deutsch. geol. Gesell.,' Jahrg. 1887, p. 465.

[4] 1888, 'Pal. N. Y.,' vol. vii, p. 83, pl. xix B, figs. 3—6.

Hall,[1] the frontal lobe is much larger compared with the size of the head, and has more arched sides, and the cheeks are very small; and in *L. Bigsbyi*,[2] which is a much more conical form, the frontal lobe is wider and more globose. In the British Silurian *L. anglicus*, Beyr., and *L. Salteri*, Fletcher,[3] the frontal lobe is of a less rectangular shape, and the arrangement of the cheek in regard to the neck-lobe is different.

V. *Family.*—PROËTIDÆ, *Barrande.*

1. *Genus.*—CYPHASPIS, *Burmeister*, 1843.

This genus is defined by its tumid and deeply furrowed head, its small and elevated almond-shaped eyes, its numerous body-rings, and its long aciculate spines. It occurs in the Silurian and Devonian. *C. ceratophthalma* which Goldfuss described under his genus *Gerastus* is the type species.

1. CYPHASPIS OCELLATA, *Whidborne.* Pl. I, figs. 20—22, and Pl. II, fig. 18.

1889. CYPHASPIS OCELLATA, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Body small and tumid. Cephalic shield wide, very convex, deeply grooved. Border prominent, elevated, bearing irregular tubercles; in outline slightly convex in front, curving rapidly round the free cheeks, coming straight to the angle, and thence continued in a long, straight, or sabre-shaped spine; in elevation, high in the rostral part, and sweeping down rapidly till its horizontal direction has changed. Glabella small, extremely prominent, egg-shaped, raised much above the rest of the head, without furrows, covered with fine, sharp-headed tubercles. Neck-furrows broad, enclosing a small lateral lobe or tubercle. Neck-lobe lower than the glabella, broad, short, flattened, much arched. Lateral processes of the neck concave toward the cheek. A wide tumid area between the frontal lobe and the border extending round and swelling out to form the cheek, on the summit of which is placed the eye, which is smooth and globular, and rises on a kind of stalk almost as high as the glabella, and rather near to it, but sloping outwards. Surface of cheek marked with a few large nodules round the base of the eye, and on the rest of it a few others interspersed with small granules and ridges (and pits), the two latter predominating in the groove before the border.

[1] 1888, Hall, 'Pal. N. Y.,' vol. vii, p. 81, pl. xix B, figs. 1, 2, and pl. xxv, fig. 5.

[2] 1859, Ibid., vol. iii, p. 364, pl. lxxvii, figs. 1—8, and pl. lxxviii, figs. 5, 6.

[3] 1852, Fletcher, 'Quart. Journ. Geol. Soc.,' vol. vi, p. 257, pl. xxvii, fig. 9, and pl. xxvii bis, fig. 4.

Suture cutting the border very obliquely in front, thence turning rather inwards as it runs up to the eye, and from the back of that tending straight outwards till it meets the border close behind the angle.

Thorax (and tail) unknown.

Size of Glabella.—The largest specimen I have seen measures 11 mm. in length without the spines, which are 4 mm. long. It is 16 mm. in width and 9 mm. in depth.

Localities.—From Lummaton I have obtained forty or fifty specimens, and others were collected by Prof. Hughes and his party of Cambridge geologists during their recent visit to Torquay, and are now in the Woodwardian Museum. There is a specimen from Wolborough in Mr. Vicary's collection.

Remarks.—This beautiful little species is perhaps the commonest Trilobite at Lummaton, but I have not been successful in finding any specimens of its pygidium. The large rounded concavities that line the glabella and the border, as well as its general shape and peculiar markings, render fragments of it readily recognisable. The setting of the cheek-spine is noticeable ; there seems at least in some instances to be a small notch between it and the corner of the cheek, so that it would appear to start from its side rather than from its angle. The substance of the border seems very massive, but in other parts the test is thin. It appears to be a species which is not liable to great variations. At all events the specimens, fragmentary as they are, seem always to present much the same contours.

Among the German species there do not seem to be any that are very liable to be confused with the present form. The one which comes nearest to it is *C. ceratophthalma* as given by Sandberger.[1] Supposing his figure to be accurate, it differs in two important particulars. It has no vestige of cheek-spines and the lobe of the glabella decidedly overhangs the margin, whereas in the English fossils it ends considerably behind it. There seems, however, no little complication in respect to the German forms of this genus. Sandberger identifies his fossil with *Phacops ceratophthalmus*, Goldf.,[2] and *Calymene hydrocephala*, F. A. Röm.,[3] following Burmeister in uniting these two species. However, as far as it is possible to judge from drawings, they appear to agree neither with each other, nor with Sandberger's, nor with our own. Goldfuss's original *P. ceratophthalmus* is reproduced by F. Römer[4] under the name *C. Burmeisteri*, Barr.[5] (which certainly seems far less like it than several of Barrande's species), evidently under the belief that Goldfuss has figured his specimen with its head curled forwards. Burmeister's[6] figure, how-

[1] 1850, Sandb., 'Verst. Rhein. Nassau,' p. 23, pl. ii, fig. 4.

[2] 1843, Goldf., 'Neues Jahrb. für Min., &c.,' p. 564, pl. v, fig. 2.

[3] 1843, F. A. Röm., 'Verst. Harzgeb.,' p. 38, pl. xi, fig. 7.

[4] 1876, Ferd. Röm., 'Lethæa Pal.,' pt. 1, pl. xxxi, fig. 6.

[5] 1852, Barr., 'Syst. Sil. Bohèm.,' vol. i, p. 484, pl. xviii, figs. 61—71.

[6] 1846, Burmeister, 'Org. Trilob.,' Ray Soc., p. 98, pl. iii, figs. 3 and 4.

ever, while coming nearer to Sandberger's and probably being more correct, retains the distinctive features of Goldfuss's; the overhanging glabella, the forward eye, and, most of all, the little pit just inside the latero-posterior angle of the cheek, to which both he and Goldfuss draw particular attention. He states his figure to be a restoration from several poor specimens. From our species it differs in the before-mentioned particulars. Coming to Römer's *C. hydrocephala*, we find better figures given by himself in his 'Beiträge,' pt. 3, p. 7, Pl. 16, fig. 11, and by Kayser,[1] than the original one which is quoted by Sandberger, and these show that it has altogether a wider head with a differently shaped cheek, a wider and more rounded glabella, and other differences; and Kayser strongly insists that it is distinct. He, on the other hand, unites with it a Bohemian form, *C. clavifrons*, Barr.[2] (not Dalm. nor Burm.), ultimately united by Barrande with *C. Barrandei*,[3] Corda. This differs from our species in having the glabella much more overhanging the front border, the space in front of it more perpendicular, and the cheek-spines much longer. The other species given by Römer in his 'Beiträge' are very different from the English one.

In *C. Hallii*, Barr.,[4] the glabella is shorter, the head is smooth, and the eyes more sessile. In *C. Cerberus*, Barr.,[5] and *C. Davidsoni*,[6] Barr., the border of the head is toothed. *C. convexa*,[7] Barr., is a narrower and less elevated form, and this is still more the case in *C. humillima*, Barr.,[8] and in *C. novella*, Barr.[9] Lastly, *C. Burmeisteri*, Barr.,[10] differs from our English species in the opposite direction to *C. Barrandei*, the glabella being smaller, the front area wider, and the surface of the head smoother. Moreover, all of the Bohemian species have the lateral processes of the neck-lobe nearly straight, and are distinctly different in the general contour of the head from our English form.

C. Belloci, Barrois,[11] has a narrower head and much longer cheek-spines which arch outwards. *C. megalops*, M'Coy,[12] of the British Silurian, is much more circular in the outline of the head, and has a smaller glabella and much more prominent eyes.

1 1878, Kayser, 'Abhandl. des geol. Specialk. Preussen,' Band 2, pt. 4, p. 17, pl. i, fig. 12, and pl. iii, figs. 16—18.

2 1846, Barr,, 'Notice prélim.,' p. 77.

3 1852, Barr., 'Syst. Sil. Bohèm.,' vol. i, p. 486, pl. xviii, figs. 38—48, Ét. F. and G.

4 Ibid., p. 483, pl. xviii, figs. 35—37, Ét. E.

5 Ibid., p. 489, pl. xviii, figs. 49—51, Ét. F.

6 Ibid., p. 490, pl. xviii, figs. 54—56, Ét. F.

7 Ibid., p. 490, pl. xviii, figs. 52, 53, Ét. G.

8 Ibid., p. 492, pl. xviii, figs. 57, 58, Ét. E.

9 Ibid., p. 491, pl. xviii, figs. 59, 60, Ét. E.

10 Ibid., p. 484, pl. xviii, figs. 61—71, Ét. D. (colony) and E.

11 1883, Barrois, 'Ann. Soc. géol. Nord,' vol. x, p. 155, pl. vi, fig. 2; and 1886, ibid., vol. xiii, p. 136, pl. ii, fig. 3.

12 1846, M'Coy, 'Syn. Sil. Foss. Ireland,' p. 54, pl. iv, fig. 5.

An American species, *C. craspedota*, Hall[1], which has much resemblance to it, differs in having a narrower head and more oblique cheek-spines, besides having a central neck-spine, and eyes which slant more backwards than in the English species.

2. *Genus.*—Proëtus, *Steininger*, 1831.

Founded for a Devonian Trilobite, *P. Cuvieri*, Stein., and others which had formerly been included in Calymene, this genus is defined by being of an oval shape, with entire borders, with large rounded eyes, and generally with ten thoracic segments. It extends from the Lower Silurian to the Carboniferous.

1. Proëtus batillus, *Whidborne*. Plate I, figs. 23—26, and Plate II, figs. 1—4.

1841. Calymene, sp., *Phil.* Pal. Foss., p. 230, pl. lviii, figs. 249 *a, c* (only).
1889. Proëtus batillus, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 28.

Description.—Cephalic shield wide, flattish, with thick dense test in two (or three) layers, nearly semicircular in outline, with stout, straight, conical cheek-spines sometimes of considerable length. Border large, prominent, and rounded, marked with six or seven slightly sinuous ridges, continued on the cheek-spines. Glabella flattened; in profile somewhat convex in front, straight behind; in outline nearly square, rounded in front where it reaches the border, slightly concave behind, with steep sides, minutely and closely granulated. Neck-furrow linear, with a minute prominence at each extremity. Neck-lobe very broad, long, and arched, showing numerous very fine transverse lines where the two outer layers of test are removed. Lateral processes of the neck-lobe sloping backwards. Facial suture cutting the front border obliquely, thence extending close to the glabella, and scarcely arched at the eye-lobe, turning outwards at the marginal furrow of the cheek, and cutting the hind margin not far from the glabella. Eye long, smooth, rounded, situated in the middle of the cheek close to the glabella, bounded below by a linear furrow. Cheek beginning just in front of the side part of the glabella, slightly tumid, bounded all round by a furrow which is linear in front, and steep and excavated at the hind margin; a similar but shallower furrow round the eye.

First segment of thorax granulated.

[1] 1888, Hall, 'Geol. N. Y.,' vol. vii, p. 148, pl. xxiv, figs. 15—20.

Tail short, flat. Axis large, conical, very elevated, not quite reaching the border, with six well-defined rings, each bearing a prominent tubercle in the centre, and one or two obscure warts on the sides. Limb almost flat, with a shallow depression running round within the border, which latter forms a small segment of a circle, and is marked with one or two raised striæ. Four or five indistinct segments on limb, which reach quite to the border.

Size of Head.—11 mm. in length, 18 mm. in width, 6 mm. in depth.

Size of Tail.—8 mm. in length, 14 mm. in width, 4 mm. in depth.

Localities.—This little species occurs at Lummaton, where it is commoner than any other Trilobite, with the exception, perhaps, of *Cyphaspis ocellata.* A single example from Wolborough is in Mr. Vicary's collection.

Remarks.—Generally speaking the individuals of this species are of very small size (Plate I, fig. 26); and, as a rule, the only part remaining is the detached glabella, which frequently wants the outer layer of the test. In this condition the surfaces of the glabella and the border are smooth. It is, however, easily recognisable, and does not seem to vary to any appreciable extent. The flatness and compactness of the head, and the extreme length of the neck-lobe are among its most prominent features. The eye is large and long, being at least half the length of the cheek, and is of a perfect kidney-shape and without the slightest trace of lenses. The edge of the cheek is turned up round it in a short even fold defined by the two furrows mentioned above. The cheek-spines seem to vary considerably in length with age, as also does the obliquity of the neck. Remains of the thorax or tail are very rare. One of Mr. Champernowne's specimens shows a portion of the first thoracic segment, the axis of which is seen to be very wide and covered with granules which are larger and more defined than those of the head. It is with some hesitation that I refer the tails above described to this species, but the pygidia of some species of *Proëtus* described by Barrande appear to give reasons for so doing. I only know of three specimens, two in my collection and one in the Torquay Museum; and why they should be so much rarer than the heads is difficult to explain. The more convex type of pygidium referable to *Proëtus* is decidedly more common at Lummaton, but there seems no reason for doubting that these all belong to *P. audax.* On the other hand, in several other Lummaton Trilobites the same rarity of the pygidium is observable. Thus I know of only a single specimen of the tail of *Cheirurus*, only one of *Harpes*, and none at all either of *Cyphaspis* or *Lichas.*

Barrande describes thirty-five species of this genus from Bohemia, of which twenty-four belong to his Étage F. To none of these can these species be referred, and only two or three approach it at all nearly. It differs from all (except *P. Bohemicus*) in having a small lateral tubercle or lobe between the frontal lobe and neck, and in the extreme length of the neck-lobe. Moreover, in

P. venustus[1] and in *P. complanatus*,[2] Barr., which are the most similar, the glabella does not quite touch the border and is somewhat narrower, and the eye is set less forward. The pygidia of these two species are very similar to those we have referred to the present species. The axis of the pygidium of *P. eremita*, Barr.,[3] is much more conical, and the outline of that of *P. curtus*, Barr.,[4] is wider. *P. Bohemicus*, Barr.,[5] and *P. myops*, Barr.,[6] are the only Bohemian species that agree with it in the glabella reaching the border; but the first of these differs in being much more convex, and in having minute cheek-spines and a more rounded eye, and the second in having no cheek-spines, a very short neck-lobe, and in being very much wider. In *P. superstes*, Barr.,[7] the glabella is much smaller and does not approach the border, and the eye is large.

Neither *P. Barrandei*, F. A. Röm.,[8] nor *P. orbicularis*, F. A. Röm.,[9] can be mistaken for our species; not only have they more rounded glabellæ and much longer cheek-spines, but they differ from it in many other respects. In *P. pictus*, Giebel,[10] the glabella seems much narrower and more rounded.

Of American forms *P. canaliculatus*, Hall,[11] *P. Rowi*, Hall,[12] and *P. Prouti*, Hall,[13] all differ from the present form in having the glabella narrower and more triangular. The latter may also be distinguished by its broad, flat border.

Professor Phillips has figured a fragment of the head-shield of this species, but without giving either description or locality.

2. Proëtus subfrontalis, *Whidborne*. Pl. II, figs. 11, 12.

1889. Proëtus subfrontalis, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Head moderately convex, smooth, and small. Glabella finely granulated, flattened, highest behind, indistinctly depressed along the centre of

1 1852, Barr., 'Syst. Sil. Bohèm.,' vol. i, p. 467, pl. xvii, figs. 1—6, Ét. E.

2 Ibid., p. 463, pl. xvii, figs. 34—41, Ét. F.

3 1878, Kayser, 'Abhandl. geol. Specialk. von Preussen,' Band 2, pt. 4, p. 15, pl. i, fig. 2—4; 1852, Barr., 'Syst. Sil. Bohèm,' vol. i, p. 462, pl. xvii, figs. 9, 10, Ét. F.

4 1852, Barr., 'Syst. Sil. Bohèm,' vol. i, p. 462, pl. xvii, figs. 7, 8, Ét. F.

5 Ibid., p. 452, pl. xvi, figs. 1—15, Ét. F.

6 Ibid., p. 442, pl. xv, figs 20—22, Ét. F.

7 1878, Ibid., vol. i, Supplement, p. 16, pl. xvi, figs. 4, 5, Ét. G.

8 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 20, pl. iii, fig. 33.

9 Ibid., p. 20, pl. iii, fig. 34.

10 1855, F. A. Röm., 'Beitr.,' pt. 3, pl. xvi, fig. 13.

11 Hall, 'Pal. N. Y.,' vol. vii, p. 107, pl. xx, figs. 10 and 11, and pl. xxiii, figs. 10, 11.

12 Ibid., p. 119, pl. xxi, figs. 2—6, 24—26, and pl. xxiii, figs. 24—29.

13 Ibid., p. 126, pl. xxiii, figs. 16—18.

each side ; nearly square, bluntly angulated and rather broader behind, circular in front; separated from the border by a wide tumid area defined by two distinct grooves, the innermost of which is continued as a deep groove to form the sides of the glabella ; frontal (and possibly other) furrows indicated by slight scars ; neck-furrow distinct, linear, bow-shaped, separating two lateral nodules ; neck-lobe very long, arched, with flattened surface, replaced on the sides by the before-mentioned nodules, inner layer with fine, close, transverse striæ. Border very prominent, rounded, concentrically striated, very convex in front.

Size.—Length of head 12 mm., depth 7 mm.

Localities.—Two species in my collection are from Lummaton; one in the Torquay Museum is probably from Wolborough.

Remarks.—These small heads differ from those of the common *Proëtus* of Lummaton by being more convex than is usual with that species, and by having a definite convex area in front of the glabella, so as to give in profile a step-like appearance, similar to that seen in *P. frontalis*,[1] Barr., from which species, however, it differs in its squarer glabella. In *P. unguloides*,[2] Barr., this area is broader, and the lobe of the glabella much smaller; in *P. complanatus*,[3] Barr., the latter is small and flat; and in *P. intermedius*,[4] Barr., it is much smaller, and the neck-lobe is narrower. In *P. pictus*, Giebel,[5] also the frontal area appears larger and flatter, and the glabella more squared in front and with more oblique sides ; F. A. Römer's figure,[6] however, of that species, evidently incorrect, comes nearer to it. In the present form the general shape of the glabella is the same as that of the common Lummaton species, from which, however, Mr. Marr concurs with me in regarding it as distinct. One of the specimens retains the cheeks, but they are too indistinct for description.

3. Proëtus Champernowni, n. sp. Plate II, figs. 13, 14.

Description.—Pygidium small, convex, semicircular, smooth. Axis elevated, very conical, about three-quarters of the length of the tail, bounded by a slight groove, terminated steeply behind, and there followed by a slight swelling towards the margin. Rings of the axis nine, decreasing rapidly, each bearing a distinct central, and the first three or four indistinct lateral tubercles close to the groove.

[1] 1852, Barr., 'Syst. Sil.,' vol. i, p. 440, pl. xv, figs. 10—14, Ét. F.

[2] Ibid., p. 443, pl. xv, figs. 23—27, Ét. F.

[3] Ibid., p. 463, pl. xvii, figs. 34—41, figs. 31—33, Ét. E and F.

[4] Ibid., p. 464, pl. xvi, figs. 31—33, Ét. E.

[5] 1858, Giebel, Sil. Faun. Unterharz., p. 6, pl. ii, fig. 7.

[6] 1855, F. A. Röm., 'Beitr.,' pt. 3, pl. xvi, fig. 13.

Articulation to the thorax assuming the form of a less elevated ring, with a central tubercle. Limb convex centrally, but becoming definitely concave near the border, which is raised and linear; bearing seven ribs divided into two elements, of which the anterior is indistinct and vanishing, and the posterior sharp, narrow, and becoming stronger and reflexed as it crosses the concavity to the border, which it reaches, thus dividing the tail into wide triangular hollows.

Size.—5 mm. long, by 10 mm. wide, and 3 mm. high.

Locality.—Lummaton. There are two specimens in my collection; and another, obtained by Prof. Hughes' party, is in the Woodwardian Museum.

Remarks.—I should not have regarded these curious little fossils as belonging to the genus *Proëtus*, were it not that they bear a very close resemblance to some very rare Bohemian species which Barrande has described from their pygidia, and has referred to it. They differ very widely from its more ordinary types of tail, and when further portions of the animals are found it is quite possible that it may become necessary to remove them from it. At present, however, I know no other genus to which they could be united, and the material at hand is altogether too scanty to form a new one. In the slightly "bottle-neck" shape of the axis and the sharp distant ribs reaching the margin, they present some analogies to *Dalmanites*, but in that genus the segments are generally much more numerous, and the tail acuminate.

We might, perhaps, trace some faint similarities to the distant family of the *Asaphidæ*, but the most interesting resemblance is to the *Bronteidæ*, to which the contour of the limb, the number of the ribs, and the tilted margin give a slight, but not insignificant approximation.

Of the Bohemian species by far the nearest to our English fossil is *Proëtus gracilis*, Barr.,[1] which approaches it in most particulars, and is evidently closely allied, but may be distinguished by its greater convexity, its closer ribs, the anterior portions of which are more rudimentary and the posterior parts not so strong laterally, and by its less elevated margin. *P. inæquicostatus*, Barr.'[2] has a much broader axis, a depressed margin, and the two elements of the ribs equally elevated; *P. natator,* Barr.,[3] has a shorter axis and fewer and more obscure ribs; and *P. latens*, Barr.,[4] and *P. eremita*, Barr.,[5] have also a shorter axis with fewer ribs and a depressed margin, and are granulated.

[1] 1852, Barr., 'Syst. Sil. de Boh.,' vol. i, p. 449, pl. xv, figs. 47—49, Ét. F. and G.

[2] Ibid., p. 449, pl. xv, figs. 45, 46, Ét. F.

[3] Ibid., p. 460, pl. xvi, figs. 36, 37, Ét. F.

[4] Ibid., p. 451, pl. xv, figs. 52, 53, Ét. F.

[5] Ibid., p. 462, pl. xvii, figs. 9, 10, Ét. F.

4. Proëtus audax, *Whidborne*. Pl. II, figs. 5—10.

1841. Calymene granulata (pars), *Phil.* Pal. Foss., p. 128, pl. lvi, fig. 248, *m* and *o* only.
1889. Proëtus audax, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Contour very tumid. Glabella large, very prominent, heart-shaped, without indentations, narrowest in front, nearly equal in length and depth, reaching or overhanging the border, but separated from it by a deep linear groove; coarsely tuberculated, the tubercles being largest behind. Border rounded in front, with strong ridges continued to the posterior angle. Fixed cheeks swollen, rising between the border and glabella, much elevated at the eye-lobe. Suture slightly oblique in front; free cheeks with two or three rows of sharp tubercles. Eye very large, elevated, smooth, and nearly round, situated in the centre of cheek close to glabella. Latero-posterior angle rounded. Neck-furrow long, narrow, and straight, continued on the cheek to the genal angle. Neck-lobe very long, narrow, and bow-shaped, with two rows of tubercles. Hind margin of cheek tuberculated.

Pygidium.—Very convex; axis broad, elevated, terminating a little before the border, with rings irregularly tuberculated; four or five ribs visible on the limb, with rather deep central grooves, disappearing at a distance of about one-third from the margin, at which the pygidium becomes slightly elevated. Border with several strong ridges, seen especially behind the axis.

Size.—A detached glabella in my collection measures 9 mm. in length, 11 mm. in depth.

A tail measures 9 mm. in length, 14 mm. in width, 6 mm. in depth.

Locality.—Lummaton. I have obtained ten specimens of the glabella, one of the cheek, and six of the tail. There is a similar glabella in the Torquay Museum, and another in the Bristol Museum.

Remarks.—The evidence of this species, though not scanty, is very fragmentary. The glabellas that I have seen are generally in bad condition; and, as all the heads and tails of Trilobites found at Lummaton are detached, there is always room for question as to the correctness of the specific identification of the two parts. In this instance I have been chiefly guided by some specimens of *P. lævigatus* (Goldf.)[1] in the British Museum. To these fossils it is very similar; but its larger size, the absence of small cheek-spines, the width and ornamentation of the neck-lobe, the ornamentation of the pygidium, and the absence of a furrow on the cheek present differences. To that species, as figured by Goldfuss, it bears a very close resemblance, being, however, distinguishable by the coarse granulation visible both on

[1] 1843, "*Gerastos lævigatus*," Goldf., 'Neues Jahrb.,' p. 557, pl. iv, figs. 3 *a*, *b*.

head and tail. From *P. granulosus*[1], which Goldfuss figures with the last mentioned form, it differs in having no cheek-spine and in bearing tuberculations on the cheeks and tail. Burmeister[2] also describes and figures *P. lævigatus*, which he identifies with *P. Cuvieri*, Stein. (' Mém. Soc. Géol. Fr.,' vol. 1, p. 355, pl. xxi, fig. 6). In this he gives distinct points of difference from our species, *e. g.* the glabella does not reach the border, and the eye is further forward, and has an excavation behind it. He remarks that in that species the granulations are obsolete. Sandberger,[3] however, seems to regard *P. lævigatus* and *P. granulosus* as one species, remarking that he has found examples of each shape both nodulated and smooth, and that at all events the cheeks are smooth in both. Certainly one or two of our English species have the more elongated glabella of *P. granulosus*, but on the supposition (of which I think there is little doubt) that the enumerated specimens all belong to the same form, the tuberculated cheek, neck-lobe, and pygidium, and the rounded margins of the cheek sufficiently define it. Römer[4] gives a figure of *P. Cuvieri*, which he identifies as *P. lævigatus*, which is decidedly distinct from ours.

From *P. cornutus* (Goldf.), which is also described by Sandberger,[5] it differs in having no perpendicular area between the glabella and the border, and no cheek-spines; from *P. Bohemicus*, Barr,[6] the only Bohemian species resembling it, in being more tumid, having larger and fewer granules, and in the shape of the pygidium; from *P. Barrandei*,[7] F. A. Röm., and *P. orbicularis*,[8] F. A. Röm., in being without elongated spines. *P. crassimargo*, F. A. Röm.,[9] approaches it very nearly, and there is a possibility of its being identical; but, as far as can be judged from his description, the glabella does not reach so far forward, the cheeks are wider, the tail plainer, and the granulations much finer. In *P. Guerangeri*, Œhlert and Davoust,[10] the head is very much longer and flatter. In *P. Richteri*, Kayser,[11] the pygidium is more largely granulated. Some of the fossils figured by Phillips[12] as *Calymene granulata* appear to belong to this species. Although granulated like the tail of *Ph. Schlotheimi*, Bronn, the Lummaton tails clearly belong to the genus *Proëtus*, and in their convexity agree with the heads of the present species.

1 1843, " *Gerastos granulosus*," Goldf., ' Neues Jahrb.,' p. 557, pl. iv, figs. 4 *a*, *b*, *c*.
2 1846, " *P. Cuvieri*," Burm., ' Org. Trilob.,' Ray Soc., p. 99, pl. iii, figs. 1, 2.
3 1850, Sandb., ' Verst. Rhein. Nass.,' p. 30, pl. iii, fig. 2 (*Trigonaspis*).
4 1876, F. Röm. ' Leth. Pal.,' pl. xxxi, fig. 3.
5 1850, Sandb., ' Verst. Rhein. Nass.,' p. 31, pl. iii, fig. 3 (*Trigonaspis ?*).
6 1852, Barr., ' Syst. Sil.,' vol. i, p. 452, pl. xvi, figs. 1—15.
7 1850, F. A. Röm., ' Beitr.,' pt. 1, p. 20, pl. iii, fig. 33.
8 Ibid., p. 20, pl. iii, fig. 34.
9 Ibid., p. 65, pl. x, fig. 9.
10 1879, Œhl. et Dav., ' Bull. Soc. Géol. Fr.,' ser. 3, vol. vii, p. 702, pl. xiii, fig. 1.
11 1878, Kayser, ' Abhand. der Geol. Specialk. Preuss.,' Band 2, pt. 4, p. 14, pl. i, fig. 5.
12 1841, Phil., ' Pal. Foss.,' pl. lvi, fig. 248, *m* and *o* only.

Several kindred species are found in the Devonian Rocks of America, and one, *P. folliceps*,[1] is even more like it than are its Continental analogues. Nevertheless this differs in being very smooth, in having the cheek more raised and furrowed, the eye smaller and more elongate, and the tail and border of the head smooth; while it agrees in having the cheek-angle rounded, without the trace of a cheek-spine. *P. macrocephalus*, Hall,[2] has a distinct side-lobe to the glabella, long cheek-spines, and more segments and a stronger border in the pygidium; and *P. crassimarginatus*,[3] Hall, has a more prominent and excavated border, a more furrowed cheek, and more segments in the tail; and it is smooth.

Upon the whole, though *P. audax* nearly approaches several foreign species, I am inclined to regard it as distinct from all of them. There seems some variability in the width of the glabella, and further evidence will be required before several of the characters can be regarded as established. Although several small German specimens in the British Museum are very like it, their narrow, arched, smooth neck-lobes, obsolete nodules and deep processes on the cheek, tuberculated pygidia, and peculiar little cheek-spines seem enough to prove them to have nothing to do with our present species.

3. *Genus.*—Dechenella, *Kayser*, 1880.

This genus was established by Prof. Kayser[4] for species of *Phillipsia* occurring in the Devonian formation, and having tails similar to those of that genus, but distinguished by their small, triangular, and deeply-furrowed glabellæ. He included in it three species from Germany and two from North America, which had been formerly variously referred to the genera Æonia, Gerastus, Proëtus, and Phillipsia.

1. Dechenella setosa. Pl. II, figs. 15—17.

1889. Dechenella setosa, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Head rather flat, semi-oval, with straight cheek-spines. Border flat, broad in front, bounded by a shallow concavity which becomes linear in front. Central parts of head moderately convex. Glabella arched in profile, somewhat flattened laterally, very triangular in outline, reaching almost to the

[1] 1888, Hall, 'Pal. N. Y.,' vol. vii, p. 101, pl. xxiii, figs. 3—8.

[2] Ibid., p. 116, pl. xxi, figs. 10—21, and pl. xxiii, figs. 30, 31.

[3] Ibid., p. 99, pl. xx, figs. 6—8, and 20—31; pl. xxii, figs. 20—26, and pl. xxv, fig. 8.

[4] 1880, Kayser, 'Zeitsch. Deutsch. geol. Gesell.,' vol. xxxii, p. 703, pl. xxvii.

border and rounded in front, with four furrows; the first frontal furrow short, horizontal, and indistinct; the second longer and slightly oblique; the occular furrow more oblique, and reaching almost to the central line; the basal furrow still more distinct and oblique, and bifurcating shortly before the central line, which it almost reaches; the lobes, separated by the furrows, gently convex. Glabella bounded by a shallow furrow which is arched to include the eye. Cheeks long and convex, beginning in front of the glabella and extending back about a quarter of their length behind the basal lobe, bounded behind by an oblique groove. Eyes rather small, long, rounded, and smooth, situated close to the glabella and beginning at the frontal groove. Facial suture cutting the border very obliquely, turning suddenly in the marginal groove at a level with the front of the glabella, coming inwards in a convex curve to the front of the eye, forming a shallow eye-lobe almost parallel to the sides of the glabella, and cutting the hind margin of the cheek obliquely almost close to the neck-lobe.

Tail elongate, slightly convex; in outline oblique in front, rounded behind. Border flat, slightly sloping, wide behind. Axis long, straight, conical, reaching almost close to the border with an indistinct prolongation behind, bounded by a linear furrow or angle; bearing eighteen or nineteen narrow, decreasing rings, distinct in front, becoming almost imperceptible near the end. Limb convex, bearing about thirteen oblique arching ribs, slightly grooved near the axis, and ending suddenly at the border. Border flanked with minute oblique striæ in the upper part, which possibly become minute marginal spines further down.

Size of Head.—15 mm. long, 22 mm. wide, and 6 mm. deep.

Size of Tail.—17 mm. long, 20 mm. wide, 6 mm. deep.

Locality.—Chircombe Bridge, in black limestone. There are seventeen specimens of the tail in Mr. Vicary's Collection, two in the British Museum, five in Museum of Practical Geology, three in the Woodwardian Museum and ten in the Torquay Museum. The only specimens of the head I know are one in Mr. Vicary's Collection, and one in the Museum of Practical Geology.

Remarks.—These fossils occur in a beautiful state of preservation, and are of a glossy-black colour, slightly tinged with translucent red. The external layer of the test is minutely pitted on the head and the margin of the tail. On the parts of the glabella from which it is removed, the lobes and furrows seem more distinctly marked than where it is remaining. The striæ on the border of the tail are very minute, and have the appearance of small hairs. They can only be seen under a lens.

Kayser's type species *Dechenella Verneuili*[1] (Barr.) differs from our English form in its shorter head, longer glabella, and more arched and angular facial suture. There is a more angular prominence on the cheek near the genal angle, and the axis

[1] 1852, Barr., 'Syst. Sil. Bohèm.,' p. 478.

of the tail has fewer rings and these are distinct to its extremity. *D. verticalis* (Burm.)[1] has a wider head, a less distinct border, and its eyes are more centrally situated. *D. elegans* (Münst.)[2] is much smaller and very unlike it in details. *D. Haldemanni* (Hall)[3] is perhaps the nearest to it, but its border is wider, the groove within itlinear, the eye further from the glabella, which is narrower, the cheeks much shorter, the hind margin less oblique, and the rings of the tail much less numerous. *D. marginalis* (Conrad),[4] has only about half as many rings in the tail, and *D. striata*, Stanier,[5] has a prominent striated border, a shorter and differently marked glabella, and much flatter cheeks.

The heads of one or two of the Bohemian species of *Proëtus* present approximations to this genus, from which they differ altogether in the shape of the tails. *P. Astyanax*, Corda,[6] of which no pygidium is given by Barrande, is especially to be noted in this relation.

In a Russian species, *D. Romanouski* described by Tschernyschew[7] the border is larger, striated, and triangularly elevated; the glabella is narrower; and the tail has a broader axis, with only sixteen rings, and is separated from the ribs of the limb by a broad smooth groove. Another species, *aff. D. Verneuili*, described by the same author, has the border still more elevated.

VI. *Family.*—Harpedidæ, *Barrande*, 1852.

1. *Genus.*—Harpes, *Goldfuss*, 1839.

This is the only genus belonging to its family, and may be at once distinguished by the large, flat, and porous ungulate limb of the head, the numerous (twenty-five to twenty-nine) thoracic segments, and the minute tail. It extends from the Lower Silurian to the Middle Devonian, and the present species is its type.

1 1846, Burmeister, 'Org. Tril.,' Ray Soc., p. 100, pl. v, fig. 9 *a*.

2 1842, Münst., 'Beitr.,' pt. 5, p. 114, pl. x, fig. 2.

3 1861, Hall, 'Descript. of New Species, &c.,' p. 74.

4 1887, Tschernyschew, 'Mém. Com. Géol. Russ.,' vol. iii, pt. 3, p. 12, pl. i, figs. 4—8.

5 1887, Stanier, 'Ann. de la Soc. géol. de Belgium,' vol. xiv, p. 75, pl. iv, fig. 1.

6 1852, Barr, 'Syst. Sil. Bohém.,' vol. i, p. 470, pl. xvii, figs. 22, 23, Ét. F.

7 1887, Tschernyschew, 'Mém. Com. Géol. Russ.,' vol. iii, pt. 4, p. 14, pl. i, fig. 10.

1. Harpes macrocephalus, *Goldf.* Pl. II, figs. 19—23.

1839.	Harpes	macrocephalus, *Goldf.*	Nov. Acta Acad. Cæs. Leop.-Carol., vol. xix, pt. 1, p. 359, pl. xxxiii, fig. 2.
? 1840.	—	speciosus, *Münst.*	Beitr., pt. 3, p. 43, pl. v, fig. 19.
1841.	—	macrocephalus, *Phil.*	Pal. Foss., p. 127, pl. lv, fig. 246.
1842.	—	— *D'Arch. and de Vern.*	Geol. Trans., ser. 2, vol. vi, pt. 2, p. 337.
1843.	—	— *Goldf.*	Neues Jahrb. f. Min., &c., 1843, p. 548.
1846.	—	ungula, *Burmeister.*	(Not Sternberg.) Org. Trilobites, Ray Soc, p 75, pl. i, fig. 11.
1853.	—	macrocephalus, *Steininger.*	Beschr. Geol. Eifel, p. 89.
1886.	—	— *Barrois.*	Ann. Soc. Géol. du Nord., p. 175, pl. iv, fig. 3.
1888.	—	— *Etheridge.*	Foss. Brit., vol. i, Pal., p. 145.

Description.—Head-shield large, arch-shaped in outline; margins nearly circular in front, straight and slightly inclining to each other on the sides; central portions of the head spheroidal, surrounded by a perfectly flat marginal expansion occupying about half its area. Latero-posterior angles of the cheek very long, acutely angular, deflected laterally upwards from the marginal plane, and produced backwards beyond the centre of the body. Central portions of the head rising suddenly and steeply, divided by a line at a distance equal to the width of the flat marginal area; portions of cheek within this convex. Glabella elongate and elevated, cylindrically oval, becoming indistinct beyond this first boundary-line, but extending as far as the second; narrowed in the posterior part; with a small sub-triangular lateral lobe separated by an indistinct oblique basal (?) furrow. Neck-furrow deep. Neck-lobe short, narrow, and prominent, but much lower than the front lobe.

Eyes small, knob-like, close behind the anterior end of the glabella.

Exterior surface smooth or very minutely tuberculate on the glabella and cheeks within the first bounding line, which is defined by the surface beyond it suddenly becoming punctate. Flat area coarsely punctate; the punctations largest close to its inner boundary and to the border.

Test thick, with several layers; texture cellular, except at the border and in the central region, where it is dense. Border with two or three strong sharp ridges below.

Tail very small, wide, triangular in outline; apex blunt; margin obliquely flattened. Axis short, wide, convex, with five nodulous ribs; limb flat centrally, but bent suddenly downward near the border with a sharp angle, bearing four bifurcating ribs reaching the border.

Size of the Head.—24 mm. in length from the border to the neck-lobe; 39 mm. from the border to the extremity of the cheek-spine; 24 mm. in width; 9 mm. in depth.

Localities.—There are four specimens from Lummaton in my collection; another (Phillips's figured specimen) in the Lee Collection in the British Museum; and two or three others in the Museum of the Torquay Natural History Society. There is also a fine but defective specimen from Wolborough in the Museum of Practical Geology at Jermyn Street. A unique and minute specimen of the tail is in the Lee Collection in the British Museum.

Remarks.—The cephalic shield of this beautiful Crustacean appears to agree exactly with the German fossil as shown by comparison with Goldfuss's fine figure and with a specimen from Germany in the British Museum. Burmeister supposed it to be the same species as *Harpes ungula*, described by Count Sternberg in 1833 in the 'Transactions of the National Museum at Prague,' pp. 45, 52, pl. ii, fig. 1; but Barrande's figures[1] of that Trilobite prove it to be specifically distinct. In that fossil the border is more regularly rounded, the eyes are much farther apart, the glabella is less prominent, the depth of the head is less, and the neck-furrow is narrower.

Barrande's *Harpes venulosus*[2] more nearly approaches it, but differs, though in a less degree, in the same particulars; the eyes especially being much wider apart, and the cheeks more elevated and wider; the lobes of the glabella are also differently arranged. *H. reticulatus*, Corda,[3] is the Bohemian species which is most similar to it; but even from that there are several distinguishing features. Its eyes are more anterior, the glabella more rounded, the neck-lobe more prominent, the lateral lobes more defined, and the marginal area flatter all round, and especially at the postero-lateral angles. *Harpes transiens*[4] is very indistinctly figured by Barrande. It bears much resemblance to the present species, but appears distinguishable by its greater width, more circular form, shorter glabella, and coarser ornamentation. *Harpes gracilis*,[5] Sandberger, is a much flatter form presenting numerous divergencies; and *Harpes Bischofii*, F. A. Röm., both as given by Römer in his 'Beiträge' and by Kayser in the 'Abhandlungen zur Geol. Specialkarte von Preussen,' Band. 2, pt. 4, is a species with a more cylindrical glabella and a very concave marginal area.

Harpes convexus,[6] Trentk., is a very small species, differing in the strong border

[1] 1852, Barr., 'Syst. Sil.,' p. 347, pl. viii, figs. 2—6, and pl. ix, figs. 1—6, Ét. E.

[2] Ibid., p. 350, pl. viii, figs. 11—15, and pl. ix, figs. 11—19, Ét. E and F.

[3] Ibid., p. 353, pl. ix, figs. 20—24, Ét. E.

[4] 1872, Ibid., vol. i, Suppl., p, 7, pl. xv, fig. 40, 41, Ét. H.

[5] 1850, Sandb., 'Verst. Rhein. Nassau,' p. 28, pl. iii, fig. 1.

[6] 1867, Trenkner, 'Pal. Novität.,' p. 2, pl. i, fig. 1; and 1885, Clarke, 'Neues Jahrb.,' pt. 3, Beil.-Band, p. 324, pl. iv, figs. 2, 3.

and some other points. It very possibly may be the young of this species, to which it bears a strong resemblance in outline.

The structure of the test shown by the Lummaton specimens is very interesting. As seen on the flat and partially decorticated portion of the head, it presents the appearance of consisting of a number of hollow pores, or rounded tubercles, according to its state of preservation, closely arranged, and with a tendency to run into irregular grooves, and in some places becoming considerably larger. However, a natural section of the test just under the border of the cheek-spines shows that these represent two rows of short cæcal tubes, situated exactly opposite to each other, and leaving the interspaces to be filled up with other material. Whatever further purpose this served, it must have considerably lightened the shield for swimming. The same result was probably produced by the very similar structure in the genus *Trinucleus.*

In all our specimens the eyes are much injured, but they appear from Goldfuss's plate to have been as peculiar in their construction as were the other parts of this curious animal. They were slightly raised, and carried two or three elongate lenses, just visible to the naked eye, as well as more numerous microscopical facets.

I do not at present know of any other species of *Harpes* from the English Devonians. The Torquay Natural History Museum is restricted to objects collected in Devonshire, and in it is a specimen of *Harpes* without locality, but which was presumed to have come from Ramsleigh Quarry near Newton Abbot. It is a variety of *H. venulosus*, Barr., approaching *H. Bischofii,* F. A. Röm. The character of the matrix, however, makes me doubt its British origin, and believe that it is really a Bohemian specimen placed by Dr. Battersby with his fossils for comparison, and that it has thus crept into the Museum by mistake.

VII. *Family.*—Bronteidæ, *Barrande.*

1. *Genus.*—Bronteus, *Goldfuss,* 1839.

The genus "Brontes" was founded by Goldfuss in 1839; but, as that name was already in use for a genus of beetles De Koninck in 1841 suggested the name "Goldius" (contracted from Goldfussius) in its place. Goldfuss, in 1843, instead of adopting this alteration, modified his original name to "Bronteus," and this has been generally accepted by later authors.

It is a matter of unusual difficulty to determine the English species of this genus. With the exception of Mr. Vicary's specimen of *B. flabellifer*, none of the heads and tails have occurred in contact. Besides this, the specimens are generally very imperfect, and much obscured by distortion and the effects of fossilization; and, while the specimens of either part fall into distinct groups, it is almost impossible to come to a satisfactory conclusion as to which of the two sets should be correlated one with another. There is, moreover, considerable variability among the individuals of each group. Neither is much help to be obtained from the descriptions given by foreign authors. Except in the case of the Bohemian species they have generally been described from the pygidia alone; and endless differences of opinion exist among the later writers as to the exact species which were intended by the earlier. Under these circumstances the present effort to define the English species must be considered to a great extent as only tentative. There would be of course the opposite and much easier course of regarding them simply as a single very variable species, but my strong impression is that the species will ultimately prove to be numerous, and that the intricacy lies rather in the poorness of the specimens than in the indistinctness of the species.

1. Bronteus delicatus, *Whidborne*. Pl. III, figs. 13—15.

1889. Bronteus delicatus, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Head considerably longer than the width of the glabella, moderately convex, rounded in front. Border small but stout, divided from the glabella by a shallow linear groove, and marked by numerous transverse striæ. Glabella triangular, narrow behind, almost uniform in height till it curves rather suddenly to the border; bounded on each side by a rounded axal furrow, separating it from the fixed cheeks, at first straight and then arching outwards, and with a small pit nearly in its centre. The first frontal depression distinct, almost crossing the glabella, parallel to the border, and distant from it about a quarter the length of the head. Behind this the frontal and ocular furrows form a deep, smooth triangle, including a lateral tubercle representing the upper lobe. Between the apex of this and the first-mentioned furrow is another short depression not reaching the margin. Basal furrow truncating the glabella, followed by a small basal lobe, with a lateral prominence bearing a tubercle. Neck-lobe high and arched. Surface of the glabella covered, except in the depressions, by fine irregular transverse ridges, tending to become nodulose, especially behind.

Tail rather short (?). Axis small, very tumid, subspherical, with no signs of trilobation, and having minute lateral prolongations; surrounded by a furrow. Ribs fifteen; the central one much larger than the rest, the lateral ribs slightly increasing in width with their distance from the centre. Furrows about half the width of the ribs, smooth. Limb rather concave near the margin. Axis and ridges marked with a few very small raised spots.

Size.—The specimens are too imperfect to permit any dimensions being given.

Localities.—There are two heads in my collection from Wolborough and Lummaton, one tail in the Woodwardian Museum from Wolborough, and another in the British Museum from Lummaton.

Remarks.—I group these specimens together with much doubt, but they appear to agree in general character sufficiently well to give presumptive evidence of their unity. The head approaches that of *Bronteus tigrinus*, of which it may perhaps prove to be a variety. It chiefly differs from it in its more elongated shape and its greater smoothness. The tail is distinguished, by the sphæroidal shape of its axis, its smoothness, and its wide central ribs, from any others that I have been able to examine.

Münster's *B. radiatus*[1] seems not very dissimilar from the tails of this species. He figures two specimens, which he says are very different. The larger of these seems to be much more like *B. intumescens*, F. A. Römer,[2] *B. Brongniarti*, Barr.,[3] or *B. Verneuili*, Œhl. and Dav.,[4] which are much more tumid and in other respects dissimilar from the present one; the smaller is more like ours, but both are said to be marked by concentric lineations, of which there is no sign in the English species.

In *B. Haidingeri*, Barr.,[5] the glabella is entirely striated and the depressions upon it do not reach the sides; the axis of the tail is distinctly trilobed, and the ornamentation of it of a totally different character from that in any English species. *B. Partschii*, Barr.,[6] which is like this species in general shape, has the head smooth and the tail covered with striæ.

2. Bronteus tigrinus, n. sp. Pl. III, fig. 12.

Description.—Head short, very wide, rounded. Border slightly rounded in front, indistinctly striated. Glabella widely triangular, narrow behind, almost uniform in height till it curves rather suddenly to the border, which it reaches; bounded on each side by deep axal furrows, at first straight and then arching very rapidly outwards, separating it from the fixed cheeks, and marked with two pits at about one-fourth and two-thirds of its length from the border, from the first of which a rounded depression parallel to the border runs almost across the glabella, and behind it the frontal and ocular furrows form a smooth triangle on each side,

[1] 1840, Münst., 'Beitr.,' pt. 3, p. 40, pl. v, figs. 13 *a*, *b*.
[2] 1852, F. A. Röm., 'Beitr.' pt. 2, p. 75, pl. xi, fig. 25.
[3] 1852, Barr., 'Syst. Sil. Bohèm,' vol. i, p. 866, pl. xlvi, figs. 1—12, Ét. F and G.
[4] 1879, Oehl. et Dav., 'Bull. Soc. Géol. Fr.,' ser. 3, vol. vii, p. 703, pl. xiii, fig. 2.
[5] 1852, Barr., 'Syst. Sil.Bohèm.,' vol. i, p. 875, pl. xlvi, figs. 32—39, Ét. E.
[6] 1852, Ibid., vol. i, p. 870, pl. xlvi, figs. 19—31, Ét. E.

containing a small lateral tubercle which represents the upper lobe. Basal furrow sharply truncating the glabella, followed by a basal lobe consisting of a central portion and two narrow, separated, lateral ridges. Neck-lobe high and arched. Surface of the glabella bearing on the posterior parts rather fine tubercles running into transverse lines, the tubercles disappearing in the front parts and the lines becoming continous striæ.

Size.—The glabella is 19 mm. in length and 21 mm. in width.

Locality.—There is a small specimen in my collection from Lummaton, and a larger one in the Torquay Museum, which probably comes from the same place.

Remarks.—The present species differs from *B. delicatus* in the great width of its glabella, and the pits in the furrows that bound it, and from the other Devonshire species in the character of its ornamentation.

In *B. umbellifer*, Beyr.,[1] *B. pustulatus*, Barr.,[2] *B. oblongus,* Corda,[3] and some other Bohemian forms, the depressions on the glabella produce a T-shaped appearance of its central parts. In *B. Partschii*, Barr.,[4] there are no signs of granulations, the depressions are more pit-like and the sides of the glabella more concave.

3. Bronteus pardalios, *Whidborne.* Pl. III, figs. 1—7.

1889. Bronteus pardalios, *Whidb.* Geol. Mag., n. s., dec. 3, vol. vi, p. 29.

Description.—Body large, flat, oval. Head short, wide, rounded. Border almost straight in front, marked with a few fine transverse ridges chiefly seen below, curving gently round the cheeks and sweeping round the angle. Glabella triangular or shovel-shaped, hardly higher than the cheeks, highest and somewhat pinched behind, sloping gradually to the border, with which it merges; bounded laterally by deep furrows, at first straight and then arching gently outwards, separating it from the fixed cheeks, and containing two pits, distant one about one-fourth and the other three-fourths of their length from the border; from the first of these there is a very slight linear depression, parallel to the border, running a short distance across the glabella, and marking the first frontal furrow; close behind this a similar oblique frontal furrow and a transverse ocular furrow, forming with the last a very indistinct upper lobe bearing one or more tubercles. Basal furrow very deep and definite, truncating the glabella, and followed by a

[1] 1852, Barr., 'Syst. Sil. Bohèm.,' vol. i, p. 879, pl. xliv, figs. 13—24, and pl. xlviii, figs. 28—30, Ét. F.

[2] Ibid., p. 889, pl. xlvi, fig. 13, and pl. xlviii, figs. 13—16, Ét. F and G.

[3] Ibid., p. 853, pl. xlvii, figs. 13—17, Ét. F.

[4] Ibid., p. 870, pl. xlvi, figs. 19—31, Ét. E.

basal lobe represented by a low central portion with two rows of tubercles, and a single tubercle on each side. Neck-furrow less distinct. Neck-lobe arched and high.

Facial sutures starting just beyond the front angle of the glabella, almost parallel to each other two-thirds of the way down, and then, after forming a small deeply arched eye-lobe, turning rapidly outwards in a graceful curve to cut the hind margin near the genal angle, and being in this part in the form of a raised, rounded ridge. Inferior margin horizontal and nearly straight.

Surface of the head covered with numerous very coarse tubercles, largest at the back of the glabella, and showing a very slight tendency to merge into transverse lines close to the front border.

Eye low, rounded, kidney-shaped, with very convex sides, surmounted by a coarsely tuberculated eye-lobe. Lenses beautifully arranged in about thirty-six arching rows of about fifty-six facets each, so that probably the total number is not far short of 1800 or 2000. Texture of test very thin. Thorax unknown.

Tail entire, fan-shaped. Axis very small, triangular, wider than long, tumid in the middle, slightly trilobed by two lateral depressions, bounded by a definite furrow. Ribs fifteen in all, flattened, divided by linear grooves disappearing at the margin; covered with uniform tubercles rather irregularly arranged, on an average three or four on the width of a rib. Central rib largest, the rest diminishing in length and width as they recede from it. Test very thin, in two layers.

Under surface. Rostral shield very wide, somewhat swollen in the centre, and covered by fine, irregular, and distant transverse grooves. Tail with two very thin layers, the exterior finely granular, the inner one covered by fine grooves similar to those of the rostral shield.

Size.—A small head retaining the cheek measures 15 mm. in length, 28 mm. in width, and 9 mm. in depth. A very large tail in the British Museum measures 76 mm. in length, 85 mm. in width, 14 mm. in depth.

Localities.—This species seems to be not infrequent at Lummaton and Wolborough. From the former place I have collected eleven heads and two tails. There are five tails from Lummaton and two from Wolborough in the British Museum, and one from Lummaton in the Woodwardian Museum. There are also eleven tails of *Bronteus* in Mr. Vicary's collection, seven in the Bristol Museum, and several in the Torquay Museum, but at the time I saw them I had not recognised that there was more than one species from these beds, and therefore am unable to say to which they belong. Phillips quotes *P. flabellifer* from "Hope," but I have not seen any specimens from that place.

Remarks.—The tails of *B. pardalios* may be distinguished from those of *B. granulatus* by their narrow linear furrows and larger and more regular spots; from those of *B. alutaceus* by their much fewer and larger spots; from those of *B.*

flabellifer by having the ribs broader than the furrows and by being less circular. The reason I have concluded the heads above described to belong to the present species is the similarity in their ornamentation; and on this supposition the head of *B. pardalios* differs from that of its congeners by its coarse granulation, by the faintness of the depressions on its glabella, by the regular slant of its profile, and by the angle of the sides of the glabella.

From the extreme tenuity of the test these fossils are peculiarly liable to distortion. Possibly it was not only thin but somewhat elastic. The heads rarely occur perfect. As a rule the central portion, defined by the facial sutures, is the only part present; more rarely the free cheek bearing the eye is preserved. This eye is a most beautiful object both from its symmetrical shape, and from the large number and graceful arrangement of its lenses. These are so placed as to present arching rows when viewed from two, or in some parts even from three, directions. In one specimen, although not completely cleared of matrix, fifty-six rows were counted, and in one of the central rows no less than thirty-six facets. It is therefore probable that the total number of lenses did not fall far short of 1800 or 2000. From the convex shape of this eye the animal must have had the power of seeing upwards as well as, like *Phacops*, laterally; and this would be further aided by the elevation of the cheeks on which it is placed. It is interesting to observe that, while in general the heads of Trilobites occur much more frequently at Lummaton than do the tails, the reverse is the case in the present genus. The explanation of this seems to lie in the construction of these tails, the radiating furrows of which must have added considerably to their strength. These furrows are to be seen as strong ridges upon the under side. The test appears to have been continued over a large portion of the under surface of the tail so as to form a kind of sack or pouch. In a specimen in my collection this part is seen to consist of two or three extremely thin layers which are not indented by the furrows of the upper test. Of these the external layer appears to have been granular, and the inner surface of the innermost is marked by very fine and slightly waving concentric threads. The latter are often to be observed in specimens where portions of the upper test have been removed.

There is a curious case of malformation in a large tail of this species in the Lee Collection in the British Museum. The furrows instead of radiating regularly from the axis to the border are quite irregular, sometimes looped together, and sometimes vanishing midway so as to leave broad marginal expanses only marked with tubercles. A similar malformation, though of a very much less extent, is seen in one of the specimens figured (Plate III, fig. 8).

With the exception of the species already mentioned I know of few that could be mistaken for the present form. Most of the Bohemian forms are easily distinguished either by the bifurcation of the middle rib of the tail or by the ornamentation of the head being linear instead of tuberculated, and there are none in which the tubercles are so regular and prominent. The only American Devonian *Bronteus*, *B. Tullius*, Hall,[1] belongs to a different section of the genus.

4. Bronteus alutaceus, *Goldfuss*. Pl. III, fig. 11.

1839.	Brontes flabellifer (pars), *Goldf.*		Nov. Act. Acad. Cæs. Leop.-Carol., vol. xix, pt. 1, p. 361, pl. xxxiii, fig. 3 *a* (pars).
1843.	Bronteus alutaceus, *Goldf.*		Neues Jahrb. für Min., p. 549, pl. vi, fig. 1.
? 1850.	— —	*Sandb.*	Verst. Rhein. Nass., p. 21, pl. ii, figs. 3 *a*—*d*.

Description.—Tail with deep linear furrows, and ribs bearing numerous fine tubercles, six or seven in the width of each rib.

Locality.—Lummaton; two specimens in my collection.

Remarks.—The fragmentary specimen figured in Plate III appears exactly to correspond, as far as it goes, with Goldfuss's species, and I have therefore no hesitation in introducing it in spite of the scantiness of the material, as the only question that remains is whether he is correct in regarding his *B. alutaceus* as more than a variety of *B. granulatus* or some other species. An argument that he is right may be found in the fact that Barrande has distinguished a large number of species in Bohemia which are divided by quite as small differences.

Sandberger gives a figure of a tail which appears much like that of Goldfuss, though the granulation is rather coarser. He also figures a glabella which is very similar in shape and general appearance to those which we have referred to *B. granulatus*, but gives no evidence of granulation. Clarke[1] seems to consider these figures distinct from *B. alutaceus* if not also from *B. granulatus.* His own figure, however, is not much more like the latter than the former.

B. alutaceus differs from the other British species in the much more numerous tubercles of the tail, and from all except *B. pardalios* by the narrowness of its furrows.

5. Bronteus flabellifer (*Goldfuss*). Pl. III, fig. 16.

1832.	Olenus flabellifer, *Goldf.*	De la Beche's Handbook (German edition), p. 540.
1839.	Brontes — —	Nov. Act. Acad. Cæs. Leop.-Carol., vol. xix, pt. 1, p. 361, pl. xxxiii, figs. 3 *a* (pars) and *c*.

[1] 1888, Hall, 'Pal. N. Y.,' vol. vii, p. 12, pl. 8 A, figs. 34—36.

[2] 1885, Clarke, 'Neues Jahrb.,' pt. 3, Beil.-Band, p. 323, pl. iv, fig. 1.

1841.	GOLDIUS FLABELLIFER	*De Koninck.*	Nouv. Mém. Acad. Brux., vol. xiv, p. 6, pl. i, fig. 1.
1842.	BRONTES —	*D'Arch. and de Vern.*	Geol. Trans., ser. ii, vol. vi, pt. 2, p. 337.
1843.	— —	*F. A. Röm.*	Verst. Harzgeb., p. 37, pl. xi, fig. 1.[1]
1843.	BRONTEUS —	*Goldf.*	Neues Jahrb., p. 549, pl. vi, fig. 3.
1845.	— —	*Emm.*	Neues Jahrb., p. 42.
1846.	— —	*Burm.*	Org. Tril., Ray Soc., p. 65.
1867.	— ALUTACEUS,	*Trenkner.*	Paläont. Novität., p. 4, pl. i, fig. 2.
1876.	— FLABELLIFER,	*F. Röm.*	Leth. Pal., pl. xxxi, fig. 3.
1885.	— —	*Clarke.*	Neues Jahrb., pt. 3, Beil.-Band, p. 323.

Description.—Head with numerous fine and distinct tubercles. Depressions on the glabella well marked; basal lobe wide, bearing three or four rows of granules in the centre, and a prominence with a tubercle on each side, confluent with the neck-lobe which is granulated.

Thorax with ten segments, each having a row of granules.

Tail flattish, almost circular. Axis short, tumid, wide, subtriangular, with rounded margins indistinctly trilobed, produced to a point on each side. Limb with fifteen narrow ribs, the side ones being the widest and not very much shorter than the central ones, marked with a few irregular, unequal, and rather confluent tubercles, only two or three on the width of the ribs. Furrows as wide as the ribs. Border linear, elevated, preceded by a distinct wide concavity. Lineations on the test of the lower side, very few, distinct, and ramose.

Size of tail 12 mm. in length, 15 mm. in width, 3 mm. in depth.

Localities.—The only two British examples known to me are the one figured on Plate III, which is in Mr. Vicary's collection, and was obtained from the Dechenella-beds of Chircombe Bridge, and a specimen of the tail in the British Museum, which is rather larger, and evidently came from the Acervularia-beds of Ramsleigh Quarry near Newton Abbot.

Remarks.—This species was first quoted, without description, by Von Dechen in the German edition of De la Beche's 'Handbook,' and some years after was described by Goldfuss as the type species of his new genus Brontes. He then figured an almost perfect specimen, but as the pygidium of his fossil was unsatisfactory, he unfortunately restored it in his plate from a specimen which he afterwards in 1843 found to belong to a different species, *B. alutaceus.*

Phillips and other authors were misled by this, and identified with it the tails of *Bronteus* found at Newton and Torquay, and hence the name *B. flabellifer* was wrongfully introduced into the British lists; and probably in all cases where it has been quoted it stands for *B. granulatus*, or another of the commoner species.

[1] The figure correctly represents this species, but Clarke, who has examined Römer's specimen states that it is incorrectly drawn, and that the specimen really belongs to *B. granulatus* (see p. 41).

The true *B. flabellifer* appears to be very rare both in England and on the Continent. It is to be distinguished from the kindred species described by Goldfuss, as well as from those with which it is associated in Devonshire, by its tail being almost circular, the upper ribs being long and wide, and the furrows being wider than the ribs. The tubercles are few and vary in size. It is as well to observe that the furrows are smooth, and agree in that respect with Goldfuss's description, although in his later figure they are represented as tuberculated.

D'Archiac and de Verneuil regard *B. radiatus,* Münst.,[1] as probably a synonym, but he represents that species as striated and not tuberculated, and in all probability it belonged to quite a different animal.

B. canaliculatus, Goldf.,[2] has the tail of a much less circular shape, approaching *B. granulatus*, but with apparently a differently shaped axis. Goldfuss's description of it is confused by an incorrect reference to Römer's 'Verst. Harzgeb.' *B. scaber*,[3] Goldf., has its central rib bifurcated.

In the synonyms given above it is to be noted that De Koninck and Ferd. Römer follow Goldfuss's first and inaccurate figure.

6. Bronteus granulatus, *Goldf.* Pl. III, figs. 8—10.

1838. Asaphus, sp., *Stein.* Mém. Soc. Géol. Fr., vol. i, pt. 2, p. 358.
1841. Brontes flabellifer, *Phil.* (Not Goldf.) Pal. Foss., p. 131, pl. xxxvii, figs. 254 *a, b, c.*
1843. Bronteus intermedius, ? *Goldf.* Neues Jahrb. für Min., p. 549, pl. vi, fig. 4.
1843. — granulatus, *Goldf.* Op. cit., p. 549, pl. vi, fig. 2.
1843. — flabellifer, *F. A. Röm.* Verst. Harzgeb., p. 37, pl. xi, fig. 1 (*fide* Clarke).
1850. — alutaceus, *Sandb.* (Pars.) Verst. Rhein. Schist. Nassau, p. 21, pl. ii, figs. 3 *a—d* (*fide* Clarke).
1851. — *M'Coy.* Desc. Brit. Pal. Foss., p. 179.
1853. — *Stein.* Geol. Beschr. Eifel., p. 88.
1885. — granulatus, *Clarke.* Neues Jahrb., pt. 3, Beil.-Band, p. 322, pl. iv, fig. 1.
1887. Goldius granulatus, *Tschernyschew.* Mém. Com. Géol. Russ., vol. iii, pt. 3, p. 15, pl. i, figs. 2, 3.
1887. Bronteus flabellifer. *Eth.* Foss. Brit., vol. i, Pal., p. 144.

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[1] 1840, Münst., 'Beitr.,' Heft 3, p. 40, pl. v, figs. 13 *a, b.*

[2] 1843, Goldf., 'Neues Jahrb. f. Min.,' p. 550, cf. with 1839, Goldf., 'Nov. Act. Acad.,' vol. xix, pt. 1, pl. xxxiii, fig. 3 *b.*

[3] 1843, Goldf., 'Neues Jahrb. f. Min.,' p. 549, pl. vi, fig. 5.

Description.—Head rather elongated, convex. Border somewhat rounded in front. Glabella triangular, marked with small tubercles passing into striæ close to the border; not very narrow behind, almost uniform in height till it curves suddenly to the border; bounded on each side by a furrow which is first straight and then oblique. A depression almost crossing the glabella, parallel with the border and distant from it about a quarter of the length; behind this the frontal and ocular furrows form a triangular depression on each side. Basal furrow linear, sharply truncating the glabella, followed by a short, low, basal lobe, bearing a few tubercles, and amalgamating with the more prominent neck-lobe. Surface smooth in the depressed parts. Cheeks tuberculated. Width of the front of glabella less than length of head.

Tail fan-shaped, widest in front, rounded behind, curving suddenly at the upper angles. Axis small, tumid, subtriangular, rounded behind, pointed at the sides, defined by a distinct groove. Limb with fifteen ribs, the central rib the largest, the uppermost very small and short; ribs marked with more or less fine tubercles irregularly arranged, averaging four on the width of the rib near the margin, divided by smooth flat grooves, much narrower than the ribs, and terminating suddenly near the margin.

Size of a tail in the British Museum, 39 mm. in length, 43 mm. in width, 9 mm. in depth.

Localities.—Lummaton and Wolborough. There is a specimen of the head from Lummaton in the Lee Collection, another in the Museum Pract. Geol., and two more in my collection. There are five specimens of the tail from Newton and one from Lummaton in the British Museum, six from Newton in the Woodwardian Museum, three (?) from the same locality in the Museum Pract. Geol., and six from Barton in my collection.

Remarks.—It is clearly to this species that the tails described by Phillips under the name of *B. flabellifer* belong. Goldfuss, in 1843, referred Phillips' two figures to his two new species *B. granulatus* and *B. intermedius* respectively, evidently distinguishing them by the shape of their axis, which in one of Phillips' figures appears more trilobed than the other. The specimens, however, that I know do not seem to show any marked distinction in this respect, and on the whole agree most nearly with *B. granulatus.* I am indeed doubtful whether there is any reason for separating Goldfuss's two species, and I have been unable to find any Continental evidence upon the point.

Römer's figure of *B. flabellifer* in his 'Verst. Harzgeb.' agrees with that species as restricted by Goldfuss; but Clarke,[1] who has had the opportunity of examining the original specimens, says that it is incorrectly drawn, that the furrows are very narrow, and that it belongs to the present form. From the true *B. flabellifer* of

[1] 1885, Clarke, 'Neues Jahrb..' pt. 3, Beil.-Band, p. 323.

Goldfuss this species differs in the extreme narrowness of its furrows. *Bronteus minor*, F. A. Röm.,[1] *B. Bischofi*, F. A. Röm.,[2] MS., and *B. Romeri*, Kays.,[3] differ from this and all the other English species in having the central rib of the tail bifurcated; and the great majority of the Bohemian species are to be distinguished from the various Devonshire forms either by possessing this bifurcation or by having the glabella entirely striated.

In *B. planus*, Corda,[4] and *B. spinifer*, Barr.,[5] the glabella does not reach the front border. *B. Edwardsii*,[6] the tail of which has an undivided central rib, comes very near to this species and to *B. delicatus*, but the granules of the head are more numerous and smaller, and the glabella has more the shape of a door-handle, and the depressions on it are differently arranged. Its tail also, which comes between that of *B. granulatus* and *B. alutaceus*, has a more distinctly trilobed axis than in either of these species.

B. granulatus is distinguished from *B. pardalios* by the smaller tubercles of the head and the more arched glabella, and by the wider furrows of the tail; from *B. delicatus* by the more numerous and distinct tubercles of the glabella, the more triangular axis, and more numerous and distinct tubercles on the ribs of the tail; and from *B. tigrinus* by the length of the head being decidedly greater than the width of the glabella.

ORDER.—PHYLLOCARIDA, *Packard*, 1879.

1. *Genus*.—ARISTOZOE, *Barrande*, 1872. BACTROPUS, *Barrande*, 1872.

The genus *Aristozoe* was formed by Barrande for some large sub-oblong Crustacean carapaces, which he regarded as Ostracods, but which Jones and Woodward[7] in 1883 surmised to be *Phyllopoda*, or as now, with Packard, they term them, *Phyllocarida*[8]. Another genus, *Bactropus*, of the same author comprised tubular fossils differing from the abdominal segments of *Ceratiocaris* in their great length. Evidence has been brought forward by Novák showing that these two fossils belong in all probability to one animal; and therefore *Bactropus* will have to be absorbed into *Aristozoe*.

[1] 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 19, pl. iii, fig. 32; not 1866, ibid., pt. 5, p. 9, pl. xxxiv, fig. 8.

[2] 1858, Giebel, 'Sil. Faun. Unterharz.,' p. 14, pl. ii, fig. 2.

[3] 1878, Kayser, 'Abhand. Geol. Specialk. Preuss.,' Band 2, pt. 4, p. 44, pl. v, fig. 13.

[4] 1852, Barrande, 'Syst. Sil. Bohème.,' vol. i, p. 863, pl. xlii, figs. 34, 35, and pl. xlviii, figs. 1—8, Ét. E.

[5] Ibid., p. 878, pl. xlii, figs. 36—40, Ét. G. [6] Ibid., p. 882, pl. xlii, figs. 30—33, Ét. E.

[7] 1883, Jones and Woodward, 'Geol. Mag.,' dec. 2, vol. x, p. 463; and 'Report Brit. Assoc.,' 1884, p. 217.

[8] 1885, Jones and Woodward, 'Geol. Mag.,' dec. 3, vol. ii, pp. 349 and 351; and 'Report Brit. Assoc.,' 1886, pp. 330—334.

1. Bactropus decoratus, *Whidborne* (part of Aristozoe). Pl. IV, fig. 21.

1889. Bactropus decoratus, *Whidborne*. Geol. Mag., dec. iii, vol. vi, p, 29.

Description.—The last segment of an abdomen. Subcylindrical, straight on one side and curved on the other, slightly conical downwards, gently swelling at about one-fifth the way down, and tapering rather more rapidly for the last third; rather oval in section. Surface traversed by about sixty delicate, transverse, parallel grooves, of which about ten are deeper than the rest, leaving fine ridges or striæ between them; and indented at the lower end by two oblique and much deeper grooves.

Size.—Length 12 mm., diameter at the upper end 3 mm., and at the lower end 2 mm.

Locality.—Lummaton or Barton. A single specimen in the Torquay Museum.

Remarks.—This small fossil seems closely allied to those figured by Barrande in the Supplement to vol. i of his 'Système Silurien de Bohème,' and described by him under the names of *B. longipes*[1] and *B. tenuis*,[2] but it differs from them very greatly in size, and in the much coarser and more regular ornamentation with which it is covered. Both extremities of the specimen are obscure, being partly hidden by the matrix.

Some time ago Mr. Marr suggested to me the possibility of *Bactropus* occurring in the Middle-Devonian rocks of England, and showed me a specimen which he had himself collected in Bohemia, and had presented to the Woodwardian Museum. I was at once struck with its resemblance to the present fossil, which I had long known; and my identification was soon afterwards confirmed by Professor Rupert Jones, upon my showing it to him. The chief reason for hesitation was that the English specimen was distinctly furrowed, whereas Mr. Marr's much larger Bohemian specimen, as well as those figured by Barrande, appeared to be smooth. Shortly afterwards, however, Prof. Rupert Jones drew my attention to a paper by Herr O. Novák,[3] in which he proves that Barrande's *Aristozoe*, *Bactropus*, and *Ceratiocaris debilis*[4] are respectively a cephalo-thoracic valve, a segment of the abdomen, and a telson of the same species of animal; and that therefore *Aristozoe* (which is the name he retains) belongs not to the Ostracods but to the Phyllocarida. In this paper, as the Professor

[1] 1872, Barr., 'Syst. Sil. Bohèm.,' vol. i, Suppl., p. 581, pl. xxi, figs. 1—22, Ét. F.

[2] Ibid., p. 582, pl. xxi, figs. 23—31, Ét. F.

[3] 1885, 'Sitzungsb. kaiser. Böhm. Gesell. Wiss.,' p. 239, pl. i; 'Remarques sur le Genre *Aristozoe*, Barrande.'

[4] 1872, Barr., 'Syst. Sil.Bohèm.,' vol. i, 'Suppl.,' p. 448, pl. xviii, figs. 20—25; pl. xix, figs. 20—27, pl. xxvi, fig. 18, and pl. xxxi, figs. 16—19.

pointed out, Herr Novák figures a greatly enlarged portion of the test of the "Bactropus" portion of his animal, and this shows transverse furrows, but they are very much finer and of a character somewhat different from those of the English specimen. We may therefore conclude that the two fossils belong to the same group, but not to the same species.

As no other part of the animal has been hitherto found in Britain, I have thought it best to retain the name *Bactropus* for the present, for the sake of clearness, although *Aristozoe* will have to be regarded as the ultimate name of the genus. It certainly could not belong to *Ceratiocaris*, as it is proportionately much too long.

2. *Genus.*—Tropidocaris, *Beecher*, 1884.

This genus has an ovoid bivalved cephalothorax marked with some strong longitudinal ribs. Three species have been described, all from the Devonian beds of North America.

1. Tropidocaris? sp. Pl. IV, figs. 20 *a*, 20 *b*.

A fragmentary specimen in my collection from Lummaton seems, as far as can be judged, to be part of the ventral region of the right (?) valve of a species allied to *T. bicarinata*, Beecher.[1] In our specimen the thickened curved line seems to be part of the ventral edge, and the upper bounding line may be the remnant of a median ridge. If, however, we regard the curved lower prominence to be a portion of a median ridge, as in Mr. Beecher's fig. 4, the upper bounding line would represent a portion of a straight ridge along the dorsal region. Fig. 20 *b* shows a reticulation observable under the microscope on the right hand portion of the specimen. In fig. 8 of Mr. Beecher's plate is a coarse hexagonal network on an analogous specimen, which, however, he refers to the impression of some other fossil. The marking in ours is very much smaller, and with somewhat irregular and very delicate mesh-lines. Such an ornamentation is not uncommon among some of the bivalved Entomostraca.

Mr. Beecher's specimens are 25 mm. and 40 mm. long respectively. Our fragment is almost in the proportions of his fig. 4, but it is too imperfect for the comparison to be more than tentative.

[1] 1884, C. E. Beecher, 'Second Geol. Surv. Pennsylvania; Ceratiocaridæ from the Upper Dev. Measures in Warren Co.,' p. 16, pl. ii, figs. 3—5.

Order.—OSTRACODA, *Latreille*, 1801.

I. *Family.*—Cypridinadæ, *Baird*, 1850.

1. *Genus.*—Cypridina, *Milne Edwards*, 1838.

Many recent forms belonging to this genus are known, and several others have been described from the Chalk and the Carboniferous. The evidence of its existence in the Devonian age given below is somewhat doubtful, on account of the bad state of preservation of the specimens.

1. Cypridina ? sp. Pl. IV, figs. 10 *a*, 10 *b*, 10 *c*.

Description.—Test broadly ovate or heart-shaped, widest in front. Anterior side defective, apparently bearing a large beak, pinched in below, and slightly damaged above, approaching that of *Bradycinetus* (one of the *Cypridinadæ*). Dorsal edge boldly arched, without any thickening. Posterior margin narrowed, meeting the ventral margin at a blunt angle, and there bounded by an undulating rim or hem. Surface smooth, but showing traces of flexuous structure-lines, which have a flaky appearance and a tendency to become frills towards the anterior end.

Size.—10 mm. in length.

Locality.—Lummaton, a single defective specimen.

Remarks.—This obscure, ovate and convex fossil, may possibly be a Cypridinad, but the squamose condition at one end and the crenulated edge at the other are unusual features in this group. The projection ends in a notch, but is broken above and below. The linear markings upon the valve have a distant resemblance to the annulated ornament seen in some species of *Cyprella*,[1] but they are not so regular, and are not merely superficial. The absence of a tubercle also separates it from that genus. The fossil is figured here in order to draw attention to it should better specimens be found. At present there is doubt whether it is an Ostracod at all.

2. Cypridina ? sp. Pl. IV, figs. 6 *a*, 6 *b*, 6 *c*.

Description.—Valve ovate, broadest and highest behind, flanged below (figs. 6 *b* and *c*) as if overlapped on the ventral margin. Surface ornamented with superficial punctations which are obscure and very minute.

[1] 1874, Jones, Kirkby and Brady, 'Monogr. Carbonif. Cyprid.,' Pal. Soc., p. 40, pl. 4, figs. 13 and 17.

Size.—5 mm. in length.

Locality.—Lummaton.

Remarks.—The anterior portion of the figured specimen is unfortunately missing, and therefore the properties of the notch and beak, of the existence of which there are some indications, cannot be defined. On account of the high position of the broken part, and the great posterior convexity of the valve, it seems preferable to regard this fossil as a *Cypridina* rather than as a *Polycope* such as that represented by Pl. IV, fig. 12, which has less convexity, and no ventral overlap, and in which the slight damage on the edge does not necessarily indicate the loss of a beak.

3. CYPRIDINA? sp. Pl. IV, figs. 18 *a*, 18 *b*, 18 *c*.

Description.—Valve ovate and pyriform, very convex in the posterior half, steep on three of its margins and tapering towards the anterior extremity, which is broken away and obscured by the matrix. Edge view of the carapace (if the two valves were closed) ovate, acute anteriorly; end view subcircular or obovate. Remaining portion of test smooth.

Size.—6 mm. in length.

Locality.—Lummaton.

Remarks.—The fossil here indicated differs from any known similar forms by its great posterior convexity. The defective specimen figured is the only one which I have at present, but two other fine examples of Cypridinads in my collection, which were unfortunately destroyed by accident before they had been properly examined, would probably have thrown further light upon the species. It is evidently nearly related to the form shown in fig. 6 in its shape and relatively high posterior convexity, and may turn out to be a variety of the same species.

2. *Genus.*—CYPRIDINELLA, *Jones, Kirkby, & Brady*, 1874.

Certain species were separated from *Cypridina* in the 'Monogr. Brit. Foss. Biv. Entom. Carbonif. Cyprid.,' p. 21, as having both the front and hind margins more or less produced and angulate. The genus does not appear to have survived the Palæozoic Age.

1. CYPRIDINELLA CÆCA, n. sp. Pl. IV, figs. 16 *a*, 16 *b*, 16 *c*.

Description.—Valve subovate, narrow and pointed behind, rounded (by damage) in front, with a faint indication of a small notch.

PLATE I.

Fish Remains. (Page 1.)

Fig.

1. Fragment of bone, nat. size; *a*, another fragment, enlarged. My Collection. Lummaton.

Phacops batracheus, *Whidborne*. (Page 2.)

2, 3. Pygidia. Lummaton. My Collection.

5. Head; preserving outer layer of test; 5 *a*, profile; 5 *b*, eye, enlarged. Lummaton. My Collection.

4, 6. Other specimens, partially retaining test; 4 *a* and 6 *a*, side views. Lummaton. My Collection.

7. Another specimen, without test; 7 *a*, side view. Lummaton. My Collection.

Phacops latifrons, *Bronn*. (Page 6.)

8. Head, wanting test; figured by Salter as *Ph. cryptophthalmus*; 8 *a*, side view. Wolborough. Museum of Practical Geology.

9. Head, wanting test. Perhaps from Wolborough. Torquay Museum.

Cheirurus Pengellii, *Whidborne*. (Page 8.)

10. Head, with free cheeks. Lummaton. Torquay Museum.

11. Head, with cheek-spines (one restored); 11 *a*, side view. Lummaton. Woodwardian Museum.

12. Head. Wolborough. Vicary Collection.

13. Tail. Lummaton. Woodwardian Museum.

15, 16. Hypostomes (slightly restored). Lummaton. My Collection.

Cheirurus Sternbergii (*Boeck.*)? (Page 11.)

14. Portion of glabella; 14 *a*, side view. Lummaton. My Collection.

Acidaspis Robertsii, *Whidborne*. (Page 12.)

17. Head, wanting test (right hand spine restored); 17 *a*, side view. Lummaton. Woodwardian Museum.

Acidaspis pilata, *Whidborne*. (Page 13.)

18. Pygidium. Lummaton. My Collection.

Lichas devonianus, *Whidborne*. (Page 15.)

19. Head, preserving test. Eyes and one cheek partially restored; 19 *a*, front view; 19 *b*, profile. Lummaton. My Collection.

Cyphaspis ocellata, *Whidborne*. (Page 17.)

20. Head, retaining test; 20 *a*, profile slightly distorted; 20 *b*, magnified portion of the border. Lummaton. My Collection.

21. Head of another specimen, wanting test, one cheek-spine restored. Lummaton. My Collection.

22. Magnified portion of the border of another specimen. Lummaton. My Collection.

Proëtus batillus, *Whidborne*. (Page 20.)

23. Head and portion of first thoracic segment. *a*, border enlarged. Lummaton. Champernowne Collection.

24. Head of another specimen; 24 *a*, side view. Lummaton. Champernowne Collection.

25. Glabella of another specimen, preserving test; *a*, border enlarged. Lummaton. My Collection.

26. Head of a rather small specimen. Lummaton. My Collection.

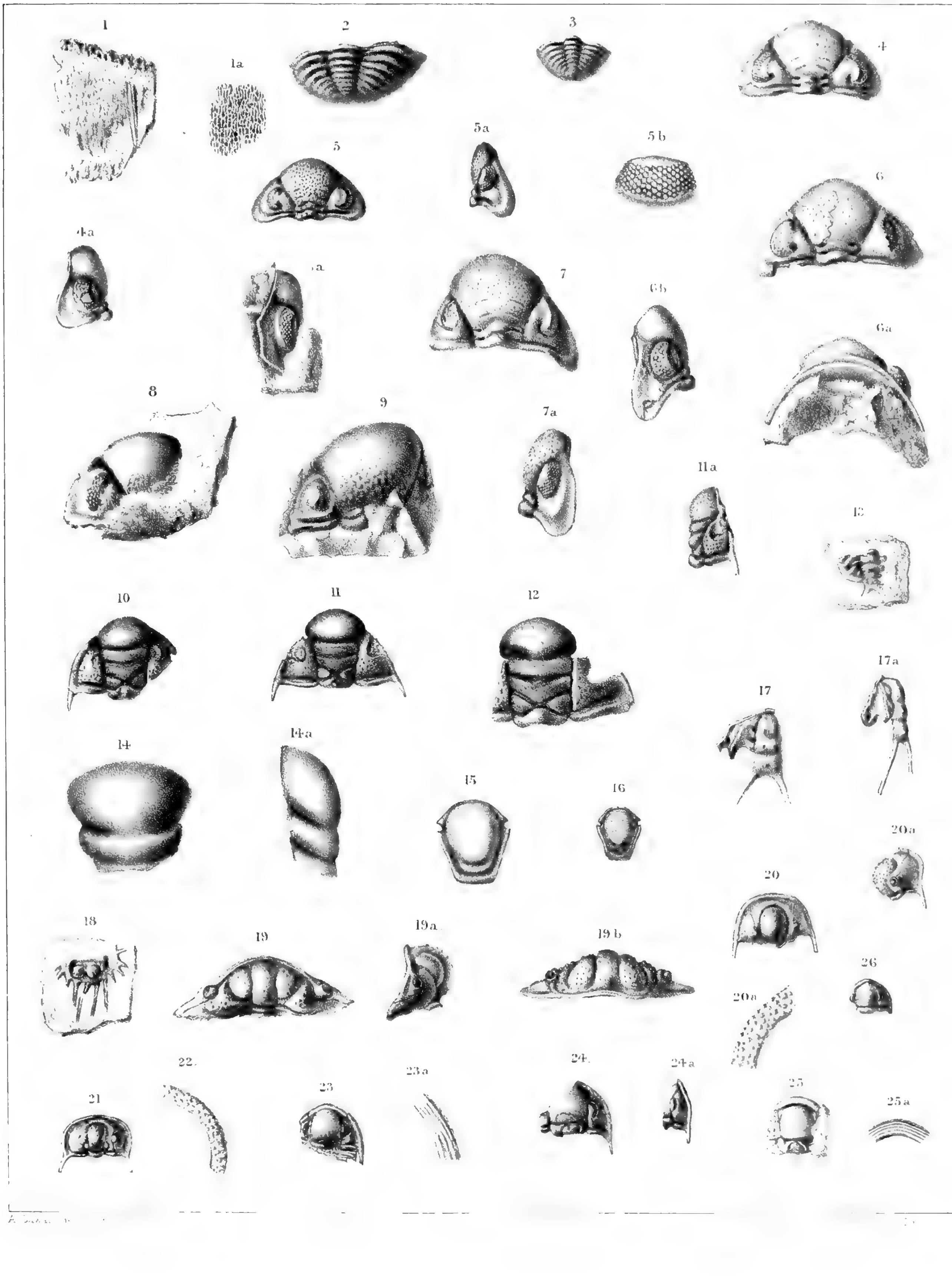
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PLATE II.

PROËTUS BATILLUS, *Whidborne.* (Page 20.)

FIG.

1. Free cheek, including cheek-spine, of a very large specimen. Lummaton. My Collection.
2. Pygidium; 2 *a*, enlarged; 2 *b*, border at posterior extremity much enlarged. Lummaton. My Collection.
3. Pygidium; 3 *a*, side view. Lummaton. Torquay Museum.
4. Head. An enlarged restoration from several specimens from Lummaton.

PROËTUS AUDAX, *Whidborne.* (Page 25.)

5, 6. Pygidia; 6 *a*, side view. Lummaton. My Collection.

7. Pygidium retaining outer test and showing tubercles in the axis. Lummaton. My Collection.
8. Glabella retaining test; 8 *a*, side view. Lummaton. My Collection.
9. Glabella of a rather more elongate specimen; 9 *a*, side view. Lummaton. My Collection.
10. Free cheek, including eye. Lummaton. My Collection.

PROËTUS SUBFRONTALIS, *Whidborne.* (Page 22.)

11. Glabella. Lummaton? Torquay Museum.
12. Glabella and distorted portion of cheek. Lummaton. My Collection.

PROËTUS CHAMPERNOWNI, n. sp. (Page 23.)

13. Portion of pygidium. Lummaton. Woodwardian Museum.
14. Portion of pygidium. Lummaton. My Collection.

DECHENELLA SETOSA, *Whidborne.* (Page 27.)

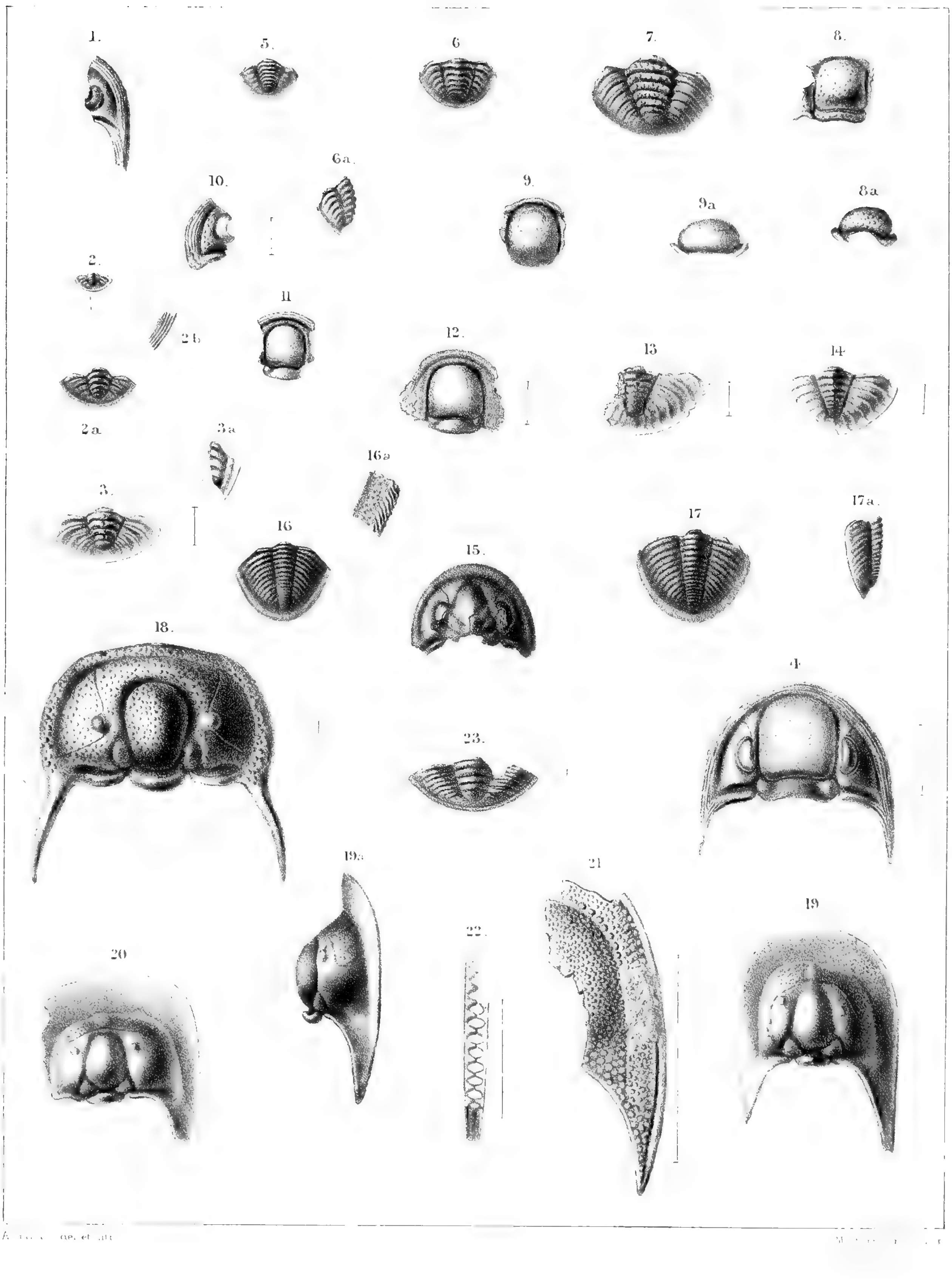
15. Head, partially retaining test. Chircombe Bridge. Vicary Collection.
16. Pygidium; 16 *a*, portion of the border of the same specimen enlarged. Chircombe Bridge. Museum of Practical Geology.
17. Pygidium of the largest specimen known; 17 *a*, side view. Chircombe Bridge. Vicary Collection.

CYPHASPIS OCELLATA, *Whidborne.* (Page 17.)

18. An enlarged restoration from several specimens from Lummaton.

HARPES MACROCEPHALUS, *Goldf.* (Page 30.)

19. Head, partially preserving test; 19 *a*, side view. Lummaton. My Collection.
20. Head of another specimen, also slightly distorted, wanting test. Lummaton. My Collection.
21. Portion of the cheek of another specimen, enlarged to show structure; the outer coat of the test is absent. Lummaton. My Collection.
22. Cheek-spine of another specimen, side view; the surface is absent except at the extremity. Lummaton. My Collection.
23. Pygidium, enlarged four diameters. Lummaton. Lee Collection, Brit. Mus.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19a
21
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PLATE III.

BRONTEUS PARDALIOS, *Whidborne.* (Page 35.)

FIG.

1, 2, 3. Glabellæ and portions of fixed cheek of three specimens. Lummaton. My Collection.

4. Head, imperfect, but retaining eye and free cheek *in situ ;* 4 *a*, side view. Lummaton. My Collection.

5. Pygidium of a very large specimen. Wolborough. British Museum. (There is a still larger, but very imperfect, specimen from Lummaton in the Woodwardian Museum.)

6. Portion of the rostral shield. Lummaton. My Collection.

7. Eye ; 7 *a*, the same, enlarged ; 7 *b*, the same, seen from above. Lummaton ? Torquay Museum.

BRONTEUS GRANULATUS, *Goldf.* (Page 40.)

8. Pygidium, with very large axis. Lee Collection, British Museum.

9. Glabella. Lummaton. My Collection.

10. Pygidium with small axis. British Museum. (This specimen was figured by Prestwich in his restoration of *B. flabellifer*, 'Geology,' &c., 1888, p. 77, pl. 2, fig. 11.)

BRONTEUS ALUTACEUS, *Goldf.* (Page 38.)

11. Fragment of a pygidium. Lummaton. My Collection.

BRONTEUS TIGRINUS, n. sp. (Page 34.)

12. Glabella and fixed cheek. Lummaton ? Torquay Museum.

BRONTEUS DELICATUS, *Whidborne.* (Page 33.)

13. Portion of a very small head. Lummaton. My Collection.

14. Portion of a large head ; 14 *a*, side view. Wolborough. My Collection.

15. Pygidium showing the spherical axis. Lummaton. Lee Collection, British Museum.

BRONTEUS FLABELLIFER, *Goldf.* (Page 38.)

16. The only known English specimen of Bronteus retaining the three portions of the body in juxtaposition. Chircombe Bridge. Vicary Collection.

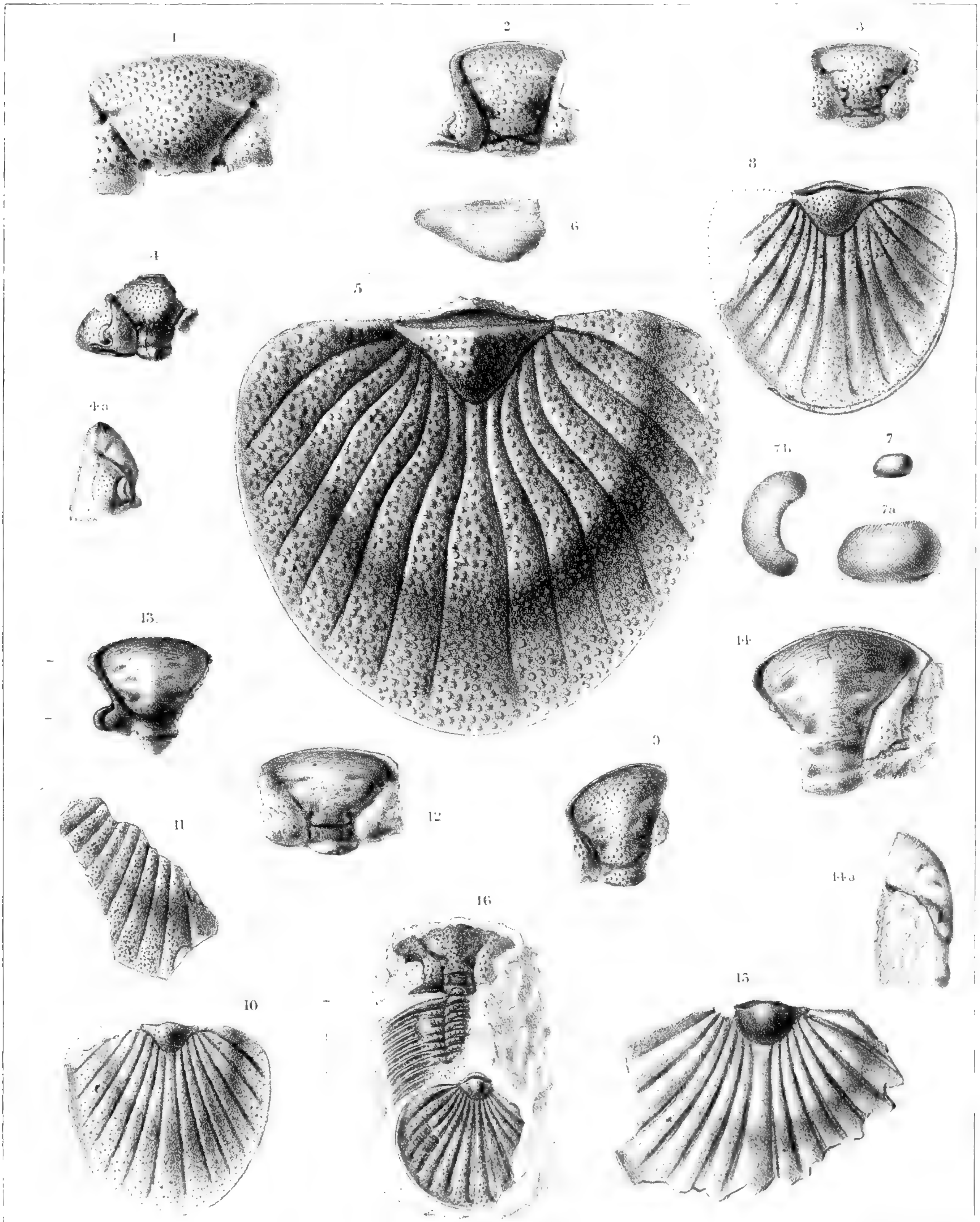

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PLATE IV.

N.B.—All the figures in this plate are from specimens from Lummaton in my Collection, except where otherwise stated.

CYPROSINA WHIDBORNEI, *Jones*. (Page 53.)

FIG.

1. Right valve; *a*, lateral view; *b*, dorsal view; *c*, end view. × $1\frac{1}{2}$ diam.
2. Left valve; *a*, lateral view; *b*, ventral view; *c*, end view. × $1\frac{1}{2}$ diam.

3, 4. Muscle-spots, from two individuals. × 10 diam.

CYPRIDELLA ? sp. (Page 47.)

5. Right valve; *a*, lateral view; *b*, ventral view; *c*, end view. × 4 diam.

CYPRIDINA ? 2 spp. ? (Page 45.)

6. Right valve; *a*, lateral view; *b*, ventral view; *c*, end view. × 4 diam.
10. Right valve; *a*, lateral view; *b*, ventral view; *c*, end view. × $3\frac{1}{2}$ diam.

POLYCOPE SIMPLEX, *Jones & Kirkby*. (Page 48.)

8. Left valve; *a*, lateral view; *b*, ventral view; *c*, end view. × 3 diam.

POLYCOPE DEVONICA, *Jones;* and varieties. (Pages 48—50.)

7. Left valve, defective in front; *a*, lateral view; *b*, ventral view; *c*, end view × 3 diam.
9. Left valve: original specimen. × $3\frac{1}{2}$ diam.
12. Var. *obliqua*, nov. Left valve, damaged in the upper front margin; *a*, lateral view; *b*, edge view; *c*, end view. × $3\frac{1}{2}$ diam.
13. Var. *major*, nov. Right valve; *a*, lateral view; *b*, ventral view; *c*, end view. × $3\frac{1}{2}$ diam.
17. Var. *concinna*, nov. Left valve; *a*, lateral view; *b*, dorsal view; *c*, end view. × $3\frac{1}{2}$ diam.

POLYCOPE HUGHESIÆ, n. sp. (Page 50.)

11. Carapace; *a*, showing left valve; *b*, dorsal view; *c*, front view. × $5\frac{1}{2}$ diam.

ENTOMIS PEREGRINA, *Whidborne*. (Page 51.)

14. Right valve; *a*, lateral view; *b*, ventral view; *c*, front view; *d*, rear view. × 6 diam.
15. Left valve; *a*, lateral view; *b*, ventral view; *c*, front view. × 5 diam. Woodwardian Museum.

CYPRIDINELLA CÆCA, n. sp. (Page 46.)

16. Right valve; *a*, lateral view; *b*, ventral view; *c*, front view. × 5 diam.

CYPRIDINA ? sp. (Page 46.)

18. Right valve; *a*, lateral view; *b*, ventral view; *c*, end view. × $3\frac{1}{2}$ diam.

SEDIS INCERTÆ. (Page 54.)

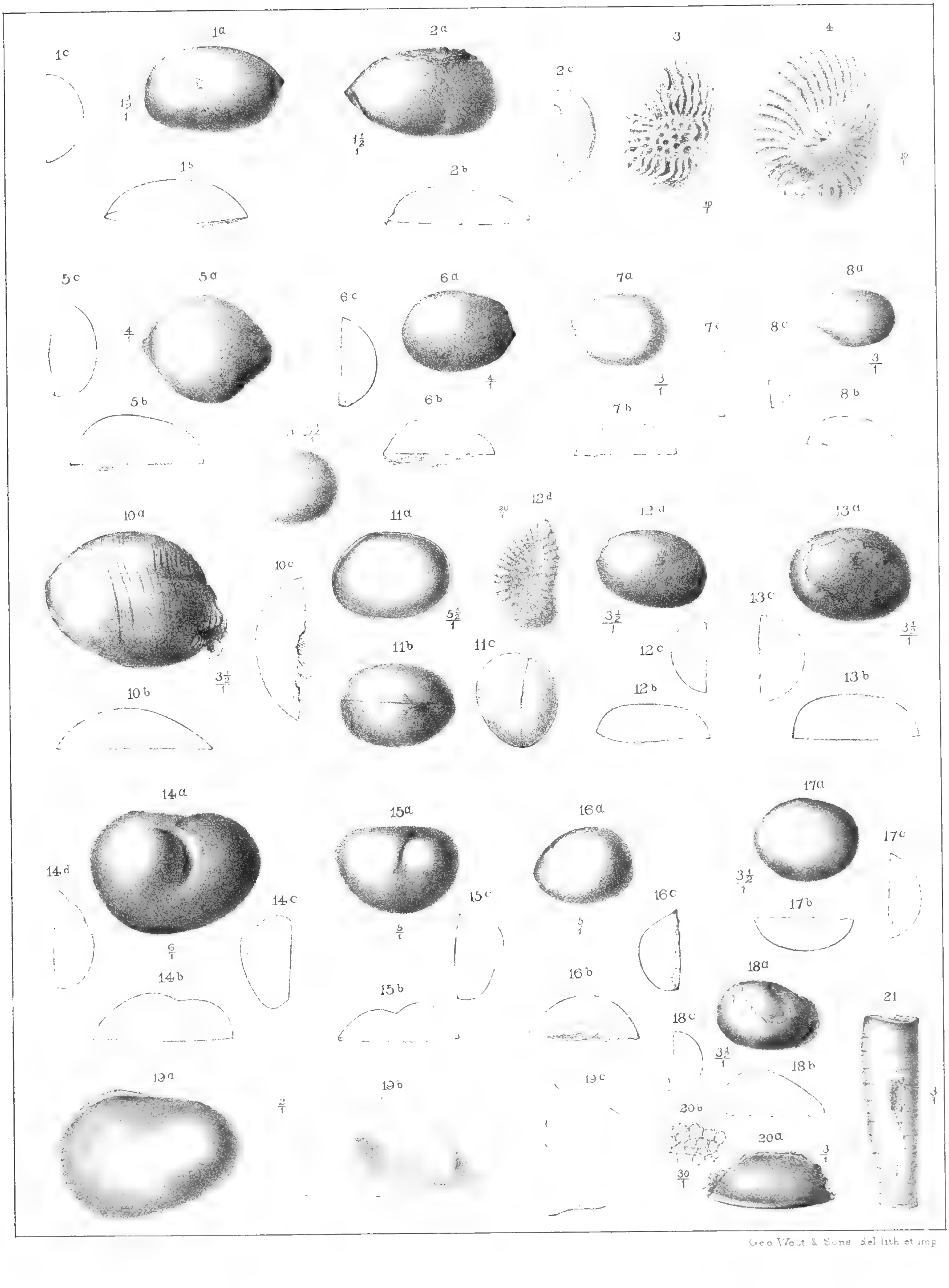
19. *a*, View from above; *b*, side view; *c*, end view. × 2 diam.

TROPIDOCARIS, sp. (Page 44.)

20. *a*, Portion of a valve; × 3 diam; *b*, portion of the ornament from the right-hand part of the specimen; × 30 diam.

BACTROPUS DECORATUS, *Whidborne*. (Page 43.)

21. Abdominal segment of Aristozoe. × 3 diam. Torquay Museum.



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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLXXII—MDCCCLXXXIX.

SUPPLEMENTS Nos. 4—9

OF THE

MONOGRAPH ON THE FOSSIL REPTILIA OF THE WEALDEN AND PURBECK FORMATIONS.

DIRECTIONS TO THE BINDER.

Supplements Nos. 4—9 of the Monograph of the Reptilia of the Wealden Formations will be found in the Volumes of the Palæontographical Society issued for the years 1871, 1873, 1876, 1878, 1879, and 1888.

Supplements Nos. 1, 2, and 3, will be found in the Volumes for the years 1856, 1857, and 1862. Directions for binding these will be found in the Volume for the year 1864.

ORDER OF BINDING AND DATES OF PUBLICATION.

PAGES	PLATES	ISSUED IN VOL. FOR YEAR	PUBLISHED
General Title-page	—	1888	March, 1889.
Preface, pp. v—vii	—	"	"
Table of Contents, p. viii	—	"	"
Title-page of Supplement No. 4, pp. 1—15	I—III	1871	June, 1872.
" " 5, pp. 1—18	I, II	1873	February, 1874.
" " 6, pp. 1—7	—	"	"
" " 7, pp. 1—7	I—VI	1876	December, 1876.
" " 8, pp. 1—15	I—VI	1878	March, 1878.
" " 9, pp. 1—19	I—IV	1879	May, 1879.

A MONOGRAPH

ON THE

FOSSIL REPTILIA

OF THE

WEALDEN AND PURBECK FORMATIONS.

SUPPLEMENTS Nos. 4—9.

BY

SIR RICHARD OWEN, K.C.B., D.C.L., F.R.S.,

FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE,

ETC. ETC.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1872—1889.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

PREFACE

TO THE

REPTILIA OF THE WEALDEN AND PURBECK FORMATIONS

(SUPPLEMENTS Nos. 4—9).

In the volume of Monographs issued by the Palæontographical Society for the year 1887, the following, which have appeared in previous volumes, are noted at pp. 25 and 29 of the 'List of Members, Volumes, &c.,' as in course of separate publication :—

1. The Reptilia of the Wealden Formation (Supplements).
2. The Reptilia of the Kimmeridge Clay.
3. The Reptilia of the Mesozoic Formations, and
4. The Cetacea of the Crag.

The Supplemental Monographs first specified are chiefly devoted to the restoration of the extinct Reptile called *Iguanodon,* from some resemblance of its teeth to those characterising the Iguana lizard. Materials for this advance were first kindly supplied by Samuel Husbands Beckles, Esq., F.R.S., one of the correspondents on whom I pressed my wish. The rich series of remains, and their determinations as parts of the skeleton of an *Iguanodon,* form the subjects of the Supplement, No. 4, pp. 1—15, Plates I, II, III, in the Palæontographical Society's volume issued in 1872. The petrified bone, forming the core of the horny spine or claw with which the fore-leg of the more peaceable vegetable-feeding Reptile was armed, forms the subject of the 4to Plate II of that Monograph, and the large folding Plate I gives the bones of the fore-limb, also of the natural size. The geological period indicated by the rock from which these evidences were extricated is that termed the 'Wealden,' in the Upper or later Secondary Period.

Further and more exact knowledge of the dental characters of *Iguanodon* was gained by the reception of fossils from a Wealden formation at Stammerham, Sussex, transmitted to me by G. B. Holmes, Esq. These were noted and illustrated in the

Supplement, No. 5, communicated to the Palæontographical Society in the year 1873. A considerable portion of the lower jaw with teeth, transmitted by Mr. Beckles, supplied the ground for determining the side of the crown to which the characteristic ridges are limited, that, namely, which is turned toward the cavity of the mouth; the opposite or outer side of the tooth being smooth. The peculiar shape of the well-preserved symphysial end of the jaw supplied grounds of inference as to the form and movements of the tongue of the great extinct phytophagous or mixed-feeding dragon. Careful display of the tooth-bearing extent of this fossil specimen demonstrated the Reptilian character of the frequent succession and shedding of the teeth—a class-character contrasting with the Mammalian limitation of teeth to two sets, which accordingly bear the designation of the "deciduous" and the "permanent" series; the first formed, which characterise the immature mammal, being also known as "milk-teeth."

In 1873 the right ramus, or half of the lower jaw, added acceptable characters of the teeth of the *Iguanodon*, showing the entire number in the dentary part of the jaw, and the true relative positions of the smooth and the sculptured surfaces of the tooth-crown. This specimen, together with others from other Wealden localities, determined the Reptilian character of a more frequent succession of teeth than in the Mammalian class, a series of larger size being developed to correspond with the increased length of the jaws, and replacing the smaller teeth of the immature periods, which were shed.

Minor differential characters of the tooth-crown are pointed out, which, if observed only in detached fossil teeth, might have made foundations for distinct species or genera of extinct Reptiles.

A generic modification of the mandible, previously unnoted, is described as indicative (in addition to, and conformative with, the dental characters) of the vegetable or mixed diet of the great extinct Reptile, which of old once trod what now forms part of the Island of Great Britain.

Characters of the extinct Reptiles of the same period, indicative of a Dinosaurian family (*Prionodontia*) by association with the genus *Iguanodon*, are defined in this Supplement (No. 5), p. 10. The characters of the bony palate, more especially in relation to the position and conformation of the inner or hinder nostrils, are noted in the several Orders of *Reptilia*, those in the *Crocodilia* being especially defined.

Species representative of a genus, but showing a considerable range as to size, are most commonly known in the Mammalian class. A familiar example is manifested in the feline genus, where the attempt has been made to add needless complexity to zoology by coining a generic name for a small species, distinct from that given by Linnæus to it as well as to the lion and tiger. But the observed modifications of the dental system are too slight to obtain the suffrages of zoologists for a distinct term.

It is interesting to note that the complexities of structure, osteological and dental, manifested by the *Iguanodon*, and suggesting an analogy to a higher class, should be likewise extended by a manifestation of their presence in an unequivocal Saurian of the same geological epoch, with the same complex type of teeth as in the *Iguanodon*. The degree of correspondence in this generic character is shown in Plate I of this 'Wealden and Purbeck Reptilia Supplement,' No. 5, where the tooth-crown characteristic of the genus of the small species (*Iguanodon Foxii*), fig. 10, is shown by the side of a corresponding molar of the larger species (*Iguanodon Mantelli*, fig. 4). The portion of skull of the small kind (Plate I, fig. 9) supplies acceptably what the larger kind of *Iguanodon* still lacks.

In Plate II a lower molar of *Iguanodon Foxii* is figured, of the natural size (fig. 14) and magnified (fig. 15), facilitating the comparison with the mandibular molars of the natural size in the larger species (Plate I, fig. 3). In the same plate the hinder or occipital surface of the smaller species of *Iguanodon* (Plate II, fig. 1, nat. size) is contrasted with figures of the corresponding part of the skull in the existing *Iguana tuberculata* (Ib., fig. 3). The base of the skull is similarly illustrated in fig. 5 (*Iguanodon Foxii*) and fig. 7 (*Iguana tuberculata*). These parts of *Iguanodon Mantelli* must be obtained and adequately made known before palæntology can be legitimately encumbered with newly invented generic terms.

The kind and degree of modification of the tooth-crown justifying recognition of a distinct genus of extinct Reptile are manifested in fig. 21, showing the outer surface of an upper molar of *Scelidosaurus Harrisonii*. In the same plate are given three views, figs. 23, 24, 25, of the instructively preserved skull of *Hylæochampsa vectianus*.

R. O.

1*st February*, 1888.

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OF

SUPPLEMENTS Nos. 4—9 OF THE MONOGRAPH ON THE FOSSIL REPTILIA OF THE WEALDEN AND PURBECK FORMATIONS.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLXI—MDCCCLXXXIX.

MONOGRAPH ON THE REPTILIA OF THE KIMMERIDGE CLAY AND PORTLAND STONE.

DIRECTIONS TO THE BINDER.

The Monograph on the Reptilia of the Kimmeridge Clay and Portland Stone will be found in the volumes of the Palæontographical Society issued for the years 1859, 1860, and 1868. The General Title-page, Title-pages Nos. I and II, Preface, and Table of Contents, will be found in the volume for 1888.

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General Title-page	—	1888	March, 1889.
Preface	—	,,	,,
Table of Contents	—	,,	,,
Title-page No. I ; 15, 16[1]	VII	1859	December, 1861.
,, ,, II ; 27, 28[2]	XII	1860	May, 1863.
,, ,, III ; 1—12	I—IV	1868	February, 1869.

[1] Pages 1—14, and Plates I—VI, belong to the Monograph on the Fossil Reptilia of the Liassic Formations, the directions for the binding of which will be found in the volume for the year 1881.

[2] Pages 1—26, and Plates I—XI, belong to the Monograph of the Fossil Reptilia of the Liassic Formations, the directions for the binding of which will be found in the volume for the year 1881.

MONOGRAPH

ON THE

REPTILIA

OF THE

KIMMERIDGE CLAY AND PORTLAND STONE.

BY

SIR RICHARD OWEN, K.C.B., D.C.L., F.R.S.,
FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE,
ETC. ETC.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
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ADLARD AND SON, BARTHOLOMEW CLOSE.

PREFACE

TO THE

REPTILIA OF THE KIMMERIDGE CLAY AND PORTLAND STONE.

THE annual volume of the Palæontographical Society for the year 1859 was issued in the year 1861, but the discovery, determination, and description of the fossil Reptilian remains therein recorded were completed before the end of 1860.

Other fossil remains, besides those mentioned in the Monographs referred to (pp. 15 and 27) from the Kimmeridge Clay, have given confirmatory evidence of the genus *Pliosaurus*, first recorded in the 'British Association Reports,' 1841, and characterised in the volumes published by the Palæontographical Society in 1861 and 1863.

R. O

February 1st, 1888.

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ON THE

BRITISH FOSSIL REPTILIA

FROM THE

KIMMERIDGE CLAY.

BY

RICHARD OWEN, F.R.S., D.C.L.,

FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE,

ETC. ETC.

No. I.

CONTAINING

Pliosaurus grandis.

Pages 15, 16; Plate VII.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1861.

MONOGRAPH

ON THE

BRITISH FOSSIL REPTILIA

FROM THE

KIMMERIDGE CLAY.

BY

RICHARD OWEN, F.R.S., D.C.L.,
FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE,
ETC. ETC.

No. II.

CONTAINING

PLIOSAURUS GRANDIS.

PAGES 27, 28; PLATE XII.

LONDON:
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THE

PALÆONTOGRAPHICAL SOCIETY.

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LONDON:

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ON THE

BRITISH FOSSIL REPTILIA

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No. I.

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1863.

THE

PALÆONTOGRAPHICAL SOCIETY.

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MDCCCLXXIV—MDCCCLXXXIX.

MONOGRAPH ON THE FOSSIL REPTILIA OF THE MESOZOIC FORMATIONS.

DIRECTIONS TO THE BINDER.

The Monograph on the Fossil Reptilia of the Mesozoic Formations will be found in the volumes of the Palæontographical Society for the years 1873, 1875, and 1877.

Cancel the Title-pages of Parts I, II, and III in the volumes for 1873, 1875, and 1877, and *substitute* the General Title-page, together with the Preface and Table of Contents, provided in the volume for the year 1888.

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1—14	I, II	1873	February, 1874
15—93	III—XXII	1875	December, 1875
95—97	XXIII, XXIV	1877	February, 1877

A MONOGRAPH

ON THE

FOSSIL REPTILIA

OF THE

MESOZOIC FORMATIONS.

BY

SIR RICHARD OWEN, K.C.B., D.C.L., F.R.S.,

FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE,

ETC. ETC.

LONDON:

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PREFACE

TO THE

REPTILIA OF THE MESOZOIC FORMATIONS.

IN collecting the materials for a work on the Teeth of Animals, I made my first acquaintance with some previously unknown *Reptilia*. A genus was defined for which the name *Pliosaurus* was proposed, and a characteristic tooth was figured in pl. lxviii of the volume of my 'Odontography,' published in 1840. The subsequently discovered characters were described and illustrated in the Monograph on the Reptilia of the Kimmeridge Clay, in the volume of the Palæontographical Society for 1859, issued in 1861, pp. 15, 16.[1]

In the same Monograph of the volume for the year 1860, issued in 1863, the huge teeth of the *Pliosaurus grandis* were described (p. 27), and figured of the natural size in the folding Plate (Pl. XII).

Pursuing the researches, so liberally illustrated in the years 1861 and 1863, further results, enriched by the additional species, *Pliosaurus trochanterius* and *Pliosaurus Portlandicus*, were given with similar illustrations in the Palæontographical volume for 1868, issued in 1869, pp. 1—12.

The publication of the first part of the Monograph on *Scelidosaurus* (Volume for 1859) had the usual result. The active and careful observer, JAMES HARRISON, Esq., to whom I was indebted for the evidences of the Scelidosaur, supplied me with the subjects for a second part of the Monograph, in which an almost entire skeleton of this extinct British Reptile was described and figured in eleven plates of 4to, and of larger (folding) size (Volume for 1860).

My friend, encouraged by the publication of a description of the first indication of the extinct reptilian *Scelidosaurus*, pursued with increased vigour

[1] This was associated, in the Pal. Soc. Vol. for 1859, with the Monograph on *Scelidosaurus*.

and zeal his quest of fossil remains in the cliff of Lower Lias at Charmouth, where he first came upon that indication, and he kindly complied with my desire to send the block of matrix indicating an included bone. I successively received from him twelve additional blocks, and superintended the careful operations of our skilled Museum masons, the results being an almost complete skeleton of the extinct Reptile.

Other fossil evidences subsequently submitted to me served for a definition of characters of a Crocodilian genus *Poikilopleuron*,[1] and of a Dinosaurian genus *Chondrosteosaurus*.[1] The volume issued by the Palæontographical Society for the year 1876 contained the Monograph on these extinct Reptilia of the British Wealden and Purbeck Formations. A trunk vertebra of a Chondrosteosaur from the Isle of Wight, the subject of Plate VI, equals in size the corresponding bone of a full-grown elephant. The exposed canal of the myelon (spinal marrow) of an eagle is introduced upon the plate, exposing that canal which lodged the corresponding sensory and motory centre in the gigantic terrestrial, cold-blooded vertebrate, to exemplify the contrasted relations of the nervous to the muscular machinery in an active, warm-blooded and in a sluggish, cold-blooded vertebrate animal. The insulation of the actual locality of the fossil took place long after the Continent of the Secondary geological period of our planet had been broken up.

Subsequent researches in formations of the Wealden and Purbeck periods unearthed fossil remains with characters on which the Crocodilian genera *Goniopholis*, *Petrosaurus*, and *Suchosaurus* were founded. The descriptions and figures form the Supplement, No. 8, of the Monograph on the Reptilia of the Wealden and Purbeck Formations, issued by the Palæontographical Society in 1878.

Characters of huge extinct Flying Dragons (*Pterosauria*) from British localities of Gault, Wealden, Kimmeridgian, Oolitic, and Liassic formations, were described and figured in the volume issued by the Palæontographical Society for the year 1873; namely, pages 1—14 of the present Monograph.

In the volume for 1875, pages 15—93, osteological modifications in fossil Reptilian remains from British Secondary formations were described and figured, which interest the comparative osteologist more than even the palæontologist.

The proportions of the skeleton of one and the same individual of a huge extinct Reptile are unusually great in the type of the genus *Omosaurus*, fossilized in the Kimmeridge clay at Swindon.

The history of its discovery exemplifies the importance and advantage of noting indications of an organic constituent in a formation, the utility of which justifies the organisation and operations of a commercial company, and the valuable result to science in arresting the disturbance of such indications until a geologist cognizant of the zoological characters so indicated has seen the fragment, and

[1] See Supplement No. 7 of the Monograph on the Reptilia of the Wealden and Purbeck Formations.

formed an opinion of its nature, and the probability of the further evidence to be obtained by excavations in given directions. The results were detailed and illustrated at pages 45—69 of the present Monograph by means of fossil specimens obtained through the kind permission of the Directors of the "Swindon Brick and Tile Company."

My conclusions as to the "Origin of Species" are given and illustrated at pages 69—93 of the present Monograph.

R. O.

February 6th, 1888.

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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLXX—MDCCCLXXXIX.

MONOGRAPH ON THE CETACEA OF THE RED CRAG.

DIRECTIONS TO THE BINDER.

The Monograph on the Cetacea of the Red Crag will be found in the volumes of the Palæontographical Society for the years 1869 and 1888.

Cancel the Title-page in the volume for the year 1869, and *substitute* that provided in the volume for the year 1888; and add the Preface and Table of Contents given in the latter volume.

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Preface	—	,,	,,
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1—40	I—V	1869	January, 1870.

MONOGRAPH

ON THE

BRITISH

FOSSIL CETACEA

FROM THE

RED CRAG.

BY

SIR RICHARD OWEN, K.C.B., D.C.L., F.R.S.,

FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE,

ETC. ETC.

LONDON:

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1870—1889.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

PREFACE

TO THE

CETACEA FROM THE RED CRAG.

THE 'Report on British Fossil Mammals,' prepared at the request of the British Association, and which appeared in the volume issued in 1840, included a description of fossil remains, chiefly teeth, for the study of which I was indebted to the Rev. PROFESSOR HENSLOW, F.R.S.

The nature of these fossils induced me to devote subsequent leisure to explorations of the localities and to acquisition of specimens, which were added as donations to the Hunterian and British Museums.

In the localities exposing a worn and abraded Pliocene formation, commonly known as the Red Crag, the chief organic remains consist of portions or fragments of skulls evidencing attrition before having become embedded in the sea-bottom of the period. I therefore preceded their description by abridging the account given by CUVIER of better preserved cranial and dental evidences of extinct Cetacean species to which the British fragmentary fossils were nearly allied.

The figures denoting the component bones exposed in cranial sections of the subjects of my descriptions, such as that shown in fig. 9, p. 20, are those used in the work entitled 'On the Archetype and Homologies of the Vertebrate Skeleton' (8vo., 1848). My brief notice of these Cetacean remains in the 'Quart. Journ. Geol. Soc.,' vol. xii, p. 228, and correspondence with friendly Collectors led to the extent of descriptive and illustrated matter which the Council of the Palæontographical Society deemed worthy of a place in the volume issued in 1870.

R. O.

February 8th, 1888.

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