PALÆONTOGRAPHICAL SOCIETY.

VOL. XLIII.

CRETACEOUS ENTOMOSTRACA.

SUPPLEMENT.

PAGES i—viii; 1—70; PLATES I—IV.

JURASSIC GASTEROPODA.

PART I, No. 4.

(GASTEROPODA OF THE INFERIOR OOLITE.)

PAGES 193—224; PLATES XII—XVI.

INFERIOR OOLITE AMMONITES.

PART IV.

PAGES 145—224; PLATES XXIV—XXXVI.

DEVONIAN FAUNA OF THE SOUTH OF ENGLAND.

PART II.

PAGES 47—154; PLATES V—VIII, VIII A, IX—XV.

ISSUED FOR 1889.

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VOLUME XLIII.

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I. A CATALOGUE OF THE WORKS ALREADY PUBLISHED;

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

III. THE DATES OF ISSUE OF THE ANNUAL VOLUMES;

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

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

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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.

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„ 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.
„ XXVII.*	„	1873	The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part I (Tertiary and Cretaceous), by Mr. Davidson, 8 plates. Supplement to the Crag Mollusca, Part II (Bivalves), by Mr. S. V. Wood, 5 plates. Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen, 2 plates. Supplement to the Reptilia of the Wealden (Hylæochampsa) No. VI, by Prof. Owen. The Fossil Reptilia of the Mesozoic Formations, Part I, by Prof. Owen, 2 plates.

* 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. XXVIII*	Issued for the Year	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.
„ XXXV*	„	1881	The Fossil Echinodermata, Cretaceous, Vol. I, Part IX, by Dr. Wright, 6 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part IV (Devonian and Silurian, from Budleigh-Salterton Pebble Bed), by Mr. Davidson, 5 plates. The Fossil Trigoniæ (Supplement No. 1), by Dr. Lycett. The Lias Ammonites, Part IV, by Dr. Wright, 10 plates. The Reptilia of the Liassic Formations, Part III (*Conclusion*), by Prof. Owen, 13 plates. The Fossil Elephants (E. primigenius and E. meridionalis), Part III (*Conclusion*), by Prof. Leith Adams, 13 plates.

* 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. XXXVI*	Issued for the Year 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.
„ XLIII*	„ 1889	The Cretaceous Entomostraca (Supplement), by Prof. T. Rupert Jones and Dr. G. J. Hinde, 4 plates. The Jurassic Gasteropoda, Part I, No. 4, by Mr. W. H. Hudleston, 5 plates. The Inferior Oolite Ammonites, Part IV, by Mr. S. S. Buckman, 13 plates. The Devonian Fauna of the South of England, Part II, by the Rev. G. F. Whidborne, 12 plates.

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§ II. LIST OF MONOGRAPHS

Completed, in course of Publication, and in Preparation.

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

The Morphology and Histology of Stigmaria ficoides by Prof. W. C. Williamson. (*Complete with Title-page and Index in the Volume for* 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 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.
The Wealden, Purbeck, and Jurassic Entomostraca, by Messrs. T. R. Jones and G. S. Brady.
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. G. C. Crick.

† 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.
,,	XLIII	,,	1889	,,	,,			,,	March, 1890.

§ IV. SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* MARCH, 1890): *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
,, ,, ,, and Mr. C. D. Sherborn (Supplement), COMPLETE	1888	1889	55	3	134	48
The Cretaceous Entomostraca, by Prof. Rupert Jones, COMPLETE	1849	1850	41	7	176	31
,, ,, ,, and Dr. G. J. Hinde (Supplement)	1889	1890	78	4	258	46
The Carboniferous Entomostraca, by Prof. Rupert Jones and Messrs. J. W. Kirkby and Prof. G. S. Brady. Part I, COMPLETE	1874, 1884	1874, 1884	95	7	374	81
The Fossil Estheriæ, by Prof. Rupert Jones, COMPLETE	1860	1863	139	5	158	19*i*
		CARRIED FORWARD...	4083	513	8856	1664

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* MARCH, 1890)—*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...	4083	513	8856	1664
The Palæozoic Phyllopoda, by Prof. Rupert Jones and Dr. H. Woodward, *in course of completion*	1887	1888	72	12	121	39
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, 1889	1887, 1888, 1889, 1890	224	16	558	162
The Inferior Oolite Ammonites, by Mr. S. S. Buckman, *in course of completion*	1886, 1887, 1888, 1889	1887, 1888, 1889, 1890	224	37	427	60
The Liassic Ammonites, by Dr. Wright, COMPLETE	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1886	503	91	726	107
		CARRIED FORWARD...	9943	1188	25,805	5174

SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* MARCH, 1890)—*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...	9943	1188	25,805	5174
The Belemnites, by Prof. Phillips, *in course of completion*	1863, 1864, 1866, 1868, 1869	1865, 1866, 1867, 1869, 1870	128	36	622	69
The Upper Cretaceous Cephalopoda, by Mr. D. Sharpe, COMPLETE	1853, 1854, 1855	1853, 1855, 1857	67	27	319	79
The Fossils of the Permian Formation, by Prof. King, COMPLETE	1849, 1854*e*	1850, 1855	287	29	511	138
The Fauna of the Devonian Formation of the South of England, by the Rev. G. F. Whidborne, *in course of completion*	1888, 1889	1889, 1890	156	16	370	90
The Sirenoid Ganoids, by Prof. Miall, *in course of completion*	1878	1878	32	6	61	6
The Fishes of the Carboniferous Formation, by Dr. Traquair, *in course of completion*	1877	1877	60	7	58	5
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, *in course of completion*	1867, 1869	1868, 1870	62	14	195	21
The Reptilia of the London Clay [and of the Bracklesham and other Tertiary Beds], by Profs. Owen and Bell, Vol. I, COMPLETE ‡	1848, 1849, 1856*f*	1849, 1850, 1859	150	58	304	39
,, ,, Vol. II, Part I, by Prof. Owen, COMPLETE	1880	1880	4	2	4	1
The Reptilia of the Cretaceous Formations, by Prof. Owen, COMPLETE‡	1851, 1857, 1858, 1862	1851, 1859, 1861, 1864	184	59	519	26
The Reptilia of the Wealden and Purbeck Formations (with Supplements 1, 2, 3), by Prof. Owen, COMPLETE ‡	1853, 1854, 1855, 1856, 1857, 1858, 1862	1853, 1855, 1857, 1858, 1859, 1861, 1864	155	62	251	17
The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), COMPLETE	1871, 1873, 1876, 1878, 1879, 1888*n*	1872, 1874, 1876, 1878, 1879, 1889	85	21	175	15
The Reptilia of the Kimmeridge Clay Formation, by Prof. Owen, COMPLETE	1859, 1860, 1868, 1888*n*	1861, 1863, 1869, 1889	16	6	23	4
The Reptilia of the Liassic Formations, by Prof. Owen, COMPLETE	1859,‖ 1860,‖ 1863, 1869, 1881*n*	1861, 1863, 1865, 1870, 1881	174	50	276	20
The Reptilia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1873, 1875, 1877, 1888*n*	1874, 1875, 1877	101	24	165	17
The Red Crag Cetacea, by Prof. Owen, COMPLETE	1869, 1888*n*	1870, 1889	42	5	43	9
The Fossil Elephants, by Prof. Leith Adams, COMPLETE	1877, 1879, 1881*n*	1877, 1879, 1881	265	28	216	3
The Pleistocene Mammalia, by Messrs. W. Boyd Dawkins and W. A. Sanford, *in course of completion*	1864, 1867, 1868, 1871, 1878, 1886	1866, 1868, 1869, 1872, 1878, 1887	333	39	340	12
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1870	1871	115	4	247	30
		TOTAL	12,359	1681	30,504	5775

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—1889) *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, 1889	...	......	......	1860
Wealden	...	...	...	...	......	......	...	1860			
Oolitic	...	...	...	1851, 1872	1855, 1856, 1857, 1858, 1861, 1878, 1880	1851	...	1860			
Liassic	...	...	...	1851, 1866, 1867	1855, 1856, 1858, 1861, 1864						
Triassic	...	...	...	...	1880	......	...	1860			
Permian	1849	1849	1849, 1876	1849, 1852	1849	......	1849	1860			
Carboniferous...	1867, 1870, 1871, 1875, 1886	1887	1876	1852	......	......	1874, 1884	1860, 1887	1872, 1878	1883, 1884	
Devonian	...	1887	...	1853, 1885, 1888	......	......	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—1889) *of the* PALÆONTOGRAPHICAL SOCIETY (*continued*).

	MOLLUSCA.				VERTEBRATA.		
	Polyzoa.	Brachiopoda.	Monomyaria, Dimyaria, and Gasteropoda.	Cephalopoda.	Fishes.	Reptiles.	Mammalia.
Pleistocene	...	1873	......	...	...	......	1864, 1867, 1868, 1871, 1877, 1878, 1879, 1881, 1886
Crag	1857	1852, 1873, 1879	1847, 1850, 1853, 1855, 1871, 1873, 1879, 1882	...	...	......	1869, 1881, 1888
Eocene	...	1852, 1873	1852, 1854, 1855, 1858, 1859, 1862, 1870, 1877	1848	...	1848, 1849, 1856, 1880	
Cretaceous.........	...	1852, 1854, 1873, 1884	1872, 1875, 1877, 1879	1853, 1854, 1855	...	1851, 1857, 1858, 1862, 1873, 1888	
Wealden	...	... ..	......	...	...	1853, 1854, 1855, 1856, 1857, 1862, 1871, 1873, 1875, 1876, 1878, 1879	
Oolitic	...	1850, 1852, 1876, 1878, 1884	1850, 1853, 1854, 1872, 1874, 1875, 1877, 1879, 1883, 1886, 1887, 1888, 1889	1850, 1861, 1868, 1869, 1886, 1887, 1888, 1889	...	(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	......	1889	1867, 1869		
Silurian............	...	1865, 1866, 1868, 1870, 1881, 1882, 1883					
Cambrian							

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

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1889.

LONDON:

MDCCCXC.

A SUPPLEMENTARY MONOGRAPH

OF THE

CRETACEOUS ENTOMOSTRACA

OF

ENGLAND AND IRELAND.

BY

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

AND

GEORGE JENNINGS HINDE, PH.D., F.G.S., &c.

PAGES i—viii; 1—70. PLATES I—IV.

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TABLE OF CONTENTS.

INTRODUCTION.

When the Monograph of the Cretaceous Entomostraca was written by one of us in 1849, our knowledge of these organisms, though considerably beyond the rudimentary stage, was very deficient in that critical acquaintance with the structural features which now determine the bounds of genera and species. It is not surprising, therefore, that, with the great amount of research which has been bestowed on the group within the last forty years, it should be found necessary to revise in many respects the determinations then arrived at. The author of the former Monograph can now see that, actuated by a desire not to increase the number of species unnecessarily, he ventured to place some of the English forms under species, described by Continental palæontologists, which have since been proved to be distinct; and, further, in view of the results of recent researches, that the limits then assigned to genera and species were together of too wide a character to be now maintained. Owing also to the imperfect figures and lax descriptions of species, some of the Cretaceous forms were inaccurately compared with species from different geological formations on the Continent and elsewhere, as well as with some still existing forms. A brief revision of the Monograph of the Cretaceous Entomostraca was attempted in 1870;[1] but, owing to various obstacles, the carrying out of the wish, then expressed, of re-examining the work and reproducing the illustrations on a smaller scale has been delayed until now. In some respects this delay has been advantageous; for, thanks to recent discoveries, not only has the number of species been materially added to, but more complete specimens of forms already known have been obtained, from which better figures have been prepared.

Of the new plates accompanying this Supplement, the figures on three are drawn mostly on the scale of about 18 diameters, suitable figures in the plates of the Monograph having been reduced by photography and redrawn on this smaller scale. Figures of new species, some on the scales of 20 and of 25 diameters, were added, and, owing to the necessities of space, without close relation-

[1] "Notes on the Cretaceous Entomostraca" by Prof. T. Rupert Jones, F.G.S., 'Geol. Mag.' vol. vii, 1870, pp. 74—77.

ship being maintained for adjoining figures. It had been intended to include the series in three plates, but fresh species were discovered, and these, together with forms in which it was desirable to illustrate particular features on a larger scale, are shown on the fourth plate on the scale of 25 and 30 diameters.

As regards the classification, we have followed as closely as possible that adopted by Brady and Norman in their excellent Monograph of the Marine and Freshwater Ostracoda of the North Atlantic and North-west Europe ('Trans. Royal Dublin Society,' ser. 2, vol. iv, 1889). Of course with respect to the fossil forms, the character of the carapace-valves furnishes the only ground for comparison with the recent; but this is in most instances now known to be so intimately correlated with the other structural features of the organism, that it may reasonably be considered as affording a safe clue to their systematic relationships.

We are enabled to give the geological horizon and locality from which the fresh material studied by us has been obtained with geater precision than was possible in the former Monograph, and we append hereto some notes of the strata in which the number and variety of species have been most marked.

§ I. *Upper Chalk.—Horstead, Norfolk.*—The Chalk in this locality belongs to the zone of *Belemnitella mucronata;* and, if we except the beds at Trimingham, it is on the highest horizon of the formation in this country. In addition to the horizontal layers of flints, which occur here the same as in the Upper Chalk of other places, there are numerous larger flint masses, subcylindrical to subspherical in form, in some instances with open tubular cavities, in others with central cavities completely inclosed by a flinty crust. These masses, known as "Paramoudras"[1] or "Pot-stones," range up to three or four feet in length and from one to three feet in diameter. The interior cavities of these stones are in some cases filled with a hard porous mass of silica, whilst in others there is a quantity of fine powdery material, resembling in appearance the Chalk itself, but it is incoherent, and, unlike the Chalk, it is for the most part siliceous in composition. This powder or "flint-meal," as it has been termed, is usually made up to a great extent of Foraminifera, Entomostraca, and other minute organisms, of which the Chalk is largely formed, and there is also in it a great number of the spicules of siliceous Sponges, likewise originally in the Chalk. The composition of this flint-meal may be regarded as representing to a great extent the structure of the Chalk whilst in the condition of a deep-sea ooze, before pressure and other subsequent changes of fossilization had consolidated the material and crushed together its component organisms.

Completely sealed up within one of these pot-stones in the Chalk at Horstead, one of us obtained, some years since, a quantity of flint-meal, which proved to be

[1] S. Woodward, 'Outlines of the Geology of Norfolk,' 1833, p. 26; H. B. Woodward, 'Geology of England and Wales,' 2nd ed., 1887, p. 399.

remarkably rich in Microzoa. The Sponge-remains[1] in this were described ten years ago, and we now give in the Appendix (p. 54) a list of the Entomostraca (Ostracoda), in which it will be seen a large majority of the entire number of species known from the Upper Chalk is present. The Ostracoda, in common with the other organisms in this material, are in beautiful preservation; in many instances both valves of the carapace are united together, and the delicate crenulated fringes, tubercles, spines, &c., in numerous forms are uninjured. The specimens are now of a dull, creamy-white tint, and nearly opaque; and by treatment with acid it is found that the carbonate of lime has been to a great extent replaced by silica, for so treated the shell still retains its form in this mineral though it is now snowy-white by reflected light, and nearly transparent by transmitted light when mounted in Canada Balsam. A similar change has likewise taken place in the Foraminifera in the same material.

Norwich.—The Chalk of Thorpe, Whitlingham, and other places on the outskirts of the city, is on the same horizon as the beds at Horstead mentioned above, but the Ostracoda obtained from it have been mostly from the Chalk itself, and not from the interior of flints. The beds of Chalk near the surface in this district have been in many places disturbed by glacial action, and the material is then softened and the smaller organisms can be more readily washed out of it. The list of species from Norwich is given at p. 54.

Antrim, Londonderry, and Down.—The Chalk of these Counties in the North of Ireland appears to be on the same geological horizon as that of Norwich and Horstead—that is, in the zone of *Belemnitella mucronata*. In character, however, it is very different, for instead of the soft earthy material with which we are familiar in England, it has been indurated by the vast sheet of basalt by which it is covered, and changed into a hard white limestone. As a consequence of this, the Microzoa in it are not recognisable unless in thin sections. The Chalk, however, contains both the ordinary flints and large Paramoudras of precisely similar character to those at Horstead, and the cavities in them are likewise filled with a flint-meal rich in Foraminifera, Entomostraca, and Sponge-spicules. For this discovery we are indebted to Mr. Joseph Wright, F.G.S., of Belfast,[2] who, with characteristic energy, obtained samples of this material from thirty-six different localities within the above-named Counties, and examined the Microzoa from each separately. In addition to more than one hundred species and varieties of Foraminifera, there were in the material seventeen species of Ostracoda determined by one of us. Six of these forms appeared to be new, and provisional MS. names were given to them

[1] 'Fossil Sponge Spicules from the Upper Chalk, found in the Interior of a single Flint-stone from Horstead, in Norfolk.' By G. J. Hinde, F.G.S. 8vo. Munich, 1880.

[2] 'A List of the Cretaceous Microzoa of the North of Ireland,' by Joseph Wright, F.G.S., 'Systematic Lists, &c., Belfast Naturalist Field Club,' Appendix iii, 1875, pp. 73—99, pls. ii, iii.

in Mr. Wright's list (op. cit., pp. 81 and 92). As in the Horstead material, these Irish Entomostraca are similarly replaced by silica, and their state of preservation is equally perfect. The list of species is given in the Appendix (pp. 55, 56).

Colchester, Essex.—The Entomostraca from this locality were obtained by Mr. John Brown, F.G.S.,[1] from the Chalk passed through in boring an artesian well. The species, as will be seen in the list in the Appendix (p. 56), are common forms, and probably derived from the Chalk with flints.

§ II. *Chalk-rock.*[2]—This thin but well-marked band of hard, cream-coloured, nodular limestone on the zone of *Holaster planus,* has also yielded a suite of Entomostraca of which a list is given in the Appendix (pp. 57, 58). These have mostly been obtained from outcrops of this rock at Dunstable and the railway-cutting between Luton and New Millend (Bedfordshire), Chinnor (Oxfordshire), and West Wycombe (Buckingham).

§ III. *Chalk-detritus.—Charing, Kent.*—The nature of this deposit, from which the large majority of species described in the 'Monograph Entomostraca Cret. Form. Engl.,' 1849, were obtained, has already been referred to in that memoir (p. 2). It is an extensive bed of soft, whitish clay, containing fragments of white and grey Chalk, which has clearly been formed by the washing from the adjacent Chalk hills, forming part of the North Downs in Kent. In this material a great variety of Microzoa has been preserved, but of course it is not practicable to determine the definite horizon from which each particular species has been derived. This defect is to some extent compensated by the perfect state of preservation of the specimens. A short notice and some figures of the commoner forms of the Entomostraca in this "Detritus" were first given by Prof. Dr. W. C. Williamson,[3] who placed them in the Genus *Cytherina.*

§ IV. "*Greensand of Cambridge.*"—This bed of glauconitic marl, formerly supposed to be on the horizon of the Upper Greensand, is now known to represent the so-called Chloritic or Glauconitic Marl, and to be really the base of the Chalk-marl, which rests here on an eroded surface of Gault. It contains numerous Microzoa; and several species of Entomostraca from it, recorded by Prof. Sollas[4]

[1] "Note on the Artesian Well at Colchester;" and "Remarks on some of the Microscopic Fossils from the Colchester Chalk," by John Brown, Esq., F.G.S., of Stanway, 'Ann. and Mag. Nat. Hist.' ser. 2, vol. xii, 1853, pp. 240—242.

[2] For references to the character of this rock see the following: W. Whitaker, 'Quart. Journ. Geol. Soc.,' vol. xvii, p. 166; ib. vol. xxi, p. 398; 'Mem. Geol. Surv.,' vol. iv, 1872, p. 46. Jukes-Browne, 'Geol. Mag.' dec. ii, vol. vii, p. 254; A. Geikie, 'Text-Book of Geology,' 2nd edit., pp. 821, 828; H. B. Woodward, 'Geology of England and Wales,' 2nd ed., pp. 403, 413; Judd, 'Quart. Journ. Geol. Soc.,' vol. xl, p. 733; John Morrison, 'Transact. Hertfordshire Nat. Hist. Soc.,' vol. v, 1889, pp. 199—202.

[3] 'Mem. Lit. and Phil. Soc. Manchester,' 2nd ser., vol. viii, 1848, pp. 78—80, pl. iv, figs. 75—80.

[4] 'Quart. Journ. Geol. Soc.,' vol. xxviii, 1872, p. 398-9. For other references to this bed see T. G. Bonney, 'Proc. Geol. Assoc.,' iii (1873), p. 4, *et seq.*; A. J. Jukes-Browne, 'Quart. Journ. Geol.

in 1872, are noted in the Appendix (p. 59). The list of species which we have seen from it is given in the Appendix (pp. 59, 60).

§ v. *Upper Greensand.*—The Entomostraca from this division are but few, and these have been obtained from the glauconitic arenaceous beds at Warminster (Wiltshire), zone of *Pecten asper*, and at Blackdown (Devonshire), zone of *Ammonites inflatus*; also at Ventnor, Isle of Wight. Those from Meux's Well, London, are also mentioned in the Appendix (p. 60).

§ vi. *Gault of Folkestone.*—From the beds of this formation at Copt Point Mr. F. G. Hilton Price, F.G.S.,[1] has recorded fourteen species of Entomostraca, the names of which will be found in the Appendix (p. 62).

From the Gault of Folkestone (Kent) and Godstone (Surrey), Mr. Davies Sherborn, F.G.S., and Mr. Frederic Chapman, have obtained a very large series of Ostracoda; Appendix (pp. 61—63). The collection made by Mr. F. Chapman in 1880 is fully represented in this Supplemental Monograph, but the still richer results of his Examination, in 1888, of each separate zone of the Gault at Folkestone, came too late to receive full justice at our hands; its chief features, however, are noted either in the text or in the Appendix.

Soc.,' vol. xxxi, pp. 256—316; A. Geikie, 'Text-Book of Geology,' 2nd edit., p. 826; H. B. Woodward, 'Geol. England and Wales,' 2nd ed., p. 410.

[1] 'The Gault,' by F. G. Hilton Price (1879), p. 50.

In figuring the *Ostracoda* we find it convenient to place the valves with the anterior end upwards (instead of to the right or to the left, as the animal would be when moving). Hence the *height* of the valves seems on the Plates to be the *breadth*, and is so referred to sometimes in the text. In Pl. IV, figs. 5 and 6 and figs. 40 and 41 have been inadvertently placed with the posterior end upwards, and therefore *reversed* in relation to the other figures.

CORRIGENDUM.

Page 48, lines 5—8, Cytherina pedata (?), 1843, should precede Cytherina serrata (?), 1847.

A SUPPLEMENTARY MONOGRAPH

OF THE

CRETACEOUS ENTOMOSTRACA OF ENGLAND AND IRELAND.

I. CYPRIDIDÆ.

I. Paracypris, *G. O. Sars*, 1865.

Among the marine members of the *Cyprididæ* is *Paracypris*, described by G. S. Brady in the 'Trans. Linn. Soc.,' vol. xxvi, 1868, p. 377. The general shape of the carapace, which is long, narrow, and somewhat curved, relatively high and thick in the anterior third, and tapering obliquely to the acute posterior extremity, is our guide in referring the following specimens to this genus.

1. Paracypris gracilis (*Bosquet*). Plate II, fig. 50.

Bairdia siliqua, var. *β*, *Jones*. Monogr. Entom. Cret., 1849, p. 25, pl. v, fig. 16 *h*.
— arcuata (*Münster*), var. gracilis, *Bosquet*. Mém. Commiss. Carte géol. Neerlande, vol. ii, 1854, p. 70, pl. v, fig. 4.
Paracypris? gracilis, *Jones*. Geol. Mag., 1870, pp. 75, 77.

Size.—Length ·77, height ·22 mm.

The original fig. 16 *h* (Pl. II, fig. 50) represents a somewhat deformed or injured individual, probably identical with the delicate, narrow, elongate, tapering form, which M. Bosquet regarded as a thin variety of Münster's *Cythere arcuata*.[1] The differences, however, are sufficient to allow of specific distinction among *Ostracoda*.

Bosquet's Tertiary *Bairdia curvata*, 'Mém. Cour. Acad. Belg.,' vol. xxiv, 1852,

[1] As described and figured by Bosquet, loc. cit., fig. 3.

p. 35, pl. ii, fig. 2, differs from fig. 50 in having a thicker posterior third, ending obtusely.

Localities.—*P. gracilis* has been collected from the *Detritus* (Lower Chalk and Chalk-marl) at Charing,[1] Kent, by the late Mr. W. Harris, F.G.S.; and from the *Chalk* at Keady Hill,[2] co. Londonderry, by Mr. Joseph Wright, F.G.S.

2. Paracypris siliqua, sp. nov. Plate II, figs. 48, 49, 51; Plate III, figs. 33, 34.

Paracypris gracilis, *Jones.* System. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 79 and 81.

Fig. 49. Length ·88; height ·32; thickness[3] ·32 mm.
Fig. 33. „ ·9; „ ·3; „ ·3 „

Elongate, narrow, arched on the back (slightly flattened at the hinge-line in some instances, figs. 49 and 51), and sloping posteriorly to an oblique point; obliquely rounded in front, sinuous and incurved on the ventral border. Edge view of the united valves is long, obovate, acute at both ends; end view, sub-orbicular. The carapace somewhat resembles a radish pod. Fig. 34 shows the most curvature or arching, and is rather blunter posteriorly than the others. Fig. 49 offers a close resemblance to the Tertiary specimen of *Paracypris polita,*[4] Sars, figured and described by G. S. Brady, 'Trans. Zool. Soc., vol. x, 1878, p. 381, pl. lxiii, fig. 5.

This form has some resemblance to the male[5] of *Pontocypris faba* (Reuss), as defined, with some doubt, by Dr. G. S. Brady, 'Challenger Report,' 1880, p. 37, pl. i, fig. 4 *d* (the female being much like *C. attenuata*, Reuss, 'Böhm. Kreidef.,' 1846, pl. xxiv, fig. 15), and 'Trans. Zool. Soc.,' vol. x, 1878, p. 382, pl. lxiii, figs. 6 *a*—*e*. Fossil in the Antwerp Crag, and recent in Bass's Strait and off Honolulu. It is, however, proportionally longer, and has less height dorsally, tapers more slowly at the posterior third, and is not so convex.

Localities.—The specimen shown in Pl. II, figs. 48 and 49, was collected by Mr. Joseph Wright, F.G.S., from the *Chalk* of the Black Hill, near Hannahstown,

[1] See 'Monograph Entom. Cret.,' 1849, p. 2.

[2] Only those localities in Ireland from which we have seen specimens are particularised in this Monograph; but other localities for these Ostracoda from the *flint-meal* are enumerated by Mr. Wright in the System. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 76—81, and 92, 93.

[3] The *thickness* in all these measurements is that of carapace (united valves).

[4] In the recent state *P. polita* is figured by Dr. Brady in the 'Trans. Linn. Soc.,' 1868, p. 378, pl. xxvii, figs. 1—4.

[5] This male (?) individual of *P. faba* differs from the male ascribed to the same species by Dr. Brady in the 'Trans. Zool. Soc.,' vol. x, pl. lxiii, figs. 6 *c*—*e*, being much less arched at the antero-dorsal, and more incurved at the ventral margin.

co. Antrim; and similar specimens at a quarry half-a-mile north of the railway-terminus at Larne, co. Antrim, and at Keady Hill, co. Londonderry.

Pl. II, fig. 51, and Pl. III, figs 33 and 34, were collected by Dr. G. J. Hinde, F.G.S.,[1] from the *Chalk* of Horstead, Norfolk.

II. Pontocypris, *G. O. Sars*, 1865.

Valves "higher in front than behind, elongated, and subreniform or subtriangular," G. S. Brady, 'Trans. Zool. Soc.,' vol. x, 1878, p. 381.

1. Pontocypris trigonalis, sp. nov. Plate III, figs. 25 and 26; and Plate IV, figs. 1 and 2.

Fig. 25 and fig. 1. Length ·55; height ·25; thickness ·2 mm.

Valve subtriangular, rounded in front, acute behind, straight below (on the ventral margin), obliquely arched above, sloping away backwards from the antero-dorsal border where the arching is highest at the anterior third.[2] Edge view of the carapace long, compressed-oval; end view sub-oval.

There are some known forms from the Cretaceous strata of Europe which are closely related to our *P. trigonalis*, but the English specimens are much more symmetrically rounded on the anterior and straighter along the ventral margin than the figured Cretaceous forms, such as *Cytherina acuminata*, Alth, Haidinger's 'Naturw. Abhandl.,' vol. iii, 2 Abth., 1850, p. 198, pl. x, fig. 16—a bad figure, but referred to by Reuss under the same name, op. cit., vol. iv, 1 Abth., 1850, p. 33, pl. vi, figs. 7 and 8 (not alike); *C. attenuata*, Reuss, 'Böhm. Kreideform.,' vol. ii, 1846, p. 104, pl. xxiv, fig. 15, refigured as *Bairdia attenuata*, Reuss, 'Denksch. Akad. Wien,' vol. vii, 1854, p. 140, pl. xxvi, fig. 3; also *Cytherina lævigata*, Römer, 'Nordd. Kreideg.,' 1841, p. 104, pl. xvi, fig. 20, refigured as *Cytherideis lævigata* by Reuss, in Geinitz's 'Elbthalgeb., &c.,' pt. 2, 1874, p. 150, pl. xxviii, figs. 1—3. These three are not alike, but possibly comprise one female and two male individuals; fig. 2 is somewhat like the male of *P. faba* (Reuss) as figured by G. S. Brady; see above, p. 2. There are also some Tertiary forms described and figured by Dr. A. E. von Reuss in Haidinger's 'Naturw. Abhandl.,' vol. iii, 1 Abth., 1850, as *Cytherina lucida* and *mytiloides*, that seem to belong to

[1] See his memoir on the 'Fossil Sponge-spicules from the Upper Chalk found in the Interior of a single Flint-stone from Horstead, Norfolk,' 8vo., Munich, 1880.

[2] The drawing, fig. 25, does not make it sufficiently convex here, and fig. 26 is wrong in giving a double straight line at the junction of the valves.

this kind of *Pontocypris,* while his *C. unguiculus* and *arcuata* (op. cit.) look more like *Paracypris,* unless they prove to be males.

Dr. G. S. Brady has described and figured an allied form as *Pontocypris faba* (Reuss), from the Antwerp Crag ('Trans. Zool. Soc.,' vol. x, 1878, p. 382, pl. lxiii, figs. 6 *a—e*), but it is obliquely rounded in front and has a greater thickness of carapace at the anterior third.

Locality.—P. trigonalis has been collected from the *Gault* of Folkestone by Mr. F. Chapman.

Neither *Pontocypris attenuata,* Brady, 'Ann. Mag. N. H.,' ser. 4, vol. ii, 1868, p. 35, pl. iv, figs. 12—14, nor *Pontocypris intermedia,* Brady, ibid., p. 220, pl. xiv, figs. 1, 2, though closely allied, embrace our *Pontocyprides* from the Chalk.

2. Pontocypris triquetra (*Jones*). Plate III, figs. 22—24, 35—37.

Bairdia triquetra, *Jones.* Monogr. Entom. Cret., 1849, p. 27, pl. vi, figs. 19 *a—c.*

Fig. 22. Length ·694; height ·361; thickness ·44 mm.
Fig. 35. „ ·725; „ ·375; „ ·375 „ (large variety or female).

This is a near ally to *P. acuminata* and *P. attenuata* referred to above, but it is much stouter, being thicker, higher, not acuminate behind, and its greatest thickness is medial (not at the anterior third); it is related also to *P. trigonalis* just described, but is thicker, higher, and more triangular.

Fig. 22 shows a sloping, and fig. 35 a rounded antero-dorsal margin; such conditions seen in Dr. G. S. Brady's figures of *P. faba,* alluded to above, are regarded by him as sexual features.

Edge view of carapace long-oval; end view nearly circular, rather oval.

Localities.— Two valves from the *Chalk* of Gravesend, four carapaces from the *Detritus*, Charing, and one valve from the *Greensand* of Blackdown, Devon.

3. Pontocypris Bosquetiana, sp. nov. Plate II, fig. 65; and Plate IV, fig. 3.

Bairdia angusta (partim), *Jones.* Monogr. Entom. Cret., 1849, p. 26, pl. vi, figs. 18 *f, f′* (not *a—e′*).
Cytherideis angusta (partim), *Jones.* Geol. Mag., 1870, pp. 75, 77.

Fig. 65. Length ·88; height ·4; thickness ·3 (?) mm.
Fig. 3. „ ·8; „ ·4 „

One of the old figures of this form (interior of a left valve, Pl. IV, fig. 3) has been reproduced here. The new fig. 65, of a specimen from the Chalk-marl at Didcot railway-station, Berkshire, gives a good idea of the exterior of a right valve of this species. It is longer than *P. triquetra*, less triangular, with a well-rounded anterior margin, and proportionally less arching of the back. The greatest thickness is at the posterior third. The surface is minutely punctate.

Edge view, lanceolate; end view, acute-oval.

This form, at first sight, seems to be near to the recent *P. trigonella*,[1] Sars; but it is rounder in front, and the greatest thickness is behind the middle of the valves. We propose to associate with this elegant form the name of the late eminent Ostracodist, J. Bosquet, of Maastricht.

In a carapace valve in Mr. F. Chapman's collection from the Gault of Folkestone Mr. Sherborn has recognised the occurrence of distinct muscle-spots—consisting of a curved row of four (convex downwards) with two above—very similar to figs. 1 *e* and 8 *e* in pl. i of the 'Monogr. Tert. Entom.,' 1857, but in a *reversed* position.

Localities.—Figs. 18 *f*, *f′*, in Pl. VI, 1849, represent the interior of a left valve from the *Gault* of Folkestone. Pl. IV, fig. 3, reproduces 18 *f*. Pl. II, fig. 65, illustrates a specimen from the *Chalk-marl* at Didcot station, Berks; and with a high power the surface is seen to be beset with distinct pimples, but very small and irregularly scattered. On another specimen, from Folkestone, minute punctations appear to be characteristic.

III. Bairdia, *M'Coy*, 1844.

1. Bairdia subdeltoidea (*Münster*). Plate II, figs. 31—34 (refigured[2] from the figs. 15 *a*—*d* of the Monograph, 1849; but figs. *e*, *f*, *f′*, *f″*, *f‴*, have not been reproduced).

Cythere subdeltoidea, *Münster*.	Jahrb. f. Min., &c., 1830, p. 64, No. 13; 1835, p. 446.
Cytherina subdeltoidea, *Römer*.	Neues Jahrb. f. Min., &c., 1838, p. 517, pl. vi, fig. 16.
— — —	Verstein. nordd. Kreidegeb., p. 105, pl. xvi, fig. 22.
— — *Reuss*.	Verstein. böhm. Kreideform., pt. 1, 1845, p. 16, pl. v, fig. 38; pt. 2, p. 104.

[1] 'Monograph Post-Tertiary Entom.,' Pal. Soc., 1874.

[2] The postero-ventral edge in fig. 34 has been serrated by mistake; it should be regular and entire, like that in fig. 33. The prickles introduced, from optical illusion, in fig. 15 *d* are necessarily omitted in fig. 34.

CYTHERINA SUBDELTOIDEA, *Geinitz.* Grund. Verst.-Kunde, 1845, p. 244, pl. viii, fig. 21.
CYTHERE TRIGONA, *Bosquet.* Mém. Soc. Roy. Sci. Liége, vol. iv, 1847, p. 358, pl. i, fig. 3.
BAIRDIA SUBDELTOIDEA, *Jones.* Monogr. Entom. Cret., 1849, p. 23, pl. v, fig. 15.
CYTHERINA — *Reuss.* Haidinger's naturw. Abhandl., vol. iii, Abth. 1, 1850, p. 40, pl. viii, fig. 1.
— — — Ibid., vol. iv, Abth. 1, 1851, p. 47.
BAIRDIA — *Bosquet.* Mém. cour., &c., Acad. Roy. Belgique, vol. xxiv, 1852, p. 29, pl. i, fig. 13.
CYPRIS PRISTINA, *Eichwald.* Lethæa Rossica, pt. 3, 1853, pp. 316 and 317, pl. xi, fig. 23.
BAIRDIA SUBDELTOIDEA, *Bosquet.* Mém. Commiss. Carte Géol. Neerlande, vol. ii, 1854, p. 66, pl. viii, fig. 4.
— — *Reuss.* Denkschr. k. Akad. Wiss. Wien, vol. vii, 1854, pp. 41 and 139.
— — *Jones.* Monogr. Entom. Tert., 1856, p. 52 (not the figures).
— — *Egger.* Neues Jahrb. f. Min., &c., 1858, p. 405, pl. i, fig. 1.
— — *Speyer.* Bericht Vereins Naturkunde Cassel (for 1860—1862), 1863, p. 43, pl. i, fig. 5 (right valve), and *B. oviformis*, ibid., fig. 6 (left valve).
— — *G. S. Brady.* Trans. Zool. Soc., vol. v, 1866, p. 365, pl. lvii, fig. 8.
— — *Jones.* Geol. Mag., 1870, pp. 75 and 157.
— — *Reuss.* In Geinitz's Elbthalgebirge in Sachsen, pt. 2, 1874, p. 140, pl. xxvi, fig. 5.
— — var. DENTICULATA, *Marsson.* Mittheil. naturw. Ver. Neu-Vorpommern und Rügen, Jahrg. 12, 1880, p. 34, pl. ii, fig. 9.
— — *J. Kafka.* Crustaceen böhm. Kreidef., 1887, p. 13, fig. 23.
— — *Jones and Sherborn.* Geol. Mag., 1887, p. 387.
— — — Suppl. Monogr. Entom. Tert., 1889, p. 16, pl. i, fig. 15.

Fig. 33. Left (large) valve: Length ·94; height ·61 mm.
Fig. 34. Right (small) valve of a smaller individual: Length ·88; height ·5 mm.
Fig. 31. Smaller individual: Length ·77; height? thickness ·38 mm.

B. subdeltoidea has been mentioned in several geological and palæontological memoirs and handbooks as occurring in the Cretaceous and Tertiary strata of Europe. As to the exact specific relationship of the many recorded fossil specimens with each other and with recent forms, there is room for doubt. In 1874 Dr. Reuss expressed an opinion that it was doubtful if any of the fossil forms were of the same species as the recent (see 'Elbthalgeb., p. 140); and Dr. G. S. Brady considers that, of the recent forms, *B. foveolata* ('Challenger Report Ostracoda,' 1880, p. 55, pl. viii, figs. 1 and 2) is most comparable with *B. subdeltoidea*, and that "it is very probable that several species are comprised under the specific name *subdeltoidea*, as applied by various palæontologists; the figures of that species given in the works of Messrs. Bosquet, Jones, Speyer, Reuss, and Egger presenting important points of difference among themselves." Of *B. foveolata* he states, "This is one of the most abundant forms of *Bairdia*, especially in the Southern Seas," and is subject to much variation. The recent form recognised as *B. subdeltoidea* in 1866 ('Tr. Zool. Soc.,' vol. v, p. 365) was from Australia, the West Indies, Crete, and Serpho.

For the great variety of recent *Bairdiæ*, Dr. Brady's 'Challenger Report,' 1880, besides his other memoirs, can be consulted; and a great variety of forms occurring fossil in the Carboniferous and Permian strata are figured and described in the 'Quart. Journ. Geol. Soc.,' vol. xxxv, 1879, pp. 565, &c. Some, however, of these may possibly belong to other genera.

A careful comparison proved the Tertiary species from Bracklesham ('Suppl. Mon. Tert.,' p. 16) to be the same as Count Münster's species, and there is no dissimilarity at all between these and the Cretaceous specimens here figured.

Localities:

Chalk: Norwich, Horstead, Colchester, and South-east England; Cave Hill, (Antrim), and Keady Hill (Londonderry).

Chalk-rock: Dunstable and Luton (Bedfordshire), West Wycombe (Buckinghamshire), Chinnor (Oxfordshire).

Chalk-marl: Didcot (Berkshire).

Detritus: Charing (Kent).

Gault: Godstone (Surrey).

Greensand: Cambridge and Warminster.

Foreign:

Cretaceous formations: Royan, Maastricht, Rügen, Gehrden,[1] Münster, Lemforde, Dresden, Weinböhla, Gosau, Dobrutscha. See also Reuss, 'Elbthalgeb.,' pp. 140, 141, 153, for the localities.

We may remark that, as with other species, the geographical and geological distribution of this form has to be revised and determined by reference to collections and late works, and is left for future consideration.

[1] For the localities of the several Cretaceous formations in North Germany see the Appendix to Römer's 'North-German Chalk-formation,' translated in Taylor's 'Scientific Memoirs,' vol. iv, Article v.

2. Bairdia Harrisiana, *Jones*. Plate II, figs. 52—55.

Bairdia Harrisiana, *Jones*. Monogr. Entom. Cret., 1849, p. 25, pl. vi, figs. 17 *a—e* (not fig. 17 *f*). Fig. 17 *e* is not reproduced here.
— — (partim?), *Reuss*. Elbthalgeb., &c., pt. 2, 1874, p. 141, pl. xxvi, figs. 6 and 7.
(Not Cytheridea Harrisiana, *Bosquet*. Mém. Commission Carte géol. Neerlande, vol. ii, 1854, p. 73, pl. v, fig. 5.)

Fig. 54. Length ·83; height ·33 mm.
Fig. 53. Thickness ·33 mm.
Fig. 52. „ ·27 „

Valves elongate, convex, narrow, somewhat arcuate; anterior end obliquely rounded, posterior oblique and subacute; left valve larger than the other, and more uniformly arched on the back, which is slightly angular in the right valve. Edge view compressed oval; end view oval.

Some of these features are present in *Argillœcia cylindrica*, G. O. Sars; but they have a closer agreement with such a *Bairdia* as the recent *B. complanata*, G. S. B., 'Trans. Linn. Soc.,' 1868, p. 390, pl. xxxiv, figs. 1—3, and the Tertiary *B. contracta*, Jones, 'Monogr. Tert. Entom.,' 1857, p. 53, pl. v, fig. 1.

The spots on the figures in the 'Monogr.,' 1849, are due to mottling produced by mineral change.

Localities.—From the *Chalk* of Keady Hill (Derry), and of Gravesend and Charlton (Kent); *Chalk-rock*, Dunstable (Bedfordshire). *Detritus*, Charing (Kent). *Gault*, Folkestone and Leacon Hill (Kent); *Greensand*, Cambridge.

Foreign.—Weinböhla and Strehlen (Reuss, 'Elbthalgeb.,' p. 141).

2*. Bairdia Harrisiana, *Jones*; var. *amplior*, nov. Plate II, fig. 57; and Plate IV, fig. 4.

Fig. 57, right valve. Length ·8; height ·32 mm.
Fig. 4, left valve. „ ·83; „ ·4 „

A right and a left valve, arched on the back, incurved at the middle of the ventral border, obliquely rounded[1] in front, and subacute behind, come from the Chalk of Kent. The left valve (Pl. IV, fig. 4) is larger, incurved for overlapping at the back, and ends less sharply behind than the right valve (Pl. II, fig. 57).

[1] The slight angularity on the front margin of the right valve in fig. 57 is too much emphasized.

These features are represented more or less closely in our *Bairdia Harrisiana*, but on a smaller scale. Of course these may be sexual differences, but it is unsafe to hazard an opinion on this point.

Locality.—Two valves from the *Chalk* of Kent.

IV. Macrocypris, *Brady*, 1867.

In this genus the right valve is larger than the left.

§ I. Species belonging to the same group as *M. Minna* (Baird) and others of like form. Several of these elongate species have been described and figured, especially by Dr. G. S. Brady in his 'Challenger Report,' 1880, p. 41, &c., and pl. ii.

1. Macrocypris siliqua, *Jones*. Plate II, figs. 38—41.

Bairdia siliqua, *Jones*. Monogr. Entom. Cret., 1849, p. 25, pl. v, figs. 16 *a—d* (not figs. 16 *e, f, g, h*).
Macrocypris siliqua, *Jones*. Geol. Mag., 1870, pp. 75, 77.

Fig. 41, right valve, inside. Length 1·41 ; height ·5 mm.
Fig. 40, right valve, outside. ,, 1·27 ; ,, ·47 ,,
Fig. 39. Thickness ·25 mm.
Fig. 38. Length 1·16 ; thickness ·3 mm.

This well-developed *Macrocypris* has many relatives in the recent state, but none of exactly the same form. The valves are long, subtriangular, narrow, convex, smooth ;[1] strongly arched on the back, slanting off posteriorly; ventral margin nearly straight; contracted and rounded in front,[2] acuminate behind.

Localities.—From the *Chalk*,[3] Ballytober (Antrim), Keady Hill (Derry), and South-eastern England; the *Detritus*, Charing; and *Greensand*, Ventnor, Isle of Wight.

Foreign.—*Eocene*, Clausenberg, Transylvania (A. von Pavay).

[1] Not spined or prickly as in fig. 16 *c*.

[2] The anterior curvature has been made rather too flat and broad in the reproduction, fig. 41.

[3] In this, and in all the other cases of Irish Chalk, the powder from the flints is referred to; and there are other localities besides those specially mentioned (see above, page 2).

2. MACROCYPRIS WRIGHTII, sp. nov. Plate II, figs. 43, 44.

MACROCYPRIS SILIQUA, *Jones.* System. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 81 and 92.

Length 2·58; height ·83; thickness ·83 mm.

Valve elongate, convex, smooth; neatly curved on the dorsal, and gracefully sinuate on the ventral border; narrow and rounded anteriorly, acute posteriorly. Greatest height behind, and greatest thickness at the middle. The united valves would have a long-acute-oval edge view, and an oval end view.

This elegant species is here named after Joseph Wright, Esq., F.G.S., of Belfast, who has contributed very much to our knowledge of both the fossil and the recent Microzoa of Ireland, and by whom this specimen was collected from the *Chalk* (powder in flint) at Ballytober, island Magee, co. Antrim.

§ II. Species of the group comprising *Macrocypris setigera, maculata,* &c., Brady.

3. MACROCYPRIS MUENSTERIANA, sp. nov. Plate II, figs. 42 and 45—47.

BAIRDIA SILIQUA, var. *a*, *Jones.* Monogr. Entom. Cret., 1849, p. 25, pl. v, figs. 16 *e*, *f*, *g*.
MACROCYPRIS ARCUATA, *Jones.* Geol. Mag., 1870, pp. 75, 77.

Fig. 42. Length ·76; height ·32 mm.
Fig. 45. „ ·72; „ ·27 (?); thickness ·27 mm.

This form is distinct from *Cythere arcuata*,[1] Münster, as figured by Römer, Reuss, and Bosquet, not being merely arcuate by a more or less obliquely arched dorsal, and centrally incurved ventral margin, for it is well arched on the back, the curve falling into the rounded anterior extremity, and sloping with a hollow curve to the pointed end, and the sinuous ventral outline is incurved at the anterior third. The greatest height is behind the middle, and the greatest thickness at the middle. The edge view is compressed acute-oval; end view oval. This species is named after Count Georg von Münster, one of the earliest observers and describers of fossil Ostracoda.

[1] None of the published illustrations are sufficiently like our figures to substantiate the provisional reference made in the 'Geol. Mag.,' 1870, p. 75. Indeed, the published figures differ among themselves, and we cannot agree with Dr. Reuss's synonyms as offered in his article on "*Bairdia arcuata*, var. *faba*," 'Elbthalgeb.,' pp. 141, 142.

This species is somewhat like *Macrocypris decora*, Brady, 'Trans. Zool. Soc.,' vol. v, 1866, p. 366, pl. lvii, fig. 13; and 'Challenger Report,' 1880, p. 44, pl. i, fig. 3, and pl. vi, fig. 8: but it is shorter, much more deeply incurved at the antero-ventral region, and more acute posteriorly. It may rather be said to have the characters of our *M. Wrightii* (see p. 10) in a much less elongated frame.

Localities.—From the *Chalk* of Kent and the *Detritus* at Charing, Kent.

4. Macrocypris concinna, sp. nov. Plate II, figs. 66, 67.

Length ·95; height ·35; thickness ·3 mm.

Valves rather long, subtriangular, nearly straight on the ventral, and neatly arched on the dorsal margin; rounded in front, narrower and obliquely rounded behind. Surface gently convex. Edge view of the united valves long-acute-oval. End view oval.

Locality.—Two specimens from the *Chalk-rock* of Dunstable; one of them (broken and not figured) is rather larger than the other (fig. 67), rather rounder in front, more obtuse posteriorly, and slightly inflexed on the ventral margin.

V. Bythocypris, *Brady*, 1880.

In this genus the left is larger than the right valve.

1. Bythocypris simulata (*Jones*). Plate I, figs. 27—29.

Cythere faba, *Jones* (not *Reuss*[1]). Monogr. Entom. Cret., 1849, p. 13, pl. ii, figs. 4 *a*—*c*.
— simulata, *Jones*. Geol. Mag., 1870, p. 75.

Length ·77; height ·38; thickness ·33 mm.

This is bean-shaped, tumid, and boldly arched, with an elliptical curve above; sinuous on the ventral border, which is incurved at its anterior third, and highest behind the middle of the valves. Anterior extremity rounded; posterior, subacute.[2]

[1] See the remarks by the late Dr. A. E. von Reuss in the 'Zeitschr. d. D. g. G.,' vol. vii, 1855, p. 278, on this species, and in the 'Elbthalgeb.,' &c., pt. ii, p. 142. The original figure of *C. faba*, Reuss, in the 'Böhm. Kreidef.,' although very poor, is certainly matched by this species better than by any other that we know. Dr. Reuss, however, found them to be different, and the name was altered.

[2] Not drawn so perfectly in the reproduction, fig. 27, as in the former fig. 4 *a*.

The edge view (fig. 28) is elongate and compressed obovate, being blunter in front than behind; the end view (fig. 29) is acute-ovate.

Locality.—One specimen only, from the *Detritus* of Charing, Kent.

The specimens referred to in the 'Monogr.,' 1849, p. 13, as from the Upper Oolite, and as somewhat resembling this species, are probably what are now known as *Cypris Purbeckensis*, Forbes, 'Quart. Journ. Geol. Soc.,' vol. xli, 1885, p. 347, pl. ix, figs. 3 and 5, with *Candona Bononiensis*, Jones, ibid., p. 348, pl. ix, fig. 7.

2. Bythocypris Reussiana, sp. nov. Plate II, figs. 56 and 61—63.

> Bairdia angusta (*partim*), *Jones* (not *Münster*). Monogr. Entom. Cret., 1849, p. 26, pl. vi, figs. 18 *a—c*, *e*, *e'* (not *d*, *f*, *f'*; 18 *d* belongs to *Bythocypris silicula*; 18 *f*, *f'* to *Pontocypris Bosquetiana*). Also part of *Bairdia Harrisiana*, Jones, ibid., p. 25, pl. vi, fig. 17 *f*.
>
> Cytherideis angusta (*partim*), *Jones*. Geol. Mag., 1870, pp. 76, 77.

Fig. 56. Length ·861; height ·38 mm.

Fig. 63. „ ·72; „ ·33 (?); thickness ·33 mm.

The left valve (fig. 56) long-obovate, moderately arched on the back, with inturned edge, ventral margin straight, also with an inflexed edge (thus adapted to overlap the other valve above and below); obliquely rounded in front, obtuse behind. The right valve[1] (former figs. 18 *e*, *e'*) narrower than the other, slightly incurved ventrally. Valves united have an edge view long-acute-oval (fig. 61); end view oval (fig. 62).

This fabiform Ostracod was too readily referred in 1849 to von Münster's vaguely described species; and neither *lævigata*, Röm., nor *attenuata*, Reuss (both mentioned as synonyms at p. 26) corresponds with it, though supported by Reuss in the 'Elbthalgeb.,' &c., ii, p. 150; for it is much too obovate and too blunt posteriorly for either of the forms figured by Reuss, op. cit., pl. xxviii, figs. 1—3. Figs. 17 *f* (fig. 56) and 18 *e* are much too nearly obovate for the figs. 1—3 above mentioned; but they approach fig. 11 in pl. xxvi, op. cit., one of the forms of *Bairdia modesta*, Reuss. There are differences, however, even here.

Named after the late well-known palæontologist of Prague and Vienna, who worked so long and ardently at the elucidation of the fossil Ostracoda and other Microzoa.

Localities.—From the *Chalk* of Charlton, Kent (fig. 56); the *Detritus* at Charing, Kent (fig. 63); and the *Gault* of Folkestone (figs. 61 and 62).

[1] Fig. 63 (fig. 18 *c*) having been drawn obliquely does not show the true shape like fig. 56 (fig. 17 *f*).

3. Bythocypris silicula (*Jones*). Plate II, fig. 64, and Plate III, figs. 27—30.

Bairdia silicula, *Jones*. Monogr. Entom. Cret., 1849, p. 27, pl. vi, figs. 20 *a*—*c*, and *B. angusta* (*partim*), Jones (not Münster), ibid., fig. 1 8

Fig. 64 (left valve, outside).	Length ·805;	height ·417 mm.	
Fig. 27 (left valve, inside).	„ ·77;	„ ·417;	thickness ·33 mm.
Fig. 30 (left valve, female ?).	„ ·75;	„ ·4 mm.	

Left valve subovate, obliquely rounded in front, and obliquely subacute behind; boldly arched on the dorsal, and nearly straight on the ventral border. Edge view of the valves, if united, long-acute-oval; end view subacute-oval.

Near to *Bythocypris Reussiana*, but more nearly oval, being much higher and more fully arched in the middle third.

Fig. 30 represents the external features of a left valve from the Chalk of Kent; the interior and outlines were roughly given in figs. 20 *a*—*c* (figs. 27—29 in Pl. III) from the Charing Detritus. Pl. II, fig. 64 (fig. 18 *d*), is also a left valve (from the Gault of Folkestone), matching fig. 20 *a*, though not so full at the dorsal margins as fig. 30.

Localities.—*Chalk*, Kent, Keady Hill (Londonderry); *Chalk-rock*, near Luton; *Detritus*, Charing; *Gault*, Folkestone.

3*. Bythocypris silicula, var. *minor*, nov. Plate III, figs. 40, 41.

Length ·7; height ·325; thickness ·3 mm.

The left valve figured as above mentioned has much less height (from ventral to dorsal border) than Pl. III, figs. 27 and 30, and Pl. II, fig. 64, the back being less boldly arched. Otherwise the outlines are much alike; and the difference may be varietal, if not merely sexual.

Locality.—One specimen from the *Chalk-rock* of Dunstable.

4. Bythocypris Brownei, sp. nov. Plate III, figs. 38, 39, and 42, 43.

Fig. 38.	Length ·8;	height ·4;	thickness ·3 mm.
Fig. 42.	„ ·7;	„ ·35;	„ ·3 „

Two subreniform or bean-shaped left-hand valves, from the Chalk-rock of Dunstable, have much in common as to their outline and contour.

One of them (figs. 38 and 39) is suboblong, broadly rounded in front, obliquely rounded behind, arched on the dorsal, and slightly incurved on the ventral edge. The other (figs. 42 and 43) is rather smaller, not so high in front, and straighter on the ventral edge than fig. 38. Both have the same moderate and uniform convexity. The united valves would show a long, sharp-ended, oval edge view, and an oval end view.

The difference between the two valves may be varietal, or even only sexual; fig. 38 being probably the female, and fig. 42 the male individual.

If these left valves are the largest, the genus *Bythocypris* takes them in.

We propose to name this species after Mr. A. J. Jukes-Browne, F.G.S., of H.M. Geological Survey, who has kindly supplied several interesting specimens, having taken much trouble in securing the Microzoa of the different strata of the Cretaceous series which he has had to examine during his work in the Geological Survey.

Localities.—From the *Chalk* of Londonderry (Mr. J. Wright); and the *Chalk-rock* of Dunstable (figs. 38, 39, 42, 43, Mr. A. J. Jukes-Browne).

5. Bythocypris ? Rœmeriana, sp. nov. Plate II, figs. 28—30.

Length ·6; height ·325; thickness ·25 mm.

This is a small, subtriangular, left valve, with an almost symmetrically arched back, straight ventral edge, and neatly rounded ends, of which the anterior is rather higher than the other. Convexity of the surface slight, lessening forwards, and rather less ventrally than towards the back; hence the edge view of the united valves would be narrow-lanceolate, and the end view narrow-obovate.

Altogether this little form reminds us of the somewhat Bairdia-like and larger *Bythocypris elongata*, Brady ('Challenger Report,' p. 47, pl. vi, fig. 1), although it is not so subtriangular above (dorsally), and not incurved below. It is from the Chalk-rock of Dunstable, and is named after the late Fr. Adolph Römer, of Clausthal, who pursued with advantage the study of the fossil Ostracoda of Germany.

Locality.—From the *Chalk-rock* of Dunstable.

6. Bythocypris ? Iernica (*Jones*). Plate III, figs. 31, 32.

Cythere Iernica, *Jones, MS.* System. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, p. 81.

Length ·775; height ·375; thickness ·3 mm.

Carapace almost symmetrically arcuate, with nearly equal and rounded ends;

curved dorsal, and concave ventral border; convexity moderate and uniform. Edge view long-oval; end view subcircular.

Locality.—Collected by Mr. Joseph Wright, F.G.S., from the powder of a hollow flint (*Chalk*) at Black Hill, co. Antrim; also at Slieve Gallion, co. Londonderry.

Cytherina lævigata, Römer, as figured by Reuss in Haidinger's 'Naturw. Abhandl.,' vol. iv, I Abtheil., p. 49, pl. vi, fig. 6, from the Chalk-marl of Lemberg, is also bent and equal-ended, but the outline is not nearly so convex above (dorsally), nor so concave below (ventrally), as in fig. 31. The figure of the Tertiary *C. lunata*, Römer, 'N. Jahrb.,' 1838, p. 517, pl. vi, fig. 18, has its ends very much too sharp for the species under notice.

II. CYTHERIDÆ.

I. Cythere, *Müller*, 1785.

See Supplem. Monogr. Tert. Entom., 1889, p. 12.

§ i. Oblong forms, with nearly uniform convexity; punctate or reticulate.

1. Cythere ? Bosquetiana (*Jones*). Plate II, figs. 35—37.

Cytherella ? Bosquetiana, *Jones*. Monogr. Entom. Cret., 1849, p. 33, pl. vi, figs. 23 *a*—*c*.
Cythere Bosquetiana, *Jones*. Geol. Mag. 1870, pp. 76, 77.

Length ·66; height ·27; thickness ·22 mm.

The unique carapace from the Charing *Detritus* has not been represented by any other specimen, and we can add nothing to the former description.

2. Cythere Bairdiana, *Jones*. Plate I, figs. 30—32.

Cythere Bairdiana, *Jones*. Monogr. Entom. Cret., 1849, p. 13, pl. ii, figs. 5 *a*—*c*.
— transiens (?), *Jones*. Quart. Journ. Geol. Soc., vol. xli, 1885, p. 349, pl. ix, figs. 13—16.

Length ·63; height ·36; thickness ·33 mm.

This unique specimen of a right valve was from the *Greensand* of Faringdon, Berks; and, though somewhat obscured by fossilization, is so much like *Cythere transiens*, Jones, from the Lower-Purbeck beds at Swindon, and the Portland beds at Brill, both as to shape and the punctation of the surface, that it is probably right to refer them both to the same species.

The recent *Cytherideis ? pulchra*, G. S. Brady, 'Trans. Zool. Soc.,' vol. v, 1866, p. 368, pl. lviii, figs. 3 *a—c* (a left valve, from the Arctic Sea), has a somewhat similar but more ovate shape, and a coarse linear punctation on a part of the surface; but its convexity lessens forwards, and its hingement is not that of a true *Cythere*.

§ II. Oblong forms, with three elevations or slight swellings.

3. Cythere Harrisiana, *Jones*. Plate I, figs. 47—52.

Cythereis interrupta, *Jones* (not Bosquet). Monogr. Entom. Cret., 1849, p. 16, pl. ii, figs. 6 *a—h*.
Cythere Harrisiana, *Jones*. Geol. Mag., 1870, pp. 75, 76.
— — *Jones and Sherborn*. Geol. Mag., 1887, p. 452, woodcut, fig. 1; and Suppl. Monogr. Tert. Entom., 1889, p. 24, woodcut, fig. 2.

Fig. 47.	Length ·66; height ·33 mm.	
Figs. 48 and 49.	Length ·72; height ·44 mm.	
Fig. 50.	„ ·66; thickness ·33 mm.	
Fig. 51.	„ ·61; „ ·305 „	
Fig. 52.	Height ·44; „ ·305 „	

The many specimens representing this sub-oblong *Cythere* have several varietal features. Fig. 47 (formerly fig. 6 *a*) was taken as the type, and is probably a male individual. Figs. 48, 50, 51 (formerly 6 *b*, 6 *e*, 6 *f*), described as var. *α*, may be regarded as the larger and somewhat coarser female carapace. Figs. 49 and 52 (formerly figs. 6 *c* and 6 *g*), treated as var. *β*, belong probably to females less coarse in structure. The body of the valve above the suddenly depressed hinder margin is full, and often subtruncate, with the two angles somewhat swollen.

Pl. I, fig. 43 (var. δ, *setosa*) evidently matches fig. 48 in shape; and figs. 44 and 45 (var. δ) have some features of their own in their relative shortness, the low ridge along the middle of the valve (or, rather, the depressions on each side of the middle), and the strong pinching in of the posterior margin.[1] The prickles on the angles of the hinder quarter of fig. 45 are present also in fig. 51, and slight in fig. 48. Figs. 43—45 show small scattered spinules. Figs. 47—52 are more or less coarsely punctate,[2] the pits being in lines, mostly longitudinal. The var. *γ* ('Monogr.,'

[1] Figs. 43—45 are magnified more than figs. 47—52, as 25 : 18.

[2] The coarse pittings were exaggerated on figs. 6 *a* and 6 *b* into tuberculate roughness.

p. 17) had longitudinal lines of much smaller punctations, as shown by a broken specimen from the Sponge-gravel of Faringdon, Berks.

One of the recent forms nearest to *C. Harrisiana* is *C. favoides*, Brady, Annals, 'Mag. Nat. Hist.,' ser. 4, vol. ii, 1868, p. 222, pl. xv, figs. 5—7, from Tenedos. The male (fig. 5) is narrow; the female (fig. 6) is broader (higher). The carapace is not so angular, and it has a different style of ornament. The Cretaceous *C. interrupta*, Bosquet, with which it was at first confused, has some features even more similar, but its central ridge is too strong.

Young individuals are not uncommon in Mr. F. Chapman's collection from the Gault of Folkestone. They have a subquadrate outline like fig. 45, but each of the posterior angles of the body of the valve is produced as a spine.

Fig. 47 = 6 *a*. Detritus, Charing. (Type.)
Fig. 48 = 6 *b*. Gault, Leacon Hill, var. α.
Fig. 49 = 6 *c*. Gault, Folkestone, var. β.
6 *d*. Gault, Folkestone, var. β.
Fig. 50 = 6 *e*. Detritus, Charing, var. α.
Fig. 51 = 6 *f*. Gault, Leacon Hill, var. α.
Fig. 52 = 6 *g*. Gault, Folkestone, var. β.
6 *h*. Detritus, Charing, var. β.
Fig. 43. Gault, Folkestone, var. δ, *setosa*.
Fig. 44. Gault, Godstone, var. δ, *setosa*.
Fig. 45. Gault, Folkestone, var. δ, *setosa*.
Lower Greensand, Faringdon, var. γ.
Fig. 46. Gault, Folkestone, var. ε, *reticosa*.

Localities.—This species has been found in the *Chalk*, Woolwich, at several places in co. Antrim, and at Keady Hill, co. Londonderry; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Cambridge and Blackdown; *Lower Greensand*, Faringdon. A similar form occurs in the *Portland Oolite* at Ridgway, Dorset.

3*. Cythere Harrisiana, Jones, var. *setosa*, nov. Plate I, figs. 43—45.

Fig. 43. Length ·84; height ·44 mm.
Fig. 44. „ ·72; „ ·4 „
Fig. 45. „ ·56; „ ·36 „

This form is much like that shown by fig. 48 (old Monogr., fig. 6 *b*), but it is more convex and inclined to have a ridge along the middle, and its posterior angles are more marked. The punctation is weaker, and obsolete in some specimens. Numerous sharp spinules are observable on some parts of the surface. In a worn condition the valves are quite smooth, as in some from Woodburn, near Carrickfergus (Antrim), collected by Mr. J. Wright. There are gradations between this form and the type on one hand, and the next variety (*reticosa*) on the other.

Localities.—Chalk, Antrim; *Gault*, Folkestone and Godstone, coll. F. Chapman.

3**. Cythere Harrisiana, *Jones*, var. *reticosa*, nov. Plate I, fig. 46.

Length ·68; height ·4 mm.

This has subquadrate valves, straight above and below, but faintly sinuous at the anterior hinge; rounded in front, with a slightly raised and denticulate margin; angular at the depressed hinder margin below the main body of the valve, there rising with two definite posterior angles, dorsal and ventral. The latter of these is the end of a low straight ridge overhanging the nearly flat ventral face of the valve, and, continuing up round the anterior third of the valve, it bounds a curved furrow-like depression behind the margin. The surface has a low boss just in front of the centre, and is strongly punctate with almost regularly placed pits, making a coarse reticulation.

This is evidently related to *C. Harrisiana;* but its squareness, more definite central and lateral swellings, and very distinct pitting separate it as a variety.

Locality.—In the *Gault* at Godstone, Surrey (coll. C. D. Sherborn), and Folkestone, Kent (coll. F. Chapman).

4. Cythere gaultina, *Jones.* Plate I, figs. 35, 36.

Cythereis gaultina, *Jones.* Monogr. Entom. Cret., 1849, p. 17, pl. ii, figs. 7 *a—c.*
Cythere gaultina, *Jones.* Geol. Mag., 1870, pp. 75, 77.

Length ·7; height ·3; thickness ·2 mm.

We have nothing to add to the description already given. We may remark, however, that Reuss's *Cythere pertusa* ('Denksch. Akad. Wiss. Wien,' vol. vii, 1854, p. 142, pl. xxvii, figs. 5 *a*, *b*, from the Cretaceous series of the Eastern Alps, may claim a relationship with *C. gaultina*, though the two differ in the arrangement of the elevations of the surface.

Localities.—The *Gault* of Folkestone, Kent, and of Godstone, Surrey.

§ III. Subquadrate forms[1] with marginal ridges and central swelling; often reticulate and spinose.

1. CYTHEREIS TRIPLICATA (*Römer*). Plate I, figs. 56—61.

CYTHERINA TRIPLICATA, *Römer*. Verstein. Kreidegeb., 1840, p. 104, pl. xvi, fig. 16.
CYTHERE AURICULATA, var. SEMIMARGINATA, *Cornuel*. Mém. Soc. géol. France, ser. 2, vol. i, pt. 1, 1846, p. 200, pl. viii, figs. 17, 18.
CYTHEREIS TRIPLICATA, *Jones*. Monogr. Entom. Cret., 1849, p. 18, pl. iii, figs. 9 *a—h*.

Fig. 56. Length ·88; height ·5 mm.
Fig. 57. „ ·83; „ ·44 „
Fig. 59. „ ·9; thickness ·47 mm.
Fig. 60. „ 1·0; height ·55 mm.
Fig. 61. Height ·58; thickness ·5 mm.

We may note that very probably *Cypridina Foersteriana*, Bosquet, 'Mém. Soc. R. Sci. Liège,' vol. iv, 1847, p. 364, pl. 2, figs. 4 *a—d*, though narrow in front and smoother, is essentially the same as *C. triplicata*, Römer. The bad drawing in the 'Verst. nordd. Kreid.' misled M. Bosquet, but our fig. 57 might seem at first sight to have only one furrow, as in Römer's figure. Bosquet's *Cythere pulchella*, var. B, also ('Mém. Comm. géol. Neerl.,' vol. i, p. 86, pl. ix, figs. 2 *a—d*) belongs to the same group.

Localities.—Chalk, Colchester and South-east England; *Chalk-rock*, Dunstable; *Chalk-marl*, Didcot; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Cambridge.

Foreign.—Chalk, Maastricht; *Hils-clay*, North Germany; *Neocomian*, Haute-Marne, France.

2. CYTHEREIS AURICULATA (*Cornuel*). Pl. I, figs. 53—55.

CYTHERE AURICULATA, *Cornuel* (partim). Mém. Soc. géol. France, ser. 2, vol. i, pt. 1, p. 200, pl. viii, figs. 14—16.

Fig. 53. Length 1·08; height ·52 mm.
Fig. 54. „ ·96; „ ·48 „
Fig. 55. „ ·8; „ ·48 „

[1] As stated in the 'Supplemental Monograph of the Tertiary Entomostraca of England' (p. 6), we find it useful to retain the *quasi*-generic term *Cythereis* for these forms.

Specimens of this particular form have been obtained by Mr. F. Chapman from the Gault of Folkestone (Kent) and Godstone (Surrey). Figs. 53 and 54 are typically suboblong, broadly rimmed and denticulate in front, and bear the two longitudinal swellings characteristic of this species. The dorsal edge is tuberculate at and behind the anterior hinge; the hinder margin is contracted, depressed, and strongly toothed.

Fig. 55 is shorter and more ovate; the dorsal edge is more arched, and thickened into a third low ridge, and the front marginal rim is thick, smooth, obliquely curved, and set on (as if by accident) far back, close against the anterior ends of the three ridges. In some respects this valve loses the chief characteristics of figs. 53 and 54; but neither its three ridges nor the front and hind margins match the features of *C. triplicata*[1] (figs. 56 and 57). A somewhat similar abnormal individual is in Mr. Chapman's collection from Folkestone.

Localities.—*Chalk-rock*, Dunstable; *Gault*, Godstone and Folkestone; *Neocomian*, Haute-Marne, France.

3. Cythereis quadrilatera (*Römer*). Plate I, figs. 69—75.

Cytherina quadrilatera, *Römer*. Verstein. norddeutsch. Kreidegeb., p. 105, pl. xvi, fig. 19.

Cythere harpa, *Cornuel*. Mém. Soc. géol. France, ser. 2, vol. i, pt. 1, 1846, p. 199, pl. viii, fig. 13.

— auriculata, var. simplex,[2] *Cornuel*. Mém. Soc. géol. France, ser. 2, vol. iii, pt. 1, 1848, p. 243, pl. iii, figs. 10, 11.

Cythereis quadrilatera, *Jones*. Monogr. Entom. Cret., 1849, p. 18, pl. iii, figs. 10 *a*—*f*; pl. iv, figs. 10 *g*—*j'*.

Cythere filicosta ? *Marsson*. Mittheil. nat. Ver. Neu-Pommern und Rügen, Jahrg. 12, 1880, p. 43, pl. iii, figs. 12 *a*, *b*.

— (Cythereis) quadrilatera, *Jones*. Quart. Journ. Geol. Soc., vol. xl, 1884, pp. 766, 772, pl. xxxiv, figs. 39—41.

Fig. 69, large valve. Length 1·16; height ·61 mm.
Fig. 70, small valve. „ 1·16; „ ·5 „
Fig. 71, adult. „ 1·05; thickness ·55 mm.
Fig. 72, adult. Height ·61; thickness ·55 mm.
Fig. 73, medium growth. Length 1·03; height ·52 mm.
Fig. 74, young individual. „ ·61; „ ·305; thickness ·27 mm.

[1] Figs. 53, 54, and 55 are magnified 25 diam., whilst figs. 56—61 are magnified only 18 diam.
[2] "*C. harpa*" is given up in favour of this variety by M. Cornuel at p. 243.

This is a well-defined suboblong species, with a median lobe or narrow swelling, club-shaped in the young forms (Pl. I, figs. 73—75,—formerly Pl. IV, figs. 10 *h*, 10 *j*, 10 *j'*), but becoming narrower and interrupted, or broken up into a chain-like line of tubercles (see the old Pl. III, fig. 10 *b*, and Pl. I, fig. 70), and ultimately it is obsolete or nearly dispersed (as in Pl. I, fig. 69 = old Pl. III, fig. 10 *a*). The older or more developed individuals become also more coarsely spinose at and near the margins. In some instances, as with the specimens from the deep boring at Richmond, Surrey, the clavate ridge is present, as loc. cit., figs. 39 and 40, but disappearing in fig. 41.

Dr. Marsson's *C. filicosta* has the medial clavate ridge of *C. quadrilatera*, but the body of the valve is more strongly squared posteriorly than in the typical form.

Localities.—Chalk, Norwich, Colchester, and South-east England; *Chalk-rock*, Dunstable; *Chalk-marl*, Dover; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Cambridge. Very similar in the *Portland Oolite* of Ridgway, Dorset.

Foreign.—Chalk-formation, North Germany, Saxony, Bohemia, &c.

4. CYTHEREIS ORNATISSIMA (*Reuss*). Plate II, figs. 1—7, 15, 16; and Plate IV, figs. 7 and 8.

CYTHERINA ORNATISSIMA, *Reuss*. Verstein. böhm. Kreideform., pt. ii, 1846, p. 104, pl. xxiv, figs. 12 and 18 (icones malæ).
— CILIATA, *Reuss*. Ibid., fig. 17 (icon mala).
— ECHINULATA, *Williamson*. Trans. Manchester Lit. Phil. Soc., vol. viii, 1847, pl. iv, figs. 75, 76.
CYTHEREIS CILIATA, *Jones*. Monogr. Entom. Cret., 1849, p. 19, pl. iv, figs. 11 *a*—11 *h'*.
CYPRIDINA MURICATA, *Reuss*. Haidinger's Nat. Abhandl., vol. iv, pt. 1, 1851, p. 50, pl. v, figs. 12 *a*—*c*.
CYTHERE ORNATISSIMA, *Bosquet*. Mém. Comm. Carte géol. Neerlande, vol. ii, 1854, pp. 107—110, pl. ix, figs. 6 *a*—*d* (and var. *nodulosa*, pl. vii, figs. 7 *a*—*d*).
— — *Jones*. Geol. Mag., 1870, pp. 75, 76.
— (CYTHEREIS) ORNATISSIMA, *Williamson*. Mem. Lit. Phil. Soc. Manchester, ser. 3, vol. v, 1872, p. 136.
— ORNATISSIMA, *Reuss*. Elbthalgebirge in Sachsen, pt. 2, 1874, p. 146, pl. xxvii, figs. 5, 6 *a*—*c*.
— (CYTHEREIS) ORNATISSIMA, *Jones*. Syst. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 79 and 81.

Pl. II, fig. 1 = Pl. IV (1849), fig. 11 *a*. Length 1·05; height ·55 mm.
Pl. II, fig. 2 = Pl. IV „ fig. 11 *c*. „ 1·16; thickness ·82 mm.
Pl. II, fig. 3 = Pl. IV „ fig. 11 *d*. „ 1·0; „ ·55 „
Pl. II, fig. 4 = Pl. IV „ fig. 11 *e*. Height ·55; „ ·568 „
Pl. II, fig. 5 = Pl. IV „ fig. 11 *f*. Length 1·02; height ·568 mm.
Pl. II, fig. 6 = Pl. IV „ fig. 11 *g*. „ ·82; „ ·47 „
Pl. II, fig. 7 = Pl. IV „ fig. 11 *g′*. „ ·91; thickness ·41 mm.
Pl. II, figs. 15 & 16 } = Pl. IV (1849), figs. 11 *h*, *h′*. Young. Length ·72;
Pl. IV, figs. 7 & 8 } height ·35; thickness ·27 mm.

This common and strongly marked species is subject to many modifications of individual growth and varietal development.

Dr. A. E. von Reuss having shown the badly figured Bohemian specimens to Mr. J. Bosquet, of Maastricht, the latter decided (1854) that *C. ornatissima* and *C. ciliata* are the same.

Fig. 11 *f* of the old Pl. IV (Pl. II, fig. 5) was made, by optical illusion, to show its beautiful reticulate pattern like small tesselated blocks. This punctate ornament is obscured and mostly obliterated by the exaggerated growth of the mesh-walls in old and large individuals,[1] but many specimens of smaller growth preserve it very well.

Pl. II, figs. 15 and 16, and Pl. IV, figs. 7 and 8, represent the young *C. ornatissima*, differing from the adult forms in its subtriangular, instead of oblong, outline; and in its posterior region not having the relative thickness of the adult. An apparent subangular elevation of the coarsely punctate, but relatively smooth, surface has been exaggerated in both fig. 11 *h* and fig. 15 (see Pl. IV, figs. 7 and 8). The centre bears a definite tubercle, the anterior hinge is strongly marked, the dorsal edge is thickened and rough, the front and hind margins are strongly depressed, and the hind margin is angular. In these features it has the essential characters of *C. ornatissima*.

Rare: fig. 15 from the Gault of Folkestone; fig. 16 from the Chalk-marl (?) of Charing.

Localities.—Chalk, Gravesend and South-east England; *Chalk-rock*, Dunstable; *Chalk-marl*, Dover; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Warminster and Ventnor.

Foreign.—Chalk-formation, Bohemia, &c. See Reuss, 'Elbthalgeb.,' p. 147.

[1] As also occurs with similar ornament in other Ostracoda, as *Cythereis Bowerbankii*, *Cythero-pteron concentricum*, &c.

4*. Cythereis ornatissima (*Reuss*), var. *paupera*, nov. (vel *ornatissima-paupera*). Plate II, figs. 10 and 11.

Fig. 10.	Length 1·0;	height	·55 mm.
Fig. 11.	„ ·82;	„	·4 „

Small and poor varieties or ill-developed forms of *C. ornatissima*, with the normal subcentral tubercle and smaller irregular swellings behind it, also a well-marked front hinge and angular ventral ridge. The marginal edges are more or less spinose, and traces of spines occur here and there on the surface, as well as an imperfect reticulation on some specimens.

Locality.—Chalk-rock, Dunstable.

4**. Cythereis ornatissima (*Reuss*), var. *nuda*, nov. (vel *ornatissima-nuda*). Plate I, fig. 76; Plate II, figs.[1] 9, 12—14; Plate IV, fig. 14.

Cythereis cornuta (non *Römer*), *Jones*. Monogr. Entom. Cret., 1849, p. 21, pl. v, figs. 13 *a*—*e* (fig. 13 *a* is *nil*, having been wrongly drawn).

Cythere ornatissima, var. *Jones*. Geol. Mag., 1870, pp. 75, 76.

Pl. I, fig. 76.	Length ·76; height ·44 mm.
Pl. II, fig. 8, and Pl. IV, fig. 14.	„ ·94; „ ·5 „
Pl. II, fig. 9.	„ ·72; „ ·33 „
Pl. IV, fig. 12.	„ ·91; thickness ·38 mm.
Pl. IV, fig. 14.	Height ·5; „ ·33 „

A simple, suboblong *Cythereis;* obliquely rounded, rimmed, and denticulate in front; depressed and angular at the posterior margin; straight on the ventral edge, with a smooth ridge; the dorsal edge roughened, and having a terminal angle corresponding with that of the ventral border. A subcentral round knob has a smaller oval tubercle behind it, and the rest of the surface is naked and smooth. This might be taken, at first sight, for *C. quadrilatera*, but its greater height (breadth) at the anterior third, and the posterior angles of the upper and lower margins distinguish it.

In general characters this is near to *C. fullonica*, Jones and Sherborn, the

[1] Fig. 8 is to be disregarded. The old fig. 13 *a* was wrongly drawn and reduced by mistake. It is reproduced correctly in Pl. IV, fig. 14.

earliest known *Cythereis.* See 'Proceed. Bath N. H. and Antiq. Field Club,' vol. vi, 1888, p. 256, pl. iv, figs. 13 *a—c.*

Localities.—Chalk, Whiteabbey (Antrim) and Kent; *Chalk-marl,* Didcot; *Detritus,* Charing; *Greensand,* Cambridge.

4***. CYTHEREIS ORNATISSIMA (*Reuss*), var. *reticulata,* nov. (vel *ornatissima-reticulata*). Plate I, figs. 67, 68, 77; Plate IV, figs. 9—12.

Pl. I, fig. 67.	Length ·72;	height ·4	mm.
Pl. I, fig. 68.	„ 1·0;	„ ·55	„
Pl. I, fig. 77.	„ ·88;	„ ·52	„
Pl. IV, fig. 9.	„ ·83;	„ ·43	„
Pl. IV, fig. 10.	„ 1·0;	„ ·6; thickness ·6 mm.	

Pl. I, fig. 68, has the general shape of *C. ornatissima,* with broad anterior margin, ventral ridge, well-developed front hinge, central tubercle, and variable medial lobe behind it, as well as a spinose condition of the front, back, and rear margins. The surface, however, is not spinose, but strongly and subconcentrically punctate. In one case the medial lobe shows a neat, linear series of granules (Pl. IV, figs. 10—12).

Pl. I, fig. 77, does not appear to be essentially different from the foregoing. The dorsal edge is coarsely dentate, and the medial post-central lobe is represented by one or two small tubercles. The punctation is stronger and neater in the specimens from Dunstable (figs. 67, 68) than in that from Ireland (fig. 77).

Pl. I, fig. 67, left-hand valve of a reticulate *Cythereis* near *ornatissima,* is contracted in height (breadth). The front marginal rim passes backward into a thin oblique ventral ridge; a subcentral lobe and a trace of a small tubercle behind it are visible.

The ornament in these three forms (Pl. I, figs. 67, 68, and 77, and Pl. IV, figs. 9—12) approaches that of *Cythere Koninckiana* and *ornata,* Bosquet (see 'Mém. Comm. géol. Neerlande,' vol. ii, pp. 110, 113, pl. ix, figs. 7 and 8); and the specific relationship is not distant. As the reticulate ornament is not foreign to, but is present in *C. ornatissima,* and as these under notice do not lose the reticulation by the overgrowth of its mesh-walls, we may regard this feature in these instances as sufficiently persistent to be a *varietal* character, and we place them as the var. RETICULATA.

Localities.—Chalk, Horstead, Gravesend, and Whiteabbey (Antrim); *Chalk-rock,* Dunstable and Luton; *Chalk-marl,* Didcot; *Detritus,* Charing; *Gault,* Folkestone.

4**** CYTHEREIS ORNATISSIMA (*Reuss*), var. *radiata*, nov. (vel *ornatissima-radiata*). Plate IV, fig. 13.

Length, 1·04; height, ·6 mm.

The right valve of a weakly developed variety of *C. ornatissima*, without a central boss and with very slightly indicated ventral ridge; the reticulation passing away, and leaving a local wrinkling of a few mesh-walls radiating from the centre towards the border. On the mid-dorsal region a set of the mesh-walls of the relatively faint reticulate ornament are strengthened so as to radiate upwards from the middle of the valve towards the dorsal edge. Hinder margin smooth, and not much depressed.

Locality.—Greensand, Cambridge. Collected by Mr. G. R. Vine.

4*****. C. ORNATISSIMA, var. *stricta*, nov. Plate I, fig. 63.

Length ·88, height ·41 mm.

A small *Cythereis*, with straight margins above and below; neatly rounded and denticulate in front; posterior margin depressed, and almost symmetrically angular, below the truncated end of the suboblong body of the valve, which is slightly wrinkled, and on which the subcentral boss and a subclavate lobe behind it are distinct. The hinder margin is also denticulate on its ventral edge, as is usual.

At first sight this looks like an abnormal *C. quadrilatera*. One of Mr. J. Wright's specimens from near Whiteabbey, Antrim, is like it; but relatively short, subtuberculate on the body, and strongly toothed in front and behind.

Locality.—Chalk-marl, Didcot Station, Berks.

5. CYTHEREIS WRIGHTII, sp. nov. Plate IV, fig. 18.

Length ·8; height ·46 mm.

A unique, neat, small, subtriangular *Cythereis*, rounded in front, with a strong and denticulate margin; angular and somewhat dentate behind; subcentral knob very distinct; dorsal edge bearing three or four distinct tubercles, and the ventral ridge spinose.

Locality.—Chalk, Keady Hill, co. Londonderry. Collected by Mr. Joseph Wright, F.G.S., with whose name we associate it.

6. CYTHEREIS TUBEROSA, sp. nov. Plate III, figs. 2 and 3.

Length ·7; height ·36; thickness ·36 mm.

Suboblong, upper and lower margins nearly straight, but the dorsal is roughly tuberculate; rounded and denticulate in front; depressed, narrow, and jagged behind the raised body of the valve, which bears the unequal elevations of the strong subcentral boss and swollen posterior corners; the latter are very lumpy in some, but more angular in other individuals. Edge view subsagittate.

Locality.—Chalk, Horstead, Norfolk.

6*. CYTHEREIS TUBEROSA, sp. nov., var. *symmetrica*, nov. (or young). Plate III, fig. 1.

Length ·52; height ·26 mm.

Small, subquadrate; neatly rounded, rimmed, and slightly denticulate in front; depressed, angular, and sharply toothed behind; straight above and below; place of the anterior hinge faintly marked. Body of the valve bearing a strong subcentral boss, two broad, subequal, sharp posterior angles, and two smaller equal angular tubercles, one in the middle of the dorsal and one opposite on the ventral edge. This is possibly the young of the foregoing.

Locality.—Chalk, Horstead, Norfolk.

7. CYTHEREIS ICENICA, sp. nov. Plate I, figs. 37—39.

CYTHEREIS MACROPHTHALMA, *Jones* (not *Bosquet*). Monogr. Entom. Cret., 1849, p. 17, pl. ii, figs. 8 *a, b, b′, b″, b‴*.

CYTHERE MACROPHTHALMA, *Jones* (not *Bosquet*). Geol. Mag., 1870, pp. 75, 77.

Length ·55; height ·33; thickness ·33 mm.

The description of the two odd English valves (from the Chalk of Norwich) given in 1849 holds good, but certainly differs from that given by M. Bosquet of his equally rare specimens from the Maastricht Chalk of Sichen, as intimated by him in the 'Mém. Comm. géol. Neerlande, 1854, p. 97. The difference is chiefly in the greater height (breadth) and more obovate shape of the English form. We may here notice that Marsson's *Cythere chelodon* (from the Chalk of Rügen, 'Mitth. Neu-Vorpommern, &c.,' 1880, p. 43, pl. iii, figs. 13 *a—f*), is an ally of this species.

C. Icenica is named after the *Iceni*—the old inhabitants of Norfolk, whence alone as yet the type form of this species has been obtained.

Locality.—Chalk, Thorpe, near Norwich.

7*. CYTHEREIS ICENICA, sp. nov., var. *quadrata*, nov. (vel *Icenica-quadrata*). Plate I, fig. 62; and Plate IV, figs. 15—17.

Pl. I, fig. 62. Length ·47; height ·27 mm.
Pl. IV, fig. 15 „ ·53; „ ·33; thickness ·3 mm.

Among the specimens collected from the siliceous meal in a Horstead flint are several specimens (some very small) referable to *C. Icenica*, but varying in breadth (height), and in the curvature of the dorsal and ventral margins. Some are subquadrate, rounded in front and angular behind, retain traces of a coarse punctation, and have the middle and marginal elevations much modified. Pl. I, fig. 62, and Pl. IV, fig. 15, show individuals having a strong, straight ventral ridge, ending with an angle. Another (not figured), instead of the low central and ventral elevations, has two parallel, thin, sharp ridges. These somewhat square forms may be grouped as variety QUADRATA.

Locality.—Chalk, Horstead, Norfolk.

8. CYTHEREIS LONSDALEANA, *Jones*. Plate I, figs. 40—42, 64—66.

CYTHEREIS LONSDALEIANA, *Jones*. Monogr. Entom. Cret., 1849, p. 20, pl. v, figs. 12 *a—c*.

Fig. 40. Length ·67; height ·35; thickness ·25 mm.
Fig. 64. „ ·72; „ ·38 mm.
Fig. 65. „ ·61; „ ·38 „
Fig. 66. „ ·83; thickness ·38 mm.

These suboblong, or obovate, valves are not very common. Individuals differ in details as to proportionate height of valve, and the thickness and extent of ridges, but the species is characteristically distinct. Thus figs. 40—42 are more oblong, and have the ridges thinner and less pronounced than in the individuals first figured, one of which (right valve, fig. 12 *b*) is much more obovate than the other (left valve, fig. 12 *a*).

Localities.—Chalk, Norwich and Horstead; *Chalk-rock*, Dunstable. A similar form occurs in the *Upper Oolite* (soft white limestone with flints), at Ridgway, Dorset.

9. Cythereis vallata, *Jones*. Plate II, fig. 19.

Cythere (Cythereis) vallata, *Jones*, MS. Syst. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, p. 81.

Length ·85; height ·37 mm.

Long, subtriangular, rounded in front, with flat margin (broken); tapering backwards, and suddenly contracted to a point at the depressed posterior margin. A raised ridge within the front margin curves backwards ventrally, and, before it ends bluntly at the postero-ventral angle, it gives off, or is replaced by, a thicker oblique ridge, which joins a short dorsal ridge, so that the body of the valve is surrounded by a nearly continuous wall-like ridge or vallum, of an ovate outline.

Locality.—Chalk, Island Magee, opposite Magheramorne, co. Antrim. (Unfortunately broken since it was figured.)

10. Cythereis spinicaudata, sp. nov. Plate II, figs. 17, 18.

Length ·7; height ·32; thickness ·2 mm.

A very neat, subtriangular, depressed form, rounded in front; nearly straight (but sloping) on the upper and lower margins, each of which ends with an acute angle, and has the depressed and sharply cuspidate posterior margin between them. A subcentral knob, smooth ventral ridge, and neat, but rather coarse, punctate ornament help to characterize this species.

Several individuals without the long caudal spine have been obtained from the washings of the Chalk-rock of Dunstable, with which Mr. A. J. Jukes-Browne, F.G.S., has favoured us. The long delicate spine has probably been broken off by trituration among the rough particles of the material washed.

It is not far removed from *C. vallata*, Pl. II, fig. 19; and may also be compared with *C. Geinitzi*, Reuss, 'Elbthal.,' p. 146, pl. xxvii, fig. 4, as having some features in common; also *C. insignis*, Reuss, 'Zeitsch. d. g. Ges.,' 1855, p. 281, pl. x, fig. 9; and Marsson's *C. acutiloba*, 'Mittheil., &c.,' 1880, p. 42, pl. iii, figs. 11 *a*, *b*.

Localities.—Chalk, Horstead, and Keady Hill, co. Londonderry; *Chalk-rock*, Dunstable.

II. Cytheridea, *Bosquet*, 1852.

See Supplem. Monogr. Tert. Entom., 1889, p. 36.

1. Cytheridea perforata (*Römer*). Plate I, figs. 1—4.

Cytherina perforata, *Römer*. Neues Jahrb. f. Min., &c., 1838, p. 516, pl. vi, fig. 11.
Cythere Hilseana, *Jones* (non *Römer*). Monogr. Entom. Cret., 1849, p. 10, pl. i, figs. 1 *a—g*.
Cytheridea Jonesiana, *Bosquet*. Mém. Cour. Acad. R. Sci. Belg., vol. xxiv, 1852, p. 38, and Mém. Comm. Carte géol. Neerl., vol. ii, 1854, p. 74, pl. viii, figs. 5 *a—d*.
— — *Reuss*. Denksch. Akad. Wiss. Wien, vol. vii, 1854, p. 141.
Bairdia perforata, *Bosquet*. Mém. Cour. Acad. Belg., vol. xxiv, 1852, p. 24, pl. i, figs. 8 *a—d*.
Cytheridea perforata, *Jones*. Monogr. Tert. Entom., 1857, p. 44, pl. iv, figs. 14 *a—e*.
— — — Geol. Mag., 1870, pp. 74 and 76.
— — *Jones and Sherborn*. Geol. Mag., 1887, p. 445; and Suppl. Monogr. Tert. Entom. 1889, p. 39, pl. i, fig. 14.

Fig. 1. Large valve (left). Length ·77; height ·5 mm.
Fig. 2. Small valve (right). „ ·695; „ ·415 mm.
Fig. 3. Right valve. „ ·83; „ ·5 „
Fig. 4. Left valve. „ ·916; „ ·55 „

This subtriangular *Cytheridea* is sufficiently well known from published descriptions and figures. Four of those in the Monograph of 1849 are reproduced as reductions, Pl. I, figs. 1—4. The tubercles in the former fig. 1 *a*, were illusory, and the black area in fig. 1 *e* was merely caused by the black wax of the mounting showing through the shell.

Localities.—Chalk, Horstead; *Chalk-rock*, Dunstable; *Chalk-marl*, Didcot and Dover; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Cambridge and Blackdown. A similar form occurs in the *Upper Oolite* at Ridgway, Dorset.

Foreign.—Chalk, Balsberg, in Sweden. See also Reuss, 'Elbthelgeb.,' p. 149.

III. Pseudocythere, *G. O. Sars*, 1865.

" Shell thin, pellucid, compressed, rounded in front, produced behind; hinge-joint simple " (G. S. Brady, 'Challenger Report,' 1880, p. 144).

1. Pseudocythere? simplex, sp. nov. Plate II, figs. 58—60; and Plate IV, figs. 37 and 38.

Pl. II, fig. 58.	Length ·8;	height ·32 mm.	
Pl. II, fig. 59.	„ ·75;	„ ·3 „	
Pl. II, fig. 60.	„ ·57;	„ ·27 „	
Pl. IV, fig. 37.	„ ·9;	„ ·33;	thickness ·33 mm.

Figs. 58 and 59 represent two right-hand valves; they are suboblong, rounded in front, angular behind, and produced at the postero-dorsal angle; straight on the dorsal and very slightly arched on the ventral border; convexity slight, greatest posteriorly. Edge view of united valves narrow-ovate, sharp above; end view oval.

Fig. 60 is a smaller left-hand valve, similar to the foregoing except that it is more arched ventrally, and the postero-dorsal angle is but slightly produced (not quite sufficiently expressed in the drawing).

Many *Cytheruræ* and *Bythocytheræ* have a more or less obtusely conical posterior projection, but we think that this form agrees best with *Pseudocythere*.

Locality.—Chalk, Horstead, Norfolk.

IV. Cytherura, *G. O. Sars*, 1865.

See Monogr. Post-Tertiary Entom., 1874, p. 191.

1. Cytherura appendiculata, *Jones*. Plate III, figs. 17, 18.

Cytherella? appendiculata, *Jones*. Monogr. Entom. Cret., 1849, p. 32, pl. vi, figs. 21 *a*, *b*.
Cytherura appendiculata, *Jones*. Geol. Mag., 1870, pp. 76, 77.

Length ·69; height ·36; thickness ·27 mm.

Unfortunately broken and lost, the unique specimen (from the *Gault* of Folkestone) has not been replaced by any fresh discovery.

V. Cytheropteron, *G. O. Sars*, 1865.

G. S. Brady, 'Report Challenger Ostracoda,' 1880, p. 135.

This genus includes many species of diverse appearance, but with such characteristics as we find also in the Cretaceous specimens under notice. The valves are subrhomboidal and tumid, and variously sculptured. The ventral region is swollen, and may be quite smooth, or bordered by a ridge, or marked with parallel wrinkles and furrows. The postero-ventral region of each valve is in some cases produced laterally into a narrow wing or a sharp spike.

§ I. The forms with full and rounded ventral region, either smooth, marked with riblets, or ridged.

1. CYTHEROPTERON CONCENTRICUM (*Reuss*). Plate I, figs. 5—10; Plate IV, fig. 19.

CYTHERINA CONCENTRICA, *Reuss*. Verstein. böhm. Kreideform., ii Abtheil., 1846, pp. 104 and 105, pl. xxiv, figs. 22 *a—c*.
CYTHERE SCULPTA, *Cornuel*.[1] Mém. Soc. géol. France, sér. 2, vol. i, pt. 1, 1846, p. 201, pl. viii, figs. 20—23; and vol. iii, pt. 1, 1848, p. 244.
CYTHERINA CONCENTRICA, *Williamson*. Trans. Manchester Lit. Phil. Soc., vol. viii, 1847, p. 79, pl. iv, fig. 77.
CYPRIDINA RŒMERIANA, *Bosquet*. Mém. Soc. Roy. Sci. Liége, vol. iv, 1847, p. 362, pl. ii, figs. 2 *a—f*.
CYTHERE PUNCTATULA, *Jones* (non *Römer*). Monogr. Entom. Cret., 1849, p. 11, pl. i, figs. 2 *a—m* (fig. 2 *n*, var.).
— CONCENTRICA, *Bosquet*. Mém. Com. Carte géol. Neerlande, vol. ii, 1854, p. 81, pl. viii, figs. *a—d*.
— — *Jones*. Geol. Mag., 1870, pp. 74 and 76.
— — *Williamson*. Trans. Manchester Lit. Phil. Soc., ser. 3, vol. v, 1872, p. 136.
— — *Reuss*. Elbthalgeb. Sachsen, 1874, p. 144, pl. xxvii, figs. 1 *a—c*.
— — *Kafka*. Crustaceen böhm. Kreideformation, 1887, p. 14, fig. 27.

Pl. I, fig. 5. Length ·66; height ·44 mm.
Pl. I, fig. 6. „ ·61; „ ·33 „
Pl. I, fig. 7. „ ·861; „ ·351 „
Pl. I, fig. 10. Height ·55; thickness ·833 mm.
Pl. IV, fig. 19. Length ·83; height ·56 „

The late M. Bosquet, of Maastricht, having carefully compared specimens of Römer's *C. punctatula* with *C. concentrica*, Reuss, decided that the former is the young state of *C. Hilseana*, Römer (see 'Mém. Comm. Neerlande,' vol. ii, p. 82). "*C. punctatula*, Römer," is therefore omitted from the synonymy.

Numerous gradations are observable in the many individual valves, whether from one or from different localities, as to the superficial ornament of this somewhat variable and yet very distinct species. The very delicate concentric reticulation, with or without spinous mesh-walls, becomes coarser and coarser

[1] M. Cornuel had mentioned his Neocomian species already in the 'Bullet. Soc. géol. France,' sér. 2, vol. ii, p. 52, 1844.

with age, as shown in the series of figs. 2*f*, *f'*, *g*, *h*, and *i*, in Pl. I of the former Monograph, 1849. When the surface is occupied by neat concentric wrinkles, somewhat more perfect even than shown in M. Bosquet's fig. 2, 'Mém. Liége,' vol. iv, pl. ii, these little valves are charmingly pretty (see Cornuel's figure, loc. cit., and Pl. IV, fig. 19). Considerable resemblance in contour and in style of ornament is to be seen between some individuals of *C. concentricum* and some recent forms, such as *C. depressum*, B. and N., 'Trans. R. Dublin Soc.,' 2nd ser., vol. iv, 1889, p. 219, pl. xxi, figs. 1, 2; also *C. latissimum* (Norman), 'Monogr. Post-Tert. Entom.,' p. 202, pl. viii, fig. 23; and particularly between *C. Montrosiense*, B. C. and R., as figured in the 'Ann. Mag. N. H.,' ser. 4, vol. ii, pl. v, figs. 4 and 5 (young), and 'Trans. R. Dublin Soc.,' 1889, p. 216, pl. xix, figs. 26 and 27 (adult), and Bosquet's figure above quoted. Some *Cytheræ*, such as *C. Speyeri*, Brady, as given in the 'Trans. R. Dubl. Soc.,' 1889, p. 141, pl. xvii, figs. 16, 17, have to some extent this kind of carapace; and Reuss's *C. texturata*, 'Zeitsch. d. g. G.,' vol. ii, p. 286, pl. x, figs. *a—d*, comes very near to this form.

Some figures selected from the former series are here reproduced on a smaller scale. Fig. 5 (the former fig. 2 *j*) is an old very much worn valve, from the Greensand of Warminster. Fig. 6 (reduction of 2 *f*) is a left valve, young, with the sculpturing of pits and spinous meshes unworn; and fig. 7 (fig. 2 *b*) is a left old, though smaller, valve, with the ornament changed to interrupted corrugation or wrinkles (like "dot and dash" in telegraphy), rounded, smooth, and more or less concentric. Some individuals show the lines of punctations without the intermediate mesh-walls being prickly.

Localities.—Chalk, Horstead and S.E. England, Magheramorne (Antrim), and Keady Hill (Londonderry); *Chalk-rock*, Dunstable; *Chalk-marl*, Didcot and Dover; *Detritus*, Charing; *Gault*, Folkestone and Leacon Hill; *Greensand*, Cambridge and Warminster. Very similar in the *Upper Oolite*, Ridgway, Dorset.

Foreign.—Chalk, Maastricht, Rügen, Bohemia, &c.; *Neocomian*, Haute-Marne, France.

1*. Cytheropteron concentricum (*Reuss*), varietas *virginea*, Jones (vel *concentricum-virgineum*). Plate I, figs. 14—17.

Cythere punctatula (non *Römer*), var. virginea, *Jones*. Monogr. Entom. Cret., 1849, p. 12, pl. i, fig. 2 *n*.

Cypridina (Cytherina on the plate) Althi, *Reuss*. Haid. Nat. Abhandl., vol. iv, pt. 1, 1850, p. 49, pl. vi, figs. 10 *a—c*.

Cythere punctatula et var. virginea, *Bosquet*. Mém. Cour., &c., Acad. Belg., vol. xxiv, 1852, pp. 73 and 74, pl. iii, figs. 10 *a—d*.

CYTHERE VIRGINEA, *Jones.* Syst. Lists, &c., Belfast Nat. Field Club, vol. i, Append. iii, 1875, pp. 81 and 92.
— CONCENTRICA, var. VIRGINEA, *Reuss.* Elbthalgeb., &c., 1874, p. 145.

Pl. I, fig. 14. Length ·5; height ·305 mm.
Pl. I, fig. 15. „ ·85; „ ·525 „
Pl. I, fig. 16. „ ·7; thickness ·45 mm.
Pl. I, fig. 17. height ·55; „ ·55 „

This form is very persistent in the Chalk of several localities, but the absence of ornament seems to be its only distinction from *C. concentricum.* The faint trace of reticulate structure in translucent valves, and some feeble ventral wrinkles or riblets in one of the Irish specimens, strengthen its position as a *variety.*

M. Bosquet (op. cit., 1854, p. 81) has indicated that Reuss's *C. Althi* may be the same as the var. *virginea* (1849), and Dr. Reuss in 1874 expressed his acquiescence in this determination. The Lemberg specimen shows some ventral riblets.

The recent *Cytheropteron læve*, Brady and Norman, 'Trans. R. Dubl. Soc.,' 1889, p. 210, pl. xx, figs. 29—31, is remarkably similar, but is broader (higher) in front, and quite destitute of ornament.

Localities.—Chalk, Horstead, Gravesend, Magheramorne (Antrim), and Keady Hill (Londonderry); *Detritus*, Charing; *Greensand*, Cambridge and Warminster.

Foreign.—Cretaceous, Gosau.

2. CYTHEROPTERON SPHENOIDES (*Reuss*). Plate I, figs. 18—20.

CYTHERE SPHENOIDES, *Reuss.* Denksch. Akad. Wiss. Wien, math.-nat. Class., vol. vii, 1854, p. 141, pl. xxvi, fig. 2.
— — — Elbthalgeb., &c., 1874, p. 147, pl. xxvii, fig. 7.

Length ·8; height ·45; thickness ·5 mm.

Subtriangular, tumid, but depressed or pinched in at the anterior, dorsal, and posterior margins. The thickness is greater and sudden just behind and below the middle (figs. 19 and 20). The front end is obliquely rounded; the ventral region is obliquely convex, with a thickened ridge above the flat ventral area of the margin. The dorsal line slopes downwards and backwards, and the hinge-teeth (fig. 19) are stronger than usual in the genus. The hinder end is narrow, depressed, and serrate with a few denticles.

In these features it differs from the Cretaceous and Tertiary *C. triangulare* (Reuss), 'Suppl. Monogr. Tert. Ent.,' p. 44, pl. ii, figs. 19 *a—c*, being more convex centrally, and more depressed at the ends and back; it is also more truly triangular in outline and less so in section. There is, however, a close agreement with *C. sphenoides* (Reuss), although our specimen has a greater central convexity, is rather higher and more angular on the back, not quite so straight ventrally, and has a denticulate posterior margin. These differences in the development of details may be of only sexual, if not of varietal value.

Locality.—Chalk-rock, Dunstable, Bedfordshire.

Foreign.—Cretaceous, Strehlen and Gosau.

§ II. The forms with a postero-ventral wing or spine.

3. CYTHEROPTERON ALATUM (*Bosquet*).

CYPRIDINA ALATA, *Bosquet.* Mém. Soc. Roy. Sci. Liége, vol. iv, 1847, p. 369, pl. iv, figs. 1 *a—d.*

CYTHERE ALATA, *Bosquet.* Mém. Comm. Carte géol. Neerlande, vol. ii, 1854, p. 117, pl. ix, figs. 10 *a—d.*

Length 1·1; height ·7; thickness 1·2 (with the wings) mm., as stated l. c., p. 370.
,, 1·1; ,, ·56; ,, ·8 (with the wings) mm., approximate, as calculated.

There are many allied forms of *Cytheropteron* with a more or less expanded sharp ridge or wing projecting from the postero-ventral region of each valve, and the determination of specific and varietal value amongst these various modifications is very difficult. The following is a list of the most striking of these winged or alate forms.

Cretaceous. *Cypridina alata*, Bosquet, 1847; *Cythere*, 1854. Expanded form.
Cretaceous. — *serratula*, Bosquet, 1847; *Cythere*, 1854. Narrow form.
Tertiary. *Cypridina vespertilio*, Reuss, 1850; Egger, 1858. Expanded form.
Tertiary. — *hastata*, Reuss, 1850; Egger, 1858. Expanded form.
Cretaceous. *Cythere longispina*, Bosquet, 1854. Expanded form.
Cretaceous. — *laticristata*, Bosquet, 1854. ,, ,,
Cretaceous. — *trigonoptera*, Bosquet, 1854. ,, ,,
Cretaceous. — *macroptera*, Bosquet, 1854. ,, ,,
Tertiary. *Cypridina papilio*, Egger, 1858. Expanded.
Tertiary; Cretaceous; Tertiary. *Cypridina cornuta*, Römer, 1838 (narrow); Bosquet, 1852 (narrow); Reuss, 1855 (narrow); Egger, 1858 (broad); Speyer, 1863 (broad).

Cretaceous and Tertiary. *Cypridina monoceros*, Reuss, 1855 (narrow); Speyer, 1863 (narrow).
Tertiary. *Cypridina undulata*, Speyer, 1863. Expanded.
Recent. *Cytheropteron gibbosum*, Brady, 1868. Expanded.
Recent. — *inornatum*, Brady and Robertson, 1872. Expanded.
Recent. — *alatum*, Sars, 1865; Brady and Robertson, 1872; Brady and Norman, 1889. Expanded form.
Post-tertiary. *Cytheropteron arcuatum*, Brady, Crosskey, and Robertson, 1874; Brady and Norman, 1889. Expanded form.
Tertiary. *Cytheropteron pipistrella*, Brady, 1878. ,, ,,
Recent. — *intermedium*, Brady, 1878. ,, ,,
Recent. — *crassispinatum*, Brady and Norman, 1889. Expanded.
Recent. — *hamatum*, Brady and Norman, 1889. Expanded.

Cytheropteron alatum (Bosquet) is one of the expanded forms, though not so widely expanded as some; and we are still inclined to take it as a convenient type for some varieties from the Chalk in our collections, because their differences do not appear to be of specific value. It was from the *Chalk* of Maastricht. We have seen a specimen very near to Bosquet's type in Mr. C. D. Sherborn's collection of fossil *Ostracoda* from a clay at the foot of the cliff at Havre, France.

3*. Cytheropteron alatum (Bosquet), var. *robusta*, nov. (vel *alatum-robustum*). Plate II, figs. 24—27.

Cythereis alata (*Bosquet*), *Jones*. Monogr. Entom. Cret., 1849, p. 21, pl. v, figs. 14 *a—d*.

Length ·833; height ·5; thickness ·61 mm.

This rather rare form, figured and described in the 'Monograph,' 1849, was referred to the *Cythere alata* of Bosquet; but its squarer outline, well-rounded and denticulate front margin, and spinose posterior edge of the wing characterise it as a variety, which we propose to term robusta.

Prof. Reuss referred a very similar but neater and weaker specimen[1] to *C. serratula*, Bosquet, the outer edge of the wings being slightly tuberculate.

Localities.—Chalk, Norwich; *Detritus*, Charing.

[1] 'Elbthalgeb.,' &c., 1874, p. 148, pl. xxvii, figs. 8 *a*, *b*.

3**. Cytheropteron alatum (Bosquet), var. *fortis* (vel *alatum-forte*). Plate II, figs. 20, 21.

Fig. 20. Length 1·0; height ·48 mm.
Fig. 21. „ ·96; „ ·48 „

This differs from Bosquet's type in being rounder in front and having the wing further forward on the ventral region, with its posterior edge only slightly spinose; and the coarse denticles on both the front and hind margins of the valve complete the varietal differences. It is not represented in any figures yet published; but Kafka's figs. 36 *a*, *b*, at p. 16 of Fritsch's 'Crustac. böhm. Kreidef.,' 1887, described as Bosquet's *Cythere serratula*, is very near to it.

Localities.—Chalk, Horstead, and Whiteabbey and Magheramorne (Antrim).

3***. Cytheropteron alatum (Bosquet), var. *cornuta* (vel *alatum-cornutum*). Plate IV, fig. 36.

Cythere cornuta (*Römer?*), *Bosquet.* Mém. Cour. Acad. Sci. Belg., vol. xxiv, 1852, p. 117, pl. vi, figs. 4 *a—d;* and Reuss, Zeitsch. d. g. G., 1855, p. 212, pl. x, figs. 10 *a*, *b*.

Length 1·1; height ·53 mm.

An elongate oblong valve, almost equally rounded and denticulate at the ends, rimmed in front, and bearing a short, angular, ventral wing, which reaches scarcely beyond the middle of the valve, leaving the posterior third depressed and bare.

Except in the shortness of the wing, this form comes close to Bosquet's figure of Römer's *Cytherina cornuta.*[1]

Localities.—Chalk, Kent; and ? *Chalk-rock*, Dunstable.

4. Cytheropteron Hibernicum, sp. nov. Plate II, figs. 22, 23.

Cythere (Cythereis) alata, *Jones.* Syst. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 81, 92.

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[1] *Cythereis cornuta* (Römer ?), Jones, 'Monogr. Tert. Entom.,' 1857, p. 39, pl. iv, fig. 19, and pl. v, figs. 15 *a*, *b*, is possibly a *Cytheropteron* near *C. alatum;* but the *Cythereis cornuta* of the 'Suppl. Monogr. Tert. Entom.,' 1889, p. 35, pl. i, fig. 22, is regarded by Dr. G. S. Brady as an undeveloped or young form of *Cythereis Jonesii*, Baird (see 'Trans. R. Dublin Soc.,' ser. 2, vol. iv, p. 169).

Length ·92; height ·6; thickness ·8 mm.

Carapace subrhomboidal in side view; broad, smooth, and convex, but sloping to the front and back; highest (widest) at the anterior third, and thickest behind the middle; bluntly sagittate and with sharp barbs in edge view; front rounded with a short prominent curve, which slopes off both above and below; back elliptically arched; ventral margin nearly straight, but overhung by the long, broad, angular wing, pointing downwards and backwards; hinder margin depressed, narrow, and truncate with sharp angles.

This is different from *Cytheropteron pipistrella*, Brady ('Trans. Zool. Soc.,' vol. x, 1878, p. 404, pl. lxix, figs. 2 *a*—*d*), in the outline of the valve, and the shape and backward position of the wing.

Locality.—Chalk, near the Gobbins, co. Antrim.

5. CYTHEROPTERON ? PHYLLOPTERUM (Bosquet). Plate III, figs. 9, 10.

CYTHERE PHYLLOPTERA, *Bosquet.* Mém. Comm. Carte géol. Neerlande, vol. ii, 1875, p. 116, pl. vii, figs. 10 *a*—*d*.
— (CYTHEREIS) SPICULATA, *Jones,* MS. Syst. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 81, 92.

Length ·825; height ·45; thickness (with spines) ·75 mm.

Mr. Wright's specimens from the Island of Magee, co. Antrim, and Keady Hill, Derry, nearly agree with M. Bosquet's species above quoted, for some have a smoother front margin and a more spinose projection on each valve than shown in our figs. 9 and 10. The position of the great spine varies somewhat, being more forward in some cases than in others, as shown by the figures; it is nearly mid-ventral in our fig. 9 and Bosquet's figs. 10 *b* and *c*, but further back in our fig. 10 and Bosquet's fig. 10 *a*. The similarity of these to *Cythereis ceratoptera* renders our determination uncertain.

Localities.—Chalk, Ballytober, Island Magee, co. Antrim, and Keady Hill, co. Londonderry.

Foreign.—Chalk, St. Pierre (Limbourg), and Ciply, near Mons.

6. CYTHEROPTERON CUSPIDATUM, sp. nov. Plate III, figs. 4 and 5.

Length ·65; height ·3; thickness (with spines) ·7 mm.

Long, low (narrow), subtriangular; straight on the dorsal, obliquely arched on the ventral border; rounded and denticulate on the front margin, but prominent at the antero-dorsal angle; contracted and subacute behind (broken in fig. 4). The anterior part of the surface has a low narrow ridge curving from below to the antero-dorsal angle ; the body of the valve has a broad swelling with a backward and downward (ventral) curve, ending in a long, sharp, tapering spine, pointing downwards and outwards. The hinder part of the valve is depressed, sloping and narrowing to the end. The dorsal edge, besides the tubercle at its front angle, already noticed, has a similar projection at or below the place of the anterior hinge, and a small tubercle behind it. There are also some irregular prickles on the upper and lower margins.

Localities.—Chalk, Horstead, Norfolk, and Keady Hill, co. Londonderry.

6*. Cytheropteron cuspidatum, sp. nov., var. *montuosa*, nov. (vel *cuspidatum-montuosum*). Plate III, figs. 14—16.

Cythere (Cythereis) montuosa, *Jones*, MS. Syst. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 81, 92.

Length ·75 ; height ·3 ; thickness (with spines) ·5 mm.

In this variety the curved swelling on the ventral region is not interrupted in front, and it bears two subcylindrical tubercles, or short blunt spines, the hinder of which is longer than the other. There are three isolated pointed tubercles on the dorsal edge, towards two of which the ends of the ventral swelling curve upwards.

Localities.—Chalk, Island Magee, co. Antrim ; *Greensand*, Warminster.

6**. Cytheropteron cuspidatum, sp. nov., var. *tricuspidata*, nov. (vel *cuspidatum-tricuspidatum*). Plate III, figs. 6, 7.

Length ·65 ; height ·25 ; thickness (with spines) ·6 mm.

Here the ventral swelling of the valve's surface is developed into three strong, conical, unequal, and more or less divergent spines.

Locality.—Chalk, Horstead, Norfolk.

7. Cytheropteron pedatum (*Marsson*). Plate IV, figs. 33—35.

Cythere pedata, *Marsson*. Mittheil. naturw. Ver. Neu-Vorpommern und Rügen, Jahrg. xii, 1880, p. 46, pl. iii, figs. 16 *a—c*.

CYTHERE (CYTHEREIS) CUSPIDIS, *Jones*, MS. System. Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, pp. 81, 92.

Length 1·26; height ·53; thickness (with spines) 1·2 mm.

Suboblong, with oblique ends, rounded in front, acute behind; surface convex; depressed, margined, and denticulate in front; rising to a strong spine at the posterior third, and suddenly sinking behind to a contracted, flat hinder margin; bordered ventrally with a narrow raised rim. The surface is punctate, and, together with the dorsal edge, bears small irregular prickles. The large spine points backwards, but its angle varies. In the Irish specimens it stands out more boldly than in Dr. Marsson's figures, two of which (figs. 16 *b* and *c*) illustrate his smooth variety "*lævis*."

Localities.—Chalk, Horstead (Norfolk), near the Gobbins (Antrim), and Keady Hill (Londonderry); *Chalk-rock*, Dunstable.

7*. CYTHEROPTERON PEDATUM, *Marsson*, var. *salebrosa*, nov. (vel *pedatum-salebrosum*). Plate III, fig. 8; Plate IV, fig. 32.

Pl. III, fig. 8. Length ·87; height ·4 mm.
Pl. IV, fig. 32. „ 1·0; „ ·406 mm.

Subtriangular, rounded and denticulate in front, obliquely subacute behind, with a narrow, flattened end. The dorsal edge is straight, and the ventral nearly parallel with it. Margined with a raised rim all round except where it is tuberculate on the postero-dorsal edge. At the dorsal region the surface is impressed with three shallow, nearly equidistant, transverse furrows;[1] the middle one largest, and the foremost weakest. Thus the surface of the body of the valve undulates with four low transverse swellings and three corresponding valleys. The whole surface is rough with irregular granulations, interspersed with small tubercles, and the thick, short spine rises from the posterior of the two main transverse swellings.

This has the look of *Cytheropteron pedatum* as to outline, and possesses a short, thick spine, rising on the posterior moiety of a rough and undulating valve. It somewhat resembles Reuss's *Cythere oxyura* from the Cretaceous Baculite-clay at the Kanara Lake, near Kustenjeh in the Dobrutscha,[2] 'Sitzungsb. Akad. Wiss. Wien,' vol. lii, p. 24, pl. —, fig. 13.

[1] Not well shown in fig. 32.
[2] See also 'Quart. Journ. Geol. Soc.,' vol. xiv, p. 206, &c.

Also in its outline, roughness of surface, and want of wings, it resembles *Cytheropteron angulatum*, Brady, 'Ann. Mag. Nat. Hist.,' vol. ix, p. 62, pl. ii, figs. 7 and 8.

Localities.—Chalk, Whiteabbey, co. Antrim; *Chalk-rock*, Dunstable, Bedfordshire.

8. Cytheropteron umbonatum (*Williamson*). Plate I, figs. 21—26.

Cytherina umbonata, *Williamson*. Mem. Manch. Lit. Phil. Soc., vol. viii, 1847, p. 79, pl. iv, fig. 78.
Cythere umbonata, *Jones*. Monogr. Entom. Cret., 1849, p. 12, pl. ii, figs. 3 *a—g*.
— longispina, *Bosquet*. Mém. Comm. Neerlande, vol. ii, 1854, p. 96, pl. vi, fig. 7.
Cytheropteron umbonatum, *Jones*. Geol. Mag., 1870, pp. 74 and 76.
Cytheroptera[on] umbonata[um], *Williamson*. Mem. Manch. Lit. Phil. Soc., ser. 3, vol. v, 1872, p. 136.
Cythere umbonata, *Marsson*. Mittheil. nat. Ver. Neu-Vorpommern und Rügen, Jahrg. xii, 1880, p. 45, pl. iii, figs. 15 *a—c*.

Fig. 21. Length ·55; thickness ·38 mm.
Fig. 23. „ ·6; „ ·35 „
Fig. 24. Height ·4; „ ·4 „
Fig. 26. Length ·583; height ·277 „

The figures formerly given in the 'Monograph,' 1849, and the present illustrations, Pl. I, figs. 11—13, 23, and 24, indicate such varying proportions in the height and thickness of the valves, the length and sharpness of the postero-ventral processes, and the extent and depth of the mid-dorsal furrow, that we are satisfied this species includes the forms mentioned in the list of synonyms above given. In examining several other specimens in our collections we find further extension of variability, not only in the features mentioned above, but even in the valves losing their subrhomboidal for a more oblong outline. The type (figs. 21—26) is neatly punctate.

Of the published forms of this kind, the recent *Cytheropteron acutum*, Brady, 'Ann. Mag. Nat. Hist.,' ser. 4, vol. iii, 1869, p. 49, pl. viii, figs. 1—4, is one of those most nearly approaching *C. umbonatum* of the Chalk.

Localities.—Chalk, Norwich and Woolwich; *Chalk-marl*, Dover; *Detritus*, Charing.

8*. Cytheropteron umbonatum (*Williamson*), var. *acanthoptera* (Marsson), (vel *umbonatum-acanthopterum*). Plate I, figs. 11—13; Plate IV, figs. 22—29.

Cythere acanthoptera, *Marsson*. Mittheil. naturw. Ver. Neu-Vorpommern und Rügen, 1880, p. 45, pl. iii, figs. 14 *a*—*c*.

Pl. I, fig. 11.	Length ·625;	height ·35;	thickness (with spines) ·55 mm.
Pl. IV, fig. 22.	„ ·7;	„ ·43;	„ „ ·66 „
Pl. IV, fig. 25.	„ ·66;	„ ·36;	„ „ ·66 „
Pl. IV, fig. 27.	„ ·7;	„ ·33 mm.	
Pl. IV, fig. 28.	„ ·7;	„ ·3;	„ „ ·73 „

In some specimens from the Chalk of Horstead, and of Island Magee, Ireland, we find the body of the valve much swollen, almost as much in front as behind, and the edges of this tumid area more or less ridged and prickled (slightly indicated in Pl. I, fig. 12), quite coarsely and irregularly in an Irish specimen; the dorsal furrow is deep; the antero-dorsal region sometimes bulges out into a low, irregular tubercle (Pl. IV, figs. 25—27); the postero-ventral spine is strong, and, having a depression at its base, is, as it were, set in a notch in some specimens, which have much stronger features than are shown in Pl. I, figs. 11—13. The punctation is coarse and mixed with prickles, mostly arising from the walls of the meshes. The valves are broader (higher) than those of the typical form, and vary in this feature as well as in the convexity of the ventral region.

Dr. Marsson's *acanthoptera* is very like our figs. 11—13 of Pl. I, but is figured with a smooth surface, and its medial depression reaches across the valve. These discrepancies, however, are slight, and we think that they are not sufficiently essential to separate the forms under notice.

Localities.—*Chalk*, Horstead (Norfolk) and Island Magee (Antrim); *Chalk-rock*, Dunstable.

Foreign.—*Chalk*, Isle of Rügen.

8**. Cytheropteron umbonatum (*Williamson*), var. *longispinata*, nov. (vel *umbonatum-longispinatum*). Plate III, figs. 11—13; Plate IV, figs. 30 and 31.

Cythere umbonata, *Marsson*. Mitth. nat. Ver. Neu-Vorpommern und Rügen, 1880, p. 45, pl. iii, figs. 15 *a*—*c*.

Pl. III, fig. 11.
Pl. IV, fig. 30. } Length 1·0; height ·53; thickness (with spines) 1·1 mm.

This is larger and more convex than the type, with long and sharp ventral spines, themselves delicately spinose, and spreading out wide (Pl. III, fig. 12, and Pl. IV, fig. 31), and sometimes nearly straight (fig. 13). The mid-dorsal furrow is generally stronger than shown in figs. 11 and 12, and occasionally is repeated to some extent in the anterior region, so as to give rise to a small antero-ventral tubercle. In one case even a feeble antero-dorsal spine is present. The surface is punctate, with the meshes, in several specimens, becoming spinose, so that the whole surface is prickly. The front margin is strongly denticulate.

The figs. 15 *a—c* by which Dr. Marsson illustrates *C. umbonata*, Williamson, evidently belong to the same variety as our Pl. III, figs. 11—13, and Pl. IV, figs. 30 and 31, although in the latter the spines are longer, the valves more prickly, and slightly modified by the subsidiary furrow in front.

Localities.—Chalk, Horstead, and chalk-flint in gravel at Mitcham, Surrey (collected by Dr. G. C. Wallich).

Foreign.—Chalk, Isle of Rügen.

9. Cytheropteron Sherborni, sp. nov. Plate I, figs. 33 and 34; Plate IV, figs. 20 and 21.

Pl. I, fig. 33. Length ·725; height ·375; thickness ·35 mm.
Pl. IV, fig. 20. ,, ·8; ,, ·43; ,, ·53 ,,

Several specimens from Horstead, Norfolk, although very tumid over the ventral border, have no postero-ventral spine; some, however, have a trace of a ventral ridge ending with a posterior angle. The surface has a variable concentric punctation, with the meshes in some instances becoming spinose, and thus making five or six concentric rows of small prickles (figs. 33 and 34). The valves are nearly oblong in outline; obliquely rounded and denticulate in front, and blunt or more or less angular behind. The mid-dorsal sulcus is present, and ends in a minute subcentral pit. Both in front and behind, the valve is depressed along the margin, sometimes considerably below the convex body of the valve.

The Post-tertiary *Cytheropteron complanatum*, Brady and Crosskey, 'Geol. Mag.,' 1871, p. 65, pl. ii, figs. 3 and 4, from Canada, has a distant resemblance to this form.

The concentric punctation is, to some extent, comparable with that of *Cythere vesiculosa*, Bosquet, 'Mém. Comm. Neerlande,' vol. ii, p. 94, pl. vi, figs. 2 *a—d*, but the arching of the semicircular lines is reversed, being towards the dorsal instead of the ventral region as in our specimens.

This species is named after Mr. C. Davies Sherborn, F.G.S., who has kindly given us great help in the preparation of this Supplemental Monograph.

Localities.—Chalk, Horstead, and Mill Bay, Island Magee, co. Antrim.

VI. Cytherideis, *Jones*, 1857.

Restricted and defined by G. S. Brady and A. M. Norman, 'Trans. Roy. Soc. Dublin,' ser. 2, vol. iv, 1889, p. 226. "Shell slender, elongate, subovate, tapering and depressed towards the front, not much compressed laterally. Hinge-margins nearly simple; shell smooth, finely punctate; right valve overlapping the left in the centre of the ventral surface." (The limbs are then described.)

1. Cytherideis parallela, sp. nov. Plate IV, figs. 5 and 6 (figured upside-down).

Length ·83; height ·33; thickness ·16 mm.

A unique valve of a small subcylindrical carapace. If the figure be looked at in the reversed position it is narrow-oblong, compressed and rounded at one (anterior) end, and obliquely subacute at the other; edge view (of the united valves) narrow-lanceolate, or compressed ovate, sharp anteriorly and blunt behind; surface smooth.

This may be a *Cytherideis,* although the anterior is more fully rounded than the posterior end. Excepting that the posterior end in this case is obliquely truncate, there are some comparable recent forms, such as *Cytherideis cylindrica*, Brady, 'Les Fonds de la Mer,' vol. i, part 1, livr. 8, 1869, p. 113, pl. xiii, figs. 11 and 12*;* and *C. lævata,* Brady, 'Challenger Report,' 1880, p. 146, pl. vi, figs. 5 *a—d;* also a Tertiary species (from the Antwerp Crag), *C. recta,* Brady, 'Trans. Zool. Soc.,' vol. x, 1878, p. 406, pl. lxiii, figs. 3 *a—d.* In some respects *C. lævata* is nearest in shape, but there is so much difference that we give our Irish specimen a separate name, *C. parallela.*

Locality.—Chalk, Keady Hill, co. Londonderry. Collected from the dust of a chalk-flint, by Mr. Joseph Wright, F.G.S.

2. Cytherideis acuminata (*Alth*). Plate IV, figs. 40, 41 (figured upside-down).

Cytherina acuminata, *Alth.* Reuss, in Haidinger's Nat. Abhandl., vol. iv, pt. 1, 1851, p. 49, pl. vi, fig. 8 (not 7), drawn upside-down.

Cythere? Wrightii, *Jones*, MS. Systematic Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, 1875, p. 81.

Length 1·0; height ·4; thickness ·36 mm.

A carapace with one of the valves damaged. Right valve (figure seen in a reversed position) like a pea-pod; elongate, suboblong, rounded in front, obliquely curving to a subacute postero-ventral angle behind; slightly arched on the dorsal, and straight on the ventral edge; surface smooth, gently convex, thickest at the anterior, highest at the posterior third; edge view of the carapace narrow-oval, somewhat blunter behind than in front.

Carapaces approximately similar in shape may be *Cytherina recta*, Reuss ('Haid. Naturw. Abhandl.,' vol. iii, part 1, 1850, pl. viii, fig. 11), *C. heterostigma*, Reuss (ibid., fig. 23), and *Aglaia complanata*, Brady and Robertson (1869), 'Trans. Roy. Dublin Soc.,' ser. 2, vol. iv, 1889, p. 94, pl. xiv, figs. 28 and 29; but Alth's *Cytherina acuminata* (Cretaceous from Lemberg), as figured by Reuss in 'Haid. Naturw. Abhandl.,' vol. iv, part 1, 1851, p. 49, pl. vi, fig. 7 (not 8), is so similar in character that we must take it to be the same.

Localities.—In the flint-dust from the *Chalk* of Glenarm, Antrim. Coll. Mr. Joseph Wright, F.G.S.

III. CYTHERELLIDÆ.

I. Cytherella, *Jones*, 1849, and *Bosquet*, 1852.

For notes on the fossil species of this genus see the 'Monograph of the Brit. Foss. Biv. Entomostraca from the Carboniferous Formations,' by Jones, Kirkby, and Brady, part 1, No. 2, 1884, pp. 57—69; also the 'Supplem. Monogr. Tert. Entom.,' by Jones and Sherborn, 1889, p. 47.

1. Cytherella ovata (*Römer*). Plate III, figs. 48—54; and Plate IV, fig. 39.

Cytherina, *Lyell and Lonsdale.* Elem. Geol., 1838, p. 55, fig. 19.
— ovata, *Römer.* Verstein. nordd. Kreidegeb., 1840, p. 104, pl. xvi, fig. 21.
— complanata, *Reuss.* Verstein. böhm. Kreideform., pt. 1, 1845, p. 16, pl. v, fig. 34 (icon mala).
— ovata, *Reuss.* Ibid., pl. vi, fig. 35.
Cythere reniformis, *Bosquet.* Mém. Soc. Roy. Sci. Liége, vol. iv, 1847, p. 356, pl. i, figs. 1 *a—f.*
Cytherella ovata, *Jones.* Monogr. Entom. Cret., 1849, p. 28, pl. vii, figs. 24 *a—i.*

CYTHERE AMYGDALOIDES, var. BREVIS (?), *Cornuel.* Mém. Soc. géol. France, ser. 2, vol. ii, pt. 1, p. 199, pl. viii, fig. 12.

— OVATA, *Reuss.* Haidinger's Nat. Abhandl., vol. iv, pt. 1, 1851, p. 48, pl. v, fig. 2.

CYTHERELLA COMPLANATA, *Reuss.* Denksch. Akad. Wiss. Wien, vol. vii, 1854, p. 140, pl. xxviii, fig. 9.

— OVATA, *Bosquet.* Mém. Comm. Carte géol. Neerl., vol. ii, 1854, p. 45, pl. viii, figs. 1 *a*—*f*.

— — *Jones.* Geol. Mag., 1870, p. 76.

— — *Reuss.* Elbthalgeb., &c., pt. 2, 1874, p. 151, pl. xxviii, fig. 4 (fig. 5 ?).

Length ·85; height ·55; thickness ·35 mm.

This common and easily distinguished species has been variously referred to and mentioned by many geologists at home and abroad, and especially studied by Reuss and Bosquet, with mutual agreement as to details except that Reuss retains his *C. elongata* from the synonymy.

Several of the old figures are reproduced here on a reduced scale from the 'Monograph' of 1849.

Fig. 48 = fig. 24 *a*.

Fig. 49 = fig. 24 *b*.

Fig. 50 = fig. 24 *c*.

Fig. 51 = fig. 24 *e*. The notches at the ends are too large.

Fig. 52 = fig. 24 *f*.

Fig. 53 = fig. 24 *h*. This should not be perfectly oval, but slightly flattened on the right-hand margin, as looked at in the figure. M. Bosquet, who had seen such nearly oval specimens, suggested that they may be sub-adult individuals; perhaps they are varietal forms. See Pl. IV, fig. 39. Mr. J. Kafka figures an oval form from the Cretaceous strata of Bohemia in A. Fritsch's 'Crustaceen böhm. Kreidef.,' 1887, p. 18, fig. 40 *c*.

Fig. 54 = fig. 24 *i*. A small and probably young form.

Localities.—*Chalk;* Norwich, Horstead, Colchester, South-east England, Magheramorne (Antrim), Keady Hill (Londonderry); *Chalk-rock*, Dunstable, Chinnor, West Wycombe, Luton; *Chalk-marl*, Dover, Didcot; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Cambridge.

Foreign.—*Chalk*, Maastricht, North Germany, Bohemia, Weinböhla (Saxony), Royan (South France), Dobrutscha, &c.; ? *Neocomian*, France.

This is a widely distributed Cretaceous species. The localities were carefully recorded by Bosquet in 1854, and by Reuss in 1874 ('Elbthalgebirge,' &c., pp. 151, 154).

2. Cytherella obovata, sp. nov. Plate III, figs. 46 and 47.

Length ·95; height ·57; thickness ·35 mm.

Obovate, but straighter on the ventral than on the dorsal margin, and even slightly incurved ventrally; the anterior more rounded than the posterior moiety, but not so thick. Edge view lanceolate; end view oval.

This carapace resembles that of *C. ovata* except in its being contracted in its posterior moiety, having less fulness both of outline and of contour in that region, and hence obovate instead of being ovate. Several published figures of *Cytherellæ* are more or less comparable with this form, but none exactly match it. *C. nitida*, Brady, is perhaps the nearest, but the postero-ventral margin is too convex; and *C. lævis*, Brady, is too high and too thick in the posterior region. *C. Leopolitana*, Reuss (as figured in 1850), differs in its ventral outline and its edge view. *C. fabacea*, Bornemann, is near it, but is not arched enough dorsally, and is too thick behind.

Locality.—Chalk, Kent.

3. Cytherella Muensteri (*Römer*). Plate III, figs. 63—67.

Cytherina Muensteri, *Römer*. Neues Jahrb. f. Min., &c., 1838, p. 516, pl. vi, fig. 13.

— parallela, *Reuss*. Verst. böhm. Kreidef., pt. 1, 1845, p. 16, pl. v, fig. 33.

Cythere truncata, *Bosquet*. Mém. Soc. Liége, vol. iv, 1847, p. 357, pl. i, figs. 2 *a—e*.

Cytherina lævis, *Williamson*. Mem. Lit. Phil. Soc. Manchester, vol. viii, 1847, p. 79, fig. 80.

Cytherella truncata, *Jones*. Monogr. Entom. Cret., 1849, p. 30, pl. vii, figs. 25 *a—e*.

— Muensteri, *Bosquet*. Mém. cour. Akad. Belg., vol. xxiv, 1852, p. 13, pl. i, figs. 2 *a—d* [the punctation is figured very much too coarse].

Cytherina parallela, *Reuss*. Haidinger's Naturw. Abhandl., vol. iv, pt. 1, 1851, p. 47, pl. vi, fig. 1.

Cytherella Muensteri, *Bosquet*. Mém. Comm. géol. Neerl., vol. ii, 1854, p. 58, pl. viii, figs. 2 *a—d*.

— parallela, *Reuss*. Denksch. Akad. Wiss. Wien, vol. vii, 1854, p. 40; and Zeitsch. d. g. Ges., vol. vii, 1855, p. 18.

— Muensteri, *Jones*. Monogr. Tert. Entom., 1856, p. 56, pl. v, figs. (12?), 13; Geol. Mag., 1870, pp. 76, 77.

— — *Williamson*. Mem. Lit. Phil. Soc. Manch., ser. 3, vol. v, 1872, p. 136.

CYTHERELLA MUENSTERI, *Reuss*. Elbthalgeb., &c., pt. 2, 1874, p. 152, pl. xxviii, figs. 6 and 7.
— — *Jones and Sherborn*. Suppl. Monogr. Tert. Entom., 1889, p. 47, pl. ii, fig. 10.

Length ·75; height ·4; thickness ·32 mm.

In the 'Supplem. Monogr. Tert. Entom.,' 1889, an attempt was made to classify such of the *Cytherellæ* as occur in the Tertiary formations of England according to their shape, as to outline and the relative position of the greatest thickness in the carapace. In this grouping *Cytherella Muensteri* comes with its thickness at or near the hinder end, which in some cases, as in *C. Reussii* (op. cit., Pl. II, figs. 8 *a*, *b*), gives a thick and almost truncate end to the carapace, but not so sudden as in the cuneiform edge views of some varieties of *C. Beyrichi* (op. cit., Pl. II, figs. 1 and 9), nor indeed as in *Cytherella Muensteri* of the Chalk. These relative measurements were taken from perfect carapaces, but internal casts of the same species, such as in the present Monograph, Pl. III, fig. 65 (formerly Pl. VII, fig. 25 *a*), has a different and more truncate aspect. There are many specimens of *C. Muensteri* which are blunt posteriorly, but not actually truncate.

M. Bosquet in 1852 explained his reasons for referring this species to *C. Muensteri* (Römer). The coarse pitting of Römer's figure was regarded by M. Bosquet as being represented by the exceedingly linear punctation that he saw in his specimens from Maastricht. Our Cretaceous specimens are smooth.

Localities.—*Chalk*, Norwich, Horstead, Colchester, and South-east England; *Chalk-rock*, Dunstable; *Chalk-marl*, Dover and Didcot; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Cambridge.

Foreign.—Maastricht, Balsberg (Sweden), &c. See also Reuss, 'Elbthalgeb.,' pp. 152 and 154.

4. CYTHERELLA SUBRENIFORMIS, sp. nov. Plate III, figs. 44 and 45.

Length ·85; height ·45; thickness ·3 mm.

Subreniform, arched dorsally and slightly incurved ventrally; ends rounded, the anterior more boldly than the other; edge view long, narrow-oval, rather blunter behind than in front; end view oval.

This *Cytherella* is nearly allied to several published forms, but matches none exactly. If it were not arched on the back it would be very near to Reuss's *C. parallela*, as figured by G. S. Brady, 'Trans. Zool. Soc.,' vol. x. In shape also it somewhat resembles Römer's not very satisfactory figure of *C. Muensteri*, but it is too hollow ventrally, too blunt posteriorly, and is not punctate. It is very near *C. pulchra*, Brady, but too reniform in shape for that species. In this respect also it differs from Kafka's "*Bairdia*" *depressa*,[1] from Koschtitz in Bohemia.

Locality.—Chalk, Kent.

5. Cytherella Williamsoniana, *Jones*. Plate III, figs. 55—62.

Cytherina serrata (?), *Williamson*. Mem. Lit. Phil. Soc. Manch., vol. viii, 1847, p. 79, fig. 74.
— pedata (?), *Geinitz*. Verstein. Kieslingwalda, &c., 1843, p. 6, pl. v (Nachtrag), fig. 13.
Cytherella Williamsoniana, *Jones*. Monogr. Entom. Cret., 1849, p. 31, pl. vii, figs. 26 *a—h* (and fig. 26 *i* var.).
Cypridina leioptycha, *Reuss*. Haidinger's Naturw. Abhandl., vol. iv, pt. 1, 1851, p. 49, pl. vi, fig. 11.
Cytherella Williamsoniana, *Bosquet*. Mém. Comm. géol. Neerlande, vol. ii, 1854, p. 62, pl. v, figs. 2 *a—d*.
— — *Reuss*. Elbthalgeb., &c., pt. 2, 1874, p. 153, pl. xxviii, figs. 9, 10 *a*, *b*.
— — *Marsson*. Mittheil., &c., 1880, p. 31, pl. ii, figs. 8 *a—c*.

Length ·6; height ·35; thickness ·25 mm.

The carapaces are subject to much modification in their relative thickness, and the valves as to their superficial ridges and furrows, which are sometimes coarse and low, and in other cases sharply defined (var. *stricta*); and in some more regular and less interrupted than in others. The surface also may be smooth (ordinary), or roughened with small tubercles and granulations (var. *granulosa*).

Localities.—Chalk, Horstead, Colchester, and South-east England, and Keady Hill (Derry); *Chalk-rock*, Dunstable; *Chalk-marl*, Dover; *Detritus*, Charing; *Gault*, Folkestone, Leacon Hill, and Godstone; *Greensand*, Ventnor.

Foreign.—Chalk, Limburg, Saxony, Isle of Rügen.

5*. Cytherella Williamsoniana, *Jones*, var. *stricta*, nov. Plate III, fig. 71.

Length ·7; height ·4 mm.

Like the ordinary or typical form, but sometimes larger, and having the longitudinal and marginal swellings of the surface narrowed and defined as ridges.

[1] 'Kritisches Verzeichniss d. Ostracoden d. böhm. Kreidef.,' p. 2, pl. i, figs. 1 *a*, *b*; and in 'Die Crustaceen der böhm. Kreidef.,' by A. Fritsch and J. Kafka, 1887, p. 14, fig. 26.

Localities.—Gault, Godstone, Surrey, and Folkestone, Kent. Collected by Mr. F. Chapman.

5**. Cytherella Williamsoniana, *Jones*, var. *granulosa*, Jones. Plate III, figs. 68, 69, 72.

Cytherella Williamsoniana, var. granulosa, *Jones*. Monogr. Entom. Cret., 1849, p. 31, pl. vii, fig. 26 *i*.
— — (?), *Bosquet*. Mém. Comm. géol. Neerlande, vol. ii, 1854, p. 62, pl. v, figs. 2 *a—d*.
— — var. Bosqueti, *Marsson*. Mittheil., &c., 1850, p. 31, pl. ii, figs. 8 *d, e*.

Length ·72; height ·42 mm.

Larger than the type specimens, roughened with granules and small tubercles. The marginal elevations on the valves are subject to the same modifications of direction and extent as in the ordinary forms, and may be narrowed as ridges, with or without granulations.

The specimen figured by Bosquet, op. cit., 1854, appears to be var. *granulosa*. In his opinion, however, the granulations are present on adults, but are lost more or less on old individuals.

Dr. Marsson's figs. 8 *d* and 8 *e* almost supply the counterpart of fig. 26 *i* (not reproduced here).

Localities.—Chalk, Norwich, Horstead, Magheramorne (Antrim); *Chalk-rock*, Dunstable; *Gault*, Folkestone.

Foreign.—Chalk, Maastricht and Rügen. See also Reuss, 'Elbthalgeb.,' pp. 153 and 154.

6. Cytherella Chapmani, sp. nov. Plate III, fig. 70.

Length ·52; height ·3 mm.

Small, short, stout, and flat, sub-oblong, slightly ovate; bearing just within the front, back, and rear margins a nearly continuous ridge, and within it a set of unequal longitudinal ridges or riblets, of which one is free, and the others apparently form a compressed spiral.

Some small *Cytherellæ* closely approaching *C. Chapmani* are in Mr. F. Chapman's Collection from the Gault of Folkestone.

Locality.—Gault, Godstone, Surrey. Collected by Mr. F. Chapman.

7. Cytherella obliquirugata, sp. nov. Plate III, fig. 73.

Length ·42; height ·22 mm.

A neat, small, ovate-oblong *Cytherella*, bordered with a slight raised rim, and bearing some oblique, parallel, sinuous riblets, tapering at their ends. One (the middle and largest of the three) is bent on itself in the postero-ventral region, turning up to the little normal sub-central pit which interrupts this branch, and thus makes four tapering, oblique, and more or less parallel riblets.

Cytherella denticulata, Bosquet ('Mém. Comm. géol. Neerlande,' vol. ii, p. 51, pl. v, fig. 1), from the Chalk of Limbourg, has some oblique ridges, but it has also one straight marginal ridge and a truncated posterior edge.

Locality.—Chalk, Winchester. Collected by Mr. A. Angel, jun.

8. Cytherella? Mantelliana, *Jones*. Plate III, figs. 19—21.

Cytherella? Mantelliana, *Jones*. Monogr. Entom. Cret., 1849, p. 32, pl. vi, figs. 22 *a—c*; and Geol. Mag., 1870, pp. 76, 77.

Length ·5; height ·25; thickness ·15 mm.

We have nothing to add to the former description of this unique carapace from the Charing *Detritus*.

APPENDIX.

I.—List of the Genera and Species of Ostracoda described and figured in the 'Monograph,' 1849, and in 'Geol. Mag.,' 1870. (Names corrected.)

Figures of the Species in the Supplemental Monograph. Pl.	Figs.	*Genera and Species.*	*In Monograph, 1849.* Pl.	Figs.
II	50	Paracypris gracilis (*Bosquet*) (olim *Bairdia siliqua*, var. β)	V	16 *h*.
II IV	65 2	Pontocypris Bosquetiana, *nov.* (olim *B. angusta*, part)	VI	18 *f*, *f'*.
III	22—24 and 35—37	— triquetra (*Jones*)	VI	19.
II	31—34	Bairdia subdeltoidea (*Münster*)	V	15.
II	52—55	— Harrisiana, *Jones*	VI	17 *a—d*.
II	38—41	Macrocypris siliqua, *Jones*	V	16 *a—d*.
II	42 and 45—47	— Muensteriana, *nov.* (olim *Bairdia siliqua*, var. α)	V	16 *e—g*.
II	56 and 61—63	Bythocypris Reussiana, *nov.* (olim *B. angusta*, part)	VI	17 *f*. 18 *a—c* and *e*.
I	27—29	— simulata (*Jones*) (olim *Cythere faba*).	II	4.
II III	64 27—30 and 40, 41	— silicula (*Jones*)	VI	18 *d* and 20.
I	30—32	Cythere Bairdiana, *Jones*	II	5.
I	47—52	— Harrisiana, *Jones*	II	6.
I	35, 36	— gaultina, *Jones*	II	7.
II	35—37	— ? Bosquetiana (*Jones*)	VI	23.
I	56—61	Cythereis triplicata (*Römer*)	III	9.
I	69—75	— quadrilatera (*Römer*)	III IV	10. 10.
II	1—7	— ornatissima (*Reuss*)	IV	11.
II IV	8, 9, 12, 14 14	— ornatissima-nuda, *nov.*	V	13.
I	64—66	— Lonsdaleana, *Jones*	V	12.
I	37—39	— Icenica, *nov.* (olim *C. macrophthalma*)	II	8.
I	1—4	Cytheridea perforata (*Römer*) (olim *C. Hilseana*)	I	1.
III	17, 18	Cytherura appendiculata, *Jones*	VI	21.
I IV	5—10 19	Cytheropteron concentricum (*Reuss*) (olim *Cythere punctatula*)	I	2 *a—m*.
I	14—17	— concentricum-virgineum, *Jones*	I	2 *n*.
I	21—26	— umbonatum (*Williamson*)	II	3.
II	24—27	— alatum-robustum, *nov.* (olim *Cythere alata*)	V	14.
III IV	48—54 39	Cytherella ovata (*Römer*)	VII	24.
III	63—67	— Muensteri (*Römer*) (olim *C. truncata*)	VII	25.
III	55—62	— Williamsoniana, *Jones*	VII	26 *a—h*.
III	68 and 72	— Williamsoniana-granulosa, *Jones*	VII	26 *i*.
III	19—21.	— ? Mantelliana, *Jones*	VI	22.

In Mr. Topley's "Geology of the Weald" ('Memoirs Geol. Survey, 1875) fifteen of the above species and varieties are tabulated, at p. 426, from the Chalk, Gault, Upper Greensand, and Lower Greensand.

II.—The Genera and Species described in this Monograph.

	Page.	Occurrence in the Cretaceous Formations of England.[1]					
		Ch.	Cr.	Cm.	Detr.	Glt.	Gs.
I. CYPRIDIDÆ.							
I. Paracypris, *Sars.*							
1. Paracypris gracilis (*Bosquet*)	1	×	...	...	×	× ?	
2. — siliqua, *sp. nov.*	2	×	...	...	...	×[2]	
II. Pontocypris, *Sars.*							
1. Pontocypris trigonalis, *sp. nov.*	3	...	...	...	...	×	
2. — triquetra (*Jones*)	4	×	...	...	×	×	
3. — Bosquetiana *sp. nov.*	4	...	...	×	...	×	
4. — attenuata ? (*Reuss*). F. Chapman's Collection	...	...	...	...	...	×	
III. Bairdia, *M'Coy.*							
1. Bairdia subdeltoidea (*Münster*)	5	×	×	×	×	...	×
2. — Harrisiana, *Jones*	8	×	×	...	×	×	×
2*. — — var. amplior, *nov.*	8	×					
IV. Macrocypris, *Brady.*							
1. Macrocypris siliqua, *Jones*	9	×	...	...	×	...	×
2. — Wrightii, *sp. nov.*	10	×					
3. — Muensteriana, *sp. nov.*	10	×	...	...	×		
4. — concinna, *sp. nov.*	11	...	×				
V. Bythocypris, *Brady.*							
1. Bythocypris simulata (*Jones*)	11	...	...	...	×		
2. — Reussiana, *sp. nov.*	12	×	...	...	×	×	
3. — silicula (*Jones*)	13	×	×	...	×	×	
3*. — — var. minor, *nov.*	13	...	×				
4. — Brownei, *sp. nov.*	13	×	×				
5. — Roemeriana, *sp. nov.*	14	...	×				
6. — ? Iernica, *sp. nov.*	14	×					
II. CYTHERIDÆ.							
I. Cythere, *Miller.*							
1. Cythere ? Bosquetiana, *Jones*	15	...	...	...	×		
2. Cythere Bairdiana, *Jones*	15	...	...	...	...	...	×[3]
3. — Harrisiana, *Jones*	16	×	×	×	×	×	×[4]
3*. — — var. setosa, *nov.*	17	...	...	...	...	×	
3**. — — — reticosa, *nov.*	18	...	...	...	...	×	
4. — gaultina, *Jones*	18	...	...	...	...	×	
5. — Koninckiana, *Bosquet.* F. Chapman's Collection	...	...	...	...	...	×	

[1] Ch. = Chalk; Cm. = Chalk-marl; Cr. = Chalk-rock; Detr. = Detritus (Cm., &c.), Charing, Kent; Glt. = Gault; Gs. = Greensand. [2] Mr. Chapman's Collection. [3] Lower Greensand. [4] And Lower Greensand.

	Page.	Occurrence in the Cretaceous Formations of England.					
		Cb.	Cr.	Cm.	Detr.	Glt.	Gs.
I*. Cythereis, *Jones*.							
1. Cythereis triplicata (*Römer*)	19	×	×	×	×	×	×
2. — auriculata (*Cornuel*)	19	...	×	...	...	×	
3. — quadrilatera (*Römer*)	20	×	×	×	×	×	×
4. — ornatissima (*Reuss*)	21	×	×	×	×	×	×
4*. — — var. paupera, *nov.*	23	...	...	...	×		
4**. — — — nuda, *nov.*	23	×	...	×	×	...	×
4***. — — — reticulata, *nov.*	24	×	×	×	×	×	×
4****. — — — radiata, *nov.*	25	...	...	...	...	...	×
4*****. — — — stricta, *nov.*	25	...	×				
5. — Wrightii, *sp. nov.*	25	×					
6. — tuberosa, *sp. nov.*	26	×	× ?				
6*. — — var. symmetrica, *nov.*	26	×					
7. — Icenica, *sp. nov*	26	×					
7*. — — var. quadrata, *nov.*	27	×					
8. — Lonsdaleana, *Jones*	27	×	×				
9. — vallata, *Jones*	28	×					
10. — spinicaudata, *sp. nov.*	28	×	×				
II. Cytheridea, *Bosquet*.							
1. Cytheridea perforata (*Römer*)	29	×	×	×	×	×	×
III. Pseudocythere ?, *Sars*.							
1. Pseudocythere ? simplex, *sp. nov.*	30	×					
IV. Cytherura, *Sars*.							
1. Cytherura appendiculata, *Jones*	30	.	...	...	...	×	
V. Cytheropteron, *Sars*.							
1. Cytheropteron concentricum (*Reuss*)	31	×	×	×	×	×	×
1*. — — var. virginea, *Jones*	32	×	...	...	...	...	×
2. — sphenoides (*Reuss*)	33	...	×				
3. — alatum (*Bosquet*)	34						
3*. — — — var. robusta, *nov.*	35	×					
3**. — — — — fortis, *nov.*	36	×					
3***. — — — — cornuta (*Bosquet*)	36	...	×	...	× ?		
4. — Hibernicum, *sp. nov.*	36	×					
5. — phyllopterum (*Bosquet*)	37	×					
6. — cuspidatum, *sp. nov.*	37	×					
6*. — — var. montuosa (*Jones*)	38	×					
6**. — — — tricuspidata, *nov.*	38	×					
7. — pedatum (*Marsson*)	38	×	×				
7*. — — — var. salebrosa, *nov.*	39	×	×				
8. — umbonatum (*Williamson*)	40	×	...	×	×	...	
8*. — — — var. acanthoptera (*Marsson*).	41	×	×				×
8**. — — — var. longispinata *nov.*	41	×	...	...	...	×	
9. — Sherborni, *sp. nov.*	42	×	...	...	...	×	
VI. Cytherideis, *Jones*.							
1. Cytherideis parallela, *nov.*	43	×					
2. — acuminata (*Alth*)	43	×					

	Page.	Occurrence in the Cretaceous Formations of England.					
		Ch.	Cr.	Cm.	Detr.	Glt.	Gs.
III. CYTHERELLIDÆ.							
I. CYTHERELLA, *Jones*.							
1. Cytherella ovata (*Römer*)	44	×	×	×	×	×	×
2. — obovata, *sp. nov.*	46	×					
3. — Muensteri (*Römer*)	46	×	×	×	×	×	×
4. — subreniformis, *sp. nov.*	47	×					
5. — Williamsoniana, *Jones*	48	×	×	×	×	×	×
5*. — — var. stricta, *nov.*	48	...	...	...	...	×	
5**. — — — granulosa, *Jones*	49	×	...	...	...	×	
6. — Chapmani, *sp. nov.*	49	...	...	...	...	×	
7. — obliquirugata, *sp. nov.*	50	×					
8. — ? Mantelliana, *Jones*	50	...	...	...	×		

III.—Ostracoda from the Upper Chalk, Thorpe, near Norwich. Collected by T. Rupert Jones.

Bairdia subdeltoidea (*Münster*).
Cythereis quadrilatera (*Römer*).
— Icenica, *nov.*
— Lonsdaleana, *Jones.*
Cytheropteron umbonatum, *Jones.*
— alatum-robustum, *nov.*
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).
— Williamsoniana-granulosa, *Jones.*

IV.—Ostracoda from Flint-meal. Collected by Dr. G. J. Hinde, F.G.S., from a Chalk-flint at Horstead, Norfolk.

Paracypris siliqua, *nov.* Not rare.
Bairdia Harrisiana, *Jones.*
Macrocypris Muensteriana, *nov.*
Cythereis ornatissima (*Reuss*). Not rare.
— ornatissima-reticulata, *nov.* Not rare.
— tuberosa, *nov.*
— tuberosa-symmetrica, *nov.*

Cythereis Icenica-quadrata, *nov.* Common.
— Lonsdaleana, *Jones.*
— spinicaudata, *nov.*
Cytheridea perforata (*Römer*).
Pseudocythere ? simplex, *nov.* Not rare.
Cytheropteron concentricum (*Reuss*). Common.
— concentricum-virgineum, *Jones.* Common.
— Sherborni, *nov.* Common.
— umbonatum-longispinatum, *nov.*
— alatum-forte, *nov.*
— cuspidatum, *nov.*
— cuspidatum-tricuspidatum, *nov.*
— pedatum (*Marsson*). Common.
Cytherella ovata (*Römer*). Common.
— Muensteri (*Römer*). Not rare.
— Williamsoniana, *Jones.*
— Williamsoniana-granulosa, *Jones.*

V.—Ostracoda from the Flint-meal of the Chalk, Antrim. Collected by Mr. Joseph Wright, F.G.S.

Paracypris siliqua, *nov.*
Bairdia subdeltoidea (*Münster*). Common.
Macrocypris siliqua, *Jones.*
— Wrightii, *nov.*
Bythocypris ? Iernica, *nov.*
Cythere Harrisiana, *Jones.*
Cythereis ornatissima (*Reuss*).
— ornatissima-reticulata, *nov.*
— ornatissima-nuda, *nov.*
— vallata, *nov.*
— spinicaudata, *nov.*
Cytheropteron concentricum (*Reuss*). Rather common.
— concentricum-virgineum, *Jones.*
— umbonatum-acanthopterum (*Marsson*).
— alatum-robustum, *nov.*
— alatum-forte, *nov.*
— phyllopterum (*Bosquet*).
— cuspidatum-montuosum, *nov.*

Cytheropteron pedatum (*Marsson*).
— pedatum-salebrosum, *nov.*
Cytherideis acuminata ? (*Reuss*).
Cytherella ovata (*Römer*). Common.
— Williamsoniana-granulosa, *Jones.* Common.

VI.—Genera and Species from the Flint-meal from the Chalk of Keady Hill, Co. Londonderry. Collected by Mr. Joseph Wright, F.G.S.

(Systematic Lists, &c., Belfast Nat. Field Club, vol. i, Appendix iii, pp. 80 and 93.)

Paracypris gracilis (*Bosquet*).
Bairdia subdeltoidea (*Münster*). Common; and a variety.
— Harrisiana, *Jones.*
Macrocypris siliqua, *Jones.*
Bythocypris Brownei, *nov.*
— silicula, *Jones.*
Cythereis Wrightii, *nov.*
— ornatissima-reticulata, *nov.*
— ornatissima-nuda (?), *nov.*
— spinicaudata, *nov.*
Cytheropteron concentricum (*Reuss*).
— alatum-forte, *nov.* (with high thin ridge).
— umbonatum-longispinatum (*Marsson*).
— pedatum (*Marsson*).
— phyllopterum (*Bosquet*).
Cytherideis ? parallela, *nov.*
— ? acuminata (*Reuss*) (*fide* J. W.).
Cytherella ovata (*Römer*). Common.
— Muensteri (*Römer*).
— subreniformis, *nov.*
— Williamsoniana, *Jones.*

VII.—Ostracoda from the Chalk in a Well at Colchester, Essex. Collected by T. Rupert Jones.

Bairdia subdeltoidea (*Münster*).
Cythereis triplicata (*Römer*).
— quadrilatera (*Römer*).[1]

[1] The figs. 39—41 in pl. xxxiv, 'Quart. Journ. Geol. Soc.,' vol. xl (1884), described at pages 766 and 772 as *Cythereis quadrilatera*, from the Upper Jurassic beds (?) in the Richmond boring, probably represent *C. auriculata*, Cornuel.

Cytherella ovata (*Römer*).
— Muensteri (*Römer*).
— Williamsoniana, *Jones*.

('Ann. Mag. Nat. Hist.,' ser. 2, vol. xii, 1853, pp. 240—242.)

VIII.—Additional Ostracoda from the Chalk of the South-east of England (Kent). Collected by T. Rupert Jones.

Cythereis ornatissima (*Reuss*).
Cytherella obovata, *sp. nov.*
— subreniformis, *sp. nov.*

IX.—Ostracode from a Chalk-flint in the Mitcham Gravel. Collected by Dr. G. C. Wallich.

Cytheropteron umbonatum-longispinatum, *nov.*

X.—Ostracoda from the Chalk, North-west of Kemsing, near Sevenoaks, Kent. Collected by Mr. F. Chapman.

Bairdia subdeltoidea (*Münster*).
Cytheropteron alatum (*Bosquet*), var.
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).

XI.—Ostracoda from the Chalk-rock of Bedfordshire, Buckinghamshire, and Oxfordshire; from Material supplied by Mr. A. J. Jukes-Browne, F.G.S., and Mr. J. Rhodes.

1. Chalk-rock; Dunstable (Bedfordshire).
   Bairdia subdeltoidea (*Münster*). Common.
   — Harrisiana ? (*Jones*).
   Macrocypris concinna, *nov.*
   Bythocypris silicula (*Jones*), and var. Not uncommon.
   — Brownei, *nov.*
   — Rœmeriana, *nov.*
   Cythere Harrisiana, *Jones.*

Cythereis triplicata (*Römer*).
— auriculata (*Cornuel*).
— quadrilatera (*Römer*). Common.
— ornatissima (*Reuss*). Common.
— — *var.* reticulata, *nov.* Common.
— — — stricta, *nov.*
— Lonsdaleana, *Jones.* Common.
— spinicaudata, *nov.*
— tuberosa, *nov.*
Cytheridea perforata (*Römer*).
Cytheropteron alatum-cornutum (*Bosquet*).
— sphenoides (*Reuss*).
— concentricum (*Reuss*).
— umbonatum-acanthopterum (*Marsson*).
— pedatum (*Marsson*). Common.
— pedatum-salebrosum, *nov.*
Cytherella ovata (*Römer*). Common.
— Muensteriana (*Römer*).
— Williamsoniana, *Jones.* Common.

2. Chalk-rock; Midland Railway cutting between Luton (Beds) and New Millend Stations, Ordnance Map, Sheet 46 S.E. Ostracoda from the top of the Basement-bed. New Millend is just north of Harpenden (Herts).

Bairdia subdeltoidea (*Münster*).
Bythocypris silicula (*Jones*).
Cythereis ornatissima-reticulata, *nov.*
Cytherella ovata (*Römer*).
— Williamsoniana, *Jones.*

3. Chalk-rock; West Wycombe, by the entrance to a cave in the hill above the village (Bucks).

Bairdia subdeltoidea (*Münster*).
Cytherella ovata (*Römer*).

4. Chalk-rock; pit above the Lower Rock, Chinnor.[1]

Bairdia subdeltoidea (*Münster*).
Cytherella ovata (*Römer*).

[1] "The Chinnor locality is in Oxfordshire. It is a pit on the Oxford Road, on the slope of Chinnor Hill. The 'Lower Rock' is the main mass of the Chalk-rock, probably *the* rock itself; for, although there is a thinner bed of similar rock some fifteen feet higher, I think this upper bed is *in* the zone of Micrasters. The section is a very good one."—A. J. JUKES-BROWNE. December 28th, 1889.

XII.—Ostracoda from the Chalk-marl at Didcot Station, Berks. Collected by T. Rupert Jones.

Pontocypris Bosquetiana, *nov.*
Bairdia subdeltoidea (*Münster*).
Cythereis triplicata (*Römer*).
— quadrilatera (*Römer*).
— ornatissima-reticulata, *nov.*
— ornatissima-nuda, *nov.*
Cytheridea perforata (*Römer*).
Cytheropteron concentricum (*Reuss*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).

(See 'Proceed. Geol. Assoc.,' vol. xi, 1889, p. 198, for a geological notice of the neighbourhood of Didcot by Mr. A. J. Jukes-Browne, F.G.S.)

XIII.—Additional Ostracoda from the "Detritus" at Charing, Kent. Collected by T. Rupert Jones.

Cythereis ornatissima-reticulata, *nov.*
— ornatissima-paupera, *nov.*

XIV.—Ostracoda from the "Upper Greensand" (Phosphate-bed), Cambridge. Enumerated by Dr. W. J. Sollas, F.R.S. ('Quart. Journ. Geol. Soc.,' vol. xxviii, 1872, p. 398.)

Bairdia subdeltoidea (*Münster*).
Cythereis triplicata (*Römer*).
— quadrilatera (*Römer*).
— ciliata (*Reuss*)[= ornatissima (*Reuss*)].
Cythere punctatula, *Römer* [= Cytheropteron concentricum (*Reuss*)].
— umbonatum, *Williamson* [= Cytheropteron].
Cytherella truncata (*Bosquet*) [= C. Muensteri (*Römer*)].

XV.—Ostracoda from the "Upper Greensand" (Phosphate-bed), Cambridge. Collected by Mr. G. R. Vine, 1889.

Bairdia subdeltoidea (*Münster*).
— Harrisiana, *Jones.*

Cythere Harrisiana, *Jones.*
Cythereis triplicata (*Römer*).
— quadrilatera (*Römer*).
— ornatissima (*Reuss*).
— ornatissima-reticulata, *nov.*
— ornatissima-nuda, *nov.*
Cytheridea perforata (*Römer*).
Cytheropteron concentricum (*Reuss*).
— concentricum-virgineum, *Jones.*
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).

XVI.—Ostracoda from the Upper Greensand at Ventnor, Isle of Wight. Collected by Dr. G. J. Hinde, F.G.S.

Macrocypris siliqua, *Jones.*
Cythereis ornatissima (*Reuss*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).
— Williamsoniana, *Jones.*

And others.

XVII.—Ostracoda from the Upper Greensand at Warminster, Wiltshire. Collected by Dr. G. J. Hinde, F.G.S.

Bairdia subdeltoidea (*Münster*).
Cythereis ornatissima (*Reuss*), var.
Cytheropteron concentricum-virgineum, *Jones.*
— cuspidatum, *nov.* ?

And others.

XVIII.—Ostracoda from the Upper Greensand of Meux's Well, London. C. Moore, F.G.S. ('Quart. Journ. Geol. Soc.,' vol. xxxiv, 1878, p. 917).

Cythere, *sp. nov.*
— virginea, *Jones* = Cytheropteron concentricum (*Reuss*), var. virginea, *Jones.*
— concentrica, *Reuss* = Cytheropteron.
Paracypris, *sp. nov.*

XIX.—Ostracoda from the Gault of Folkestone. Mr. Fred. Chapman's Collection, 1880.

Pontocypris trigonalis, *nov.*
Bairdia Harrisiana, *Jones.*
Cythere Harrisiana, *Jones.*
Cythereis triplicata (*Römer*).
— ornatissima (*Reuss.*)
— ornatissima-reticulata, *nov.*
Cytheridea perforata (*Römer*).
Cytheropteron concentricum (*Reuss*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).
— Williamsoniana, *Jones.*

XX.—Ostracoda from the Gault of Folkestone, Kent. Mr. Fred. Chapman's Collection, 1888.

Paracypris gracilis (?) (*Bosquet*).
— siliqua, *nov.*
Pontocypris trigonalis, *nov.* Not uncommon.
— triquetra, *Jones.*
— attenuata (?) (*Reuss*).
— Bosquetiana, *nov.* Not uncommon.
Bairdia Harrisiana, *Jones.*
Cythere Harrisiana, *Jones.* Common.
— Harrisiana-setosa, *nov.*
— Harrisiana-reticosa, *nov.*
— gaultina, *Jones.*
— Koninckiana, *Bosquet.*
Cythereis triplicata (*Römer*). Common.
— auriculata (*Cornuel*). Common.
— quadrilatera (*Römer*). Young and adult; common.
— ornatissima (*Reuss*). Young and adult.
— ornatissima-reticulata, *nov.* Common.
Cytheridea perforata (*Römer*). Common.
Cytheropteron concentricum, *Reuss.* Common.
— umbonatum-longispinatum, *nov.*
Cytherella ovata, *Römer.* Common.

Cytherella Muensteri, *Römer*.
— Williamsoniana, *Jones*.
— Williamsoniana-granulosa, *Jones*.
— Williamsoniana-stricta, *nov.*
— Chapmani, *nov.*

Besides one or more new species.

XXI.—Ostracoda from the Gault of Folkestone (Kent). Enumerated by Mr. F. G. Hilton Price, F.G.S. (in his Memoir 'The Gault,' 1879, p. 50).

Cythere concentrica, *Reuss* = Cytheropteron concentricum (*Reuss*).
— (Cythereis) gaultina, *Jones* = Cythere.
— — Harrisiana, *Jones* = Cythere.
— — ornatissima, *Reuss* = Cythereis ornatissima (*Reuss*).
— — — var. cornuta, *Jones* = Cythereis ornatissima (*Reuss*), var. nuda, *nov.*
— — quadrilatera, *Römer* = Cythereis quadrilatera (*Römer*).
— — triplicata, *Römer* = Cythereis triplicata (*Römer*).
Cytherella Muensteri (*Römer*).
— ovata (*Römer*).
— Williamsoniana, *Jones*.
Cytheridea Jonesiana, *Bosquet* }
— perforata, *Römer* } = Cytheridea perforata (*Römer*).
Cytherideis (Bairdia) angusta, *Münster* = Bythocypris Reussiana, *sp. nov.*
Cytherura (Cytherella) appendiculata, *Jones* = Cytherura.

XXII.—Ostracoda from the Gault of Godstone, Surrey. Mr. Fred. Chapman's Collection, 1880.

Bairdia subdeltoidea (*Münster*).
Cythere Harrisiana, *Jones*.
Cythereis triplicata (*Römer*).
— auriculata (*Cornuel*).
— quadrilatera (*Römer*).
— ornatissima (*Reuss*).
— ornatissima-reticulata, *nov.*
Cytheridea perforata (*Römer*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).

Cytherella Williamsoniana, *Jones.*
— Williamsoniana-stricta, *nov.*
— Chapmani, *nov.*

XXIII.—Ostracoda from the Gault at Godstone, Surrey. Collected by Mr. C. Davies Sherborn, F.G.S.

Cythere Harrisiana, *Jones*, var. setosa, *nov.* Young.
— — var. reticosa, *nov.*
— gaultina, *Jones.*
Cythereis triplicata (*Römer*).
— auriculata (*Cornuel*).
— quadrilatera (*Römer*).
— ornatissima (*Reuss*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).

XXIV.—List of Ostracoda from the Gault in Meux's Well, London. Charles Moore, F.G.S. ('Quart. Journ. Geol. Soc.,' vol. xxxiv, 1878, p. 918), and F. G. H. Price, F.G.S. ("The Gault," 1879, p. 43).

Cythere ornatissima, *Reuss* = Cythereis.
— quadrilatera, *Römer* = Cythereis.
Polycope, sp. = (?).
Macrocypris ? arcuata (*Münster*) = Macrocypris Muensteriana, *sp. nov.*
? Cytheridea perforata (*Römer*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).
— Beyrichi, *Reuss.*
— Williamsoniana, *Jones.*
Cythere concentrica, *Reuss* = Cytheropteron.
— quadrilatera ? *Römer* = Cythereis.
Paracypris ? gracilis, *Jones.*

XXV.—Ostracoda from a Cream-coloured Limestone (without Flints) overlying the Bluish-grey, Sandy, Micaceous Clay at the Lighthouse, Havre, France. Collected by Mr. C. D. Sherborn, F.G.S.

Cythereis triplicata (*Römer*).

Cythereis ornatissima (*Reuss*).
Cytheropteron concentricum (*Reuss*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).

XXVI.—Ostracoda from the Blue-grey, Sandy, Micaceous Clay (referred to the Aptian Formation by Lapparent) at the Base of the Cliff at the Havre Lighthouse, France.

Cythereis triplicata (*Römer*).
— auriculata (*Cornuel*).
— quadrilatera (*Römer*).
— ornatissima (*Reuss*).
— — var. reticulata, *nov.*
Cytheridea perforata (*Römer*).
Cytheropteron concentricum (*Reuss*).
— alatum (*Bosquet*).
Cytherella ovata (*Römer*).
— Muensteri (*Römer*).
— Williamsoniana, *Jones.*

XXVII.—Ostracoda from the Lower Greensand [?] of Meux's Well, London. C. Moore, F.G.S. ('Quart. Journ. Geol. Soc.,' vol. xxxiv, 1878, p. 919).

Bairdia Harrisiana, *Jones.*
— subdeltoidea (*Münster*).
— angusta (*Münster*) = Bythocypris Reussiana, *sp. nov.*
Cytherella compressa (*Münster*).
— Beyrichi, *Reuss.*
Cythere interrupta, *Bosquet* = Cythere Harrisiana, *Jones.*
— concentrica, *Reuss* = Cytheropteron.

LIST OF THE PRINCIPAL MEMOIRS ON CRETACEOUS OSTRACODA PUBLISHED SINCE 1849.

1850. Alth, A. Geogn.-palaeont. Beschreibung der nächste Umgebung von Lemberg. *Haidinger's Naturw. Abhandl.*, vol. iii, pt. 2, 1850, pp. 197, 198, pl. x.

1851. Reuss, A. E. von. Die Foraminiferen und Entomostraceen des Kreidemergels von Lemberg. *Haidinger's Naturw. Abhandl.*, vol. iv, pt. 1, 1851, pp. 46—52, pl. vi.

1854. Bosquet, J. Monographie des Crustacés fossiles du Terrain Crétacé du Duché de Limbourg. *Mémoires de la Commission pour la Description et la Carte géologique de la Neerlande*, 4to Haarlem, 1854, pp. 53—126, pls. iv—x.

1854. Reuss, A. E. von. Beiträge zur Charakteristik der Kreideschichten in der Ostalpen. *Denkschrift. k. Akad. Wissensch. math.-nat. Cl.* (*Wien*), vol. vii, 1854, pp. 139—142, pls. xxvi, xxvii, xxviii.

1855. ——— Ein Beitrag zur genaueren Kenntniss der Kreidegebilde Meklenburgs. *Zeitschr. deutschen geol. Gesellsch.*, vol. vii, 1855, pp. 277—283, pls. x and xi.

1865. ——— Die Foraminiferen und Ostracoden der Kreide am Kanara-See bei Küstendsche. *Sitzungsb. d. kais. Akad. der Wissenschaften math.-nat. Cl.* (*Wien*), vol. lii, 1865, pp. 21—26, pl. i.

1870. Jones, T. Rupert. Notes on the Cretaceous Entomostraca. *Geological Magazine*, vol. vii, 1870, pp. 74—77.

1871. Pavay, Alexis von. Kolozsvár környékéneh földtani viszonyai. A Magyar királyi földtani intezet évkönyve. *Pest*, 1871, pp. 350—356. (Cretaceous species in the Eocene Strata of Transylvania.)

1875. Wright, Joseph, and T. Rupert Jones. Systematic Lists illustrative of the Flora, Fauna, Palæontology, and Archæology of the North of Ireland, by Members of the *Belfast Naturalists' Field Club*, vol. i, Appendix III, 1875. *A List of the Cretaceous Microzoa of the North of Ireland*, by Joseph Wright, pp. 81 and 92.

1880. Marsson, Th. Die Cirripedien und Ostracoden der weissen Schreibkreide der Insel Rügen. *Mittheilungen aus dem Naturwissenschaftlichen Vereine von Neu-Vorpommern und Rügen in Griefswald,* 1880, pp. 1—50, pls. ii and iii.

1887. Kafka, J., in A. Fritsch's Die Crustaceen der böhmischen Kreideformation. 4to., *Prague*, 1887. Woodcuts. (Nearly half of Kafka's 20 Bohemian species are also British.)

INDEX.

The names in CAPITALS are adopted; those in *italics* are synonyms; those in common type are genera and species which are referred to.

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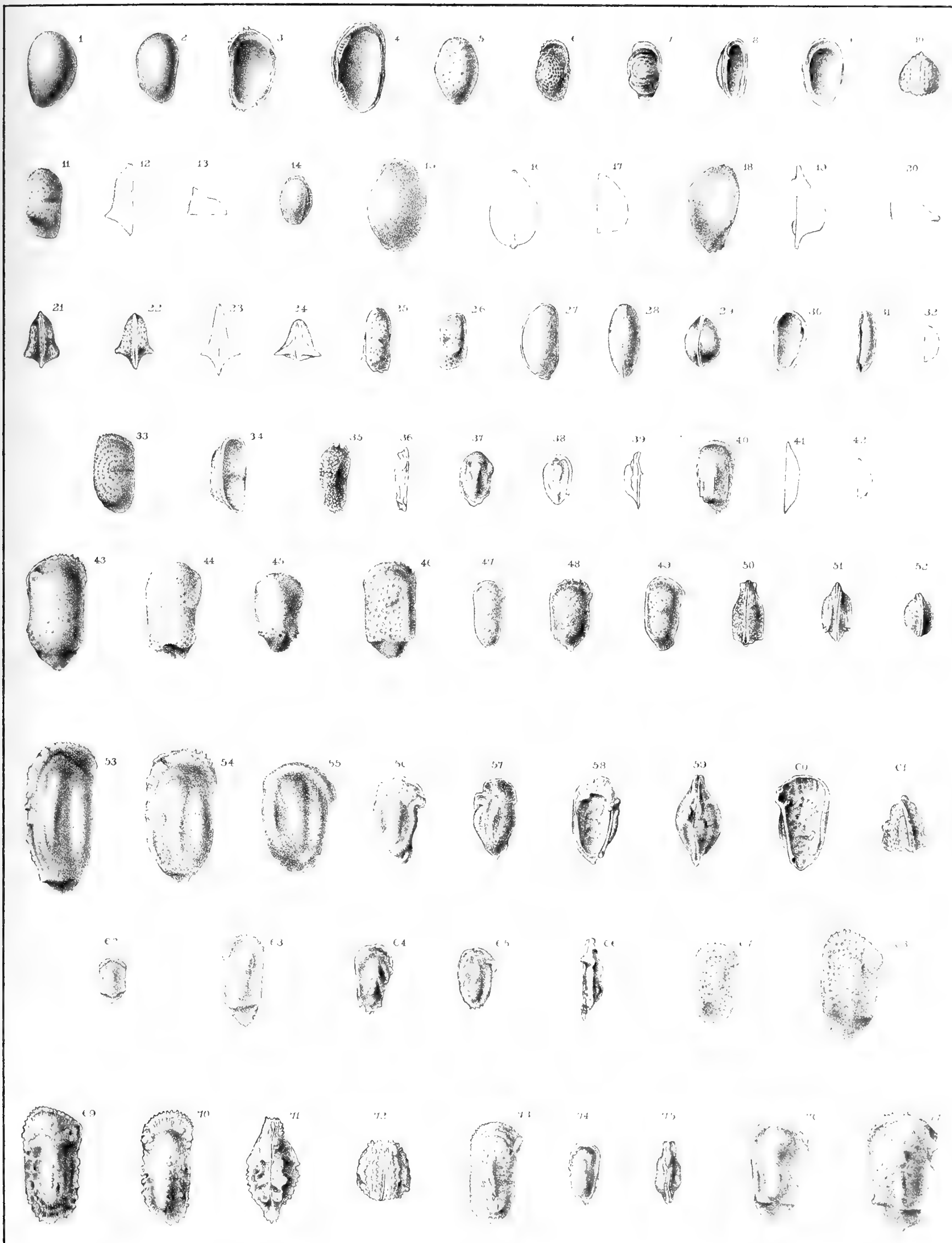
PLATE I.

Fig.		
1.	*Cytheridea perforata* (Römer). (Page 29.) Left (larger) valve.	
2.	— — — Right (smaller) valve.	× 18 diam.
3.	— — — Right valve, inside.	
4.	— — — Left valve, inside.	
5.	*Cytheropteron concentricum* (Reuss). (Page 31.) Worn, old carapace, showing left valve.	
6.	— — — Left valve, rather young, prickly.	
7.	— — — Left valve, older, wrinkled. (See also Pl. IV, fig. 19.)	× 18 „
8.	— — — Left valve, dorsal edge.	
9.	— — — Left valve, inside.	
10.	— — — Anterior view of a carapace.	
11.	— *umbonatum* (Will.), var. *acanthoptera* (Marsson). (Page 41.) (See also Pl. IV, figs. 22—24.) Left valve.	
12.	— — — — — Dorsal view.	× 18 „
13.	— — — — — Posterior view.	
14.	— *concentricum* (Reuss), var. *virginea*, Jones. (Page 32.) Carapace, oblique.	× 18 „
15.	— — — — — Left valve.	
16.	— — — — — Ventral view.	× 20 „
17.	— — — — — End view.	
18.	— *sphenoides* (Reuss). (Page 33.) Right valve.	
19.	— — — Dorsal view.	× 20 „
20.	— — — Anterior view.	
21.	— *umbonatum* (Will.). (Page 40.) Carapace, ventral view.	× 18 „
22.	— — — Carapace, dorsal view.	
23.	— — — Carapace (thin), ventral outline.	× 20 „
24.	— — — Carapace (large), posterior view.	
25.	— — — Carapace, ventral view, oblique.	× 18 „
26.	— — — Carapace, dorsal view.	
27.	*Bythocypris simulata* (Jones). (Page 11.) Carapace (damaged at the posterior end), showing the right valve.	
28.	— — — Dorsal aspect.	× 18 „
29.	— — — Anterior aspect.	
30.	*Cythere Bairdiana*, Jones. (Page 15.) Right valve, inside.	
31.	— — — Dorsal aspect.	× 18 „
32.	— — — End outline.	
33.	*Cytheropteron Sherborni*, sp. nov. (Page 42.) Left valve.	× 20 „
34.	— — — Right valve, ventral edge and inside.	
35.	*Cythere gaultina*, Jones. (Page 18.) Right valve.	× 18 „
36.	— — — Dorsal aspect.	
37.	*Cythereis Icenica*, sp. nov. (Page 26.) Right valve.	
38.	— — — Right valve.	× 18 „
39.	— — — Dorsal aspect.	
40.	— *Lonsdaleana*, Jones. (Page 27.) Right valve.	
41.	— — — Edge outline.	× 20 „
42.	— — — End outline.	
43.	*Cythere Harrisiana*, Jones, var. *setosa*, nov. (Page 17.) Right valve.	
44.	— — — — — — Left valve.	× 25 „
45.	— — — — — — Left valve.	
46.	— — — var. *reticosa*, nov. (Page 18.) Right valve.	
47.	— — — (Page 16.) Ordinary form. Left valve.	
48.	— — — Var. *α*. Left valve.	
49.	— — — Var. *β*. Left valve.	× 18 „
50.	— — — Var. *β*. Carapace, dorsal aspect.	
51.	— — — Var. *α*. Carapace, ventral aspect.	
52.	— — — Var. *β*. Carapace, anterior aspect.	
53.	*Cythereis auriculata* (Cornuel). (Page 19.) Right valve.	
54.	— — — Right valve.	× 25 „
55.	— — — Right valve (deformed).	
56.	— *triplicata* (Römer). (Page 19.) Left valve.	
57.	— — — Right valve.	
58.	— — — Right valve, inside.	× 18 „
59.	— — — Carapace, dorsal aspect.	
60.	— — — Left valve, inside.	
61.	— — — Carapace, anterior aspect.	
62.	— *Icenica*, sp. nov., var. *quadrata*, nov. (Page 27.) (See also Pl. IV, figs. 15—17.) Left valve.	× 20 „
63.	— *ornatissima* (Reuss), var. *stricta*, nov. (Page 25.) Right valve.	× 20 „
64.	— *Lonsdaleana*, Jones. (Page 27.) Left valve.	
65.	— — — Right valve.	× 18 „
66.	— — — Dorsal edge of right valve.	
67.	— *ornatissima* (Reuss), var. *reticulata*, nov. (Page 24.) Left valve.	× 20 „
68.	— — — — — Left valve.	
69.	— *quadrilatera* (Römer). (Page 20.) Left valve.	
70.	— — — Right valve.	
71.	— — — Carapace, dorsal aspect.	
72.	— — — Carapace, anterior aspect.	× 18 „
73.	— — — Left valve, not full grown.	
74.	— — — Right valve, young.	
75.	— — — Carapace, young; dorsal aspect.	
76.	— *ornatissima* (Reuss), var. *nuda*, nov. (Page 23.) Left valve.	× 25 „
77.	— — — var. *reticulata*, nov. (Page 24.) Left valve.	



CRETACEOUS ENTOMOSTRACA (Supplement)

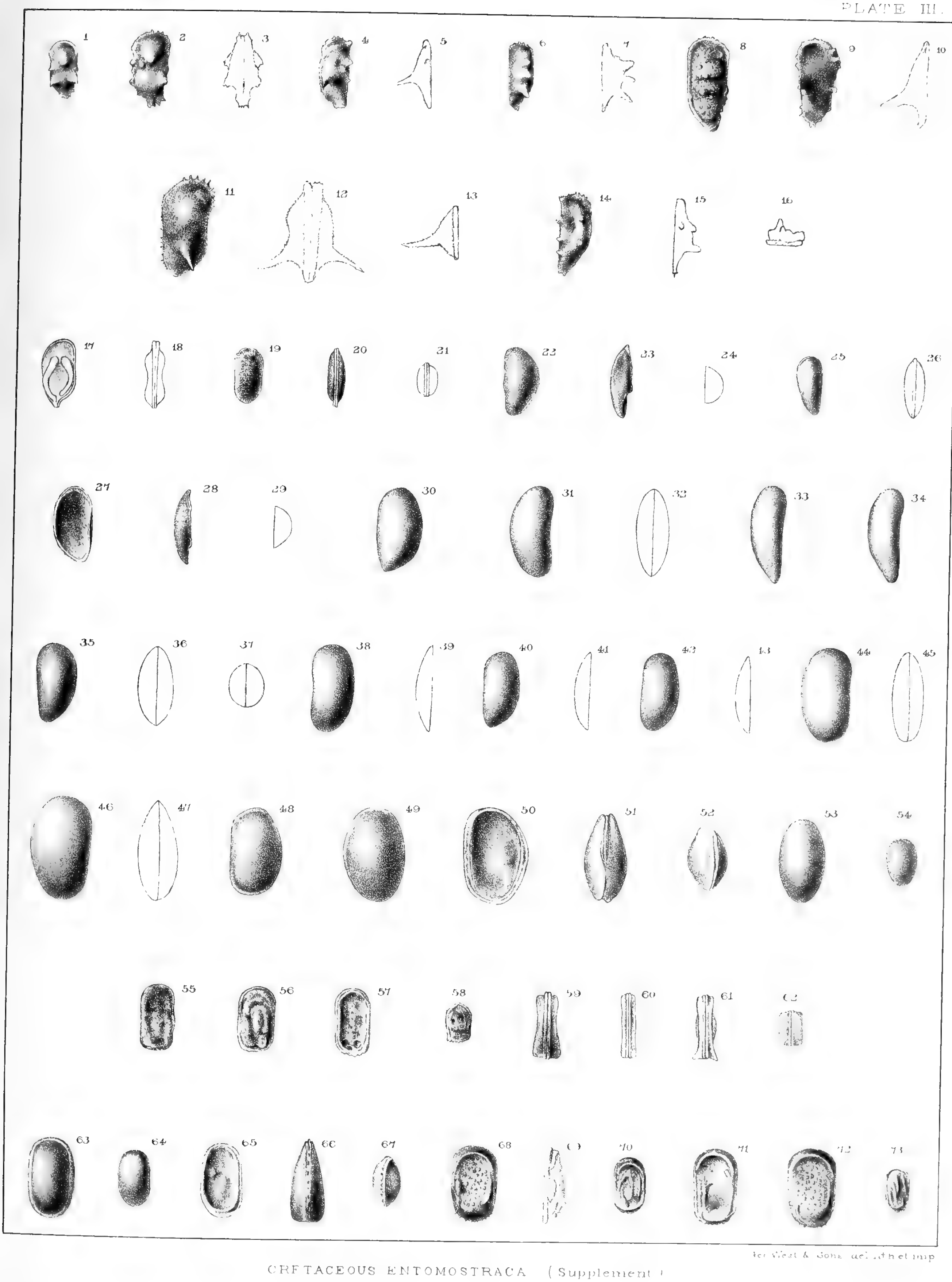
PLATE II.

Fig.		
1.	*Cythereis ornatissima* (Reuss). (Page 21.) Left valve.	× 18 diam.
2.	— — — Carapace, dorsal aspect.	
3.	— — — Carapace, ventral aspect.	
4.	— — — Carapace, anterior aspect.	
5.	— — — Left valve, not fully developed, though large.	
6.	— — — Left valve, rather young.	
7.	— — — Carapace, rather young; dorsal aspect.	
8.	— — — var. *nuda*, nov. (Page 23.) (Bad figure. See Pl. IV, fig. 14.)	
9.	— — — — — Left valve.	
10.	— — — var. *paupera*, nov. (Page 23.) Left valve.	× 20 „
11.	— — — — — — Right valve.	
12.	— — — var. *nuda*, nov. (Page 23.) Carapace, dorsal view.	× 18 „
13.	— — — — — — Carapace, ventral view.	
14.	— — — — — — Carapace, anterior end.	
15.	— — — (Page 21.) Young. Left valve. (Pl. IV, fig. 7.)	× 18 „
16.	— — — Young. Carapace, dorsal view. (Pl. IV, fig. 8.)	
17.	— *spinicaudata*, sp. nov. (Page 28.) Left valve.	× 20 „
18.	— — — Edge outline.	
19.	— *vallata*, Jones. (Page 28.) Left valve.	× 20 „
20.	*Cytheropteron alatum* (Bosquet), var. *fortis*, nov. (Page 36.) Left valve.	× 25 „
21.	— — — — — — Right valve.	
22.	— *Hibernicum*, sp. nov. (Page 36.) Left valve.	× 25 „
23.	— — — Ventral view.	
24.	— *alatum* (Bosquet), var. *robusta*, nov. (Page 35.) Right valve.	× 18 „
25.	— — — — — — Carapace, dorsal view.	
26.	— — — — — — Carapace, ventral view.	
27.	— — — — — — Carapace, anterior view.	
28.	*Bythocypris Rœmeriana*, sp. nov. (Page 14.) Left valve.	× 20 „
29.	— — — Edge view.	
30.	— — — End view.	
31.	*Bairdia subdeltoidea* (Münster). (Page 5.) Carapace, dorsal view.	× 18 „
32.	— — — Carapace, anterior view.	
33.	— — — Left (large) valve.	
34.	— — — Right (small) valve.	
35.	*Cythere? Bosquetiana*, Jones. (Page 15.) Carapace, showing right valve.	× 18 „
36.	— — — Carapace, dorsal view.	
37.	— — — Carapace, end view.	
38.	*Macrocypris siliqua*, Jones. (Page 9.) Carapace, dorsal view.	× 18 „
39.	— — — Carapace, end view.	
40.	— — — Right valve.	
41.	— — — Right valve, inside.	
42.	— *Muensteriana*, sp. nov. (Page 10.) Right valve, inside.	× 25 „
43.	— *Wrightii*, sp. nov. (Page 10.) Left valve (imperfect), edge outline.	× 12 „
44.	— — — Left valve.	
45.	— *Muensteriana*, sp. nov. (Page 10.) Carapace, left valve shown, oblique.	× 18 „
46.	— — — Carapace, dorsal view.	
47.	— — — Carapace, anterior view.	
48.	*Paracypris siliqua*, sp. nov. (Page 2.) Right valve, edge outline.	× 25 „
49.	— — — Right valve	
50.	— *gracilis* (Bosquet). (Page 1.) Carapace, right valve seen.	× 18 „
51.	— *siliqua*, sp. nov. (Page 2.) Right valve.	× 25 „
52.	*Bairdia Harrisiana*, Jones. (Page 8.) Carapace, dorsal aspect.	× 18 „
53.	— — — Carapace, anterior aspect.	
54.	— — — Carapace, left valve shown.	
55	— — — Right valve.	
56.	*Bythocypris Reussiana*, sp. nov. (Page 12.) Left valve.	× 18 „
57.	*Bairdia Harrisiana*, Jones, var. *amplior*, nov. (Page 8.) Right valve.	× 25 „
58.	*Pseudocythere? simplex*, sp. nov. (Page 30.) Left valve. (See also Pl. IV, figs. 37 and 38.)	× 20 „
59.	— — — Left valve.	
60.	— — — Right valve. Young, or variety.	
61.	*Bythocypris Reussiana*, sp. nov. (Page 12.) Carapace, dorsal aspect.	× 18 „
62.	— — — Carapace, anterior aspect.	
63.	— — — Carapace, right valve shown.	
64.	— *silicula* (Jones). (Page 13.) Left valve.	× 20 „
65.	*Pontocypris Bosquetiana*, sp. nov. (Page 4.) Right valve.	× 25 „
66.	*Macrocypris concinna*, sp. nov. (Page 11.) Left valve, edge outline.	× 20 „
67.	— — — Left valve.	

CRETACEOUS ENTOMOSTRACA (Supplement)

PLATE III.

Fig.		
1.	*Cythereis tuberosa*, sp. nov., var. *symmetrica*, nov. (Page 26.) Right valve.	× 20 diam
2.	— — — (Page 26.) Carapace, showing right valve.	× 20 „
3.	— — — Carapace, ventral outline.	
4.	*Cytheropteron cuspidatum*, sp. nov. (Page 37.) Left valve.	× 20 „
5.	— — — Left valve, dorsal edge.	
6.	— — — var. *tricuspidata*, nov. (Page 38.) Right valve.	
7.	— — — — — — Right valve, dorsal edge.	
8.	— *pedatum* (Marsson), var. *salebrosa*, nov. (Page 39.) Left valve. (See Pl. IV, fig. 32.)	× 20 „
9.	— *phyllopterum* (Bosquet). (Page 37.) Left valve.	× 20 „
10.	— — — Left valve, ventral view.	
11.	— *umbonatum* (Will.), var. *longispinata* (Marsson). (Page 41.) Right valve. (See Pl. IV, figs. 30, 31.)	× 20 „
12.	— — — — — — Carapace, ventral outline.	
13.	— — — — — — End outline of valve.	
14.	— *cuspidatum*, sp. nov., var. *montuosa* (Jones). (Page 38.) Right valve.	× 20 „
15.	— — — — — — Edge outline.	
16.	— — — — — — End outline.	
17.	*Cytherura appendiculata*, Jones. (Page 30.) Carapace, showing right valve.	× 18 „
18.	— — — Carapace, edge view.	
19.	*Cytherella Mantelliana*, Jones. (Page 50.) Carapace, showing right valve.	× 18 „
20.	— — — Carapace, edge view.	
21.	— — — Carapace, end view.	
22.	*Pontocypris triquetra* (Jones). (Page 4.) Left valve (damaged).	× 18 „
23.	— — — Edge view.	
24.	— — — End outline.	
25.	— *trigonalis*, sp. nov. (Page 3.) (See also Pl. IV, figs. 1 and 2.) Carapace, showing right valve.	× 20 „
26.	— — — Carapace, edge outline.	
27.	*Bythocypris silicula* (Jones). (Page 13.) Left valve, inside.	× 18 „
28.	— — — Edge view.	
29.	— — — End view.	
30.	— — — Left valve.	× 20 „
31.	— ? *Iernica* (Jones). (Page 14.) Carapace, showing right valve.	× 20 „
32.	— — — Carapace, edge view.	
33.	*Paracypris siliqua*, sp. nov. (Page 2.) Right valve.	× 20 „
34.	— — — Right valve.	
35.	*Pontocypris triquetra* (Jones), var. (? female). (Page 4.) Carapace, showing left valve.	× 20 „
36.	— — — — — Carapace, edge outline.	
37.	— — — — — Carapace, end outline.	
38.	*Bythocypris Brownei*, sp. nov. (Page 13.) Left valve.	× 20 „
39.	— — — Edge outline.	
40.	— *silicula* (Jones), var. *minor*, nov. (or male ?) (Page 13.) Left valve.	× 20 „
41.	— — — — — — — Edge outline.	
42.	— *Brownei*, sp. nov. (? male). (Page 13.) Left valve.	× 20 „
43.	— — — Edge outline.	
44.	*Cytherella subreniformis*, sp. nov. (Page 47.) Carapace, showing right valve.	× 20 „
45.	— — — Carapace, edge outline.	
46.	— *obovata*, sp. nov. (Page 46.) Carapace, showing right valve.	× 20 „
47.	— — — Carapace, edge outline.	
48.	— *ovata* (Römer). (Page 44.) Left (small) valve.	× 18 „
49.	— — — Right (large) valve.	
50.	— — — Right valve, inside.	
51.	— — — Carapace, dorsal aspect.	
52.	— — — Carapace, anterior aspect (oblique).	
53.	— — — Oval variety. Right valve. (See also Pl. IV, fig. 39, corrected.)	
54.	— — — Young. Right valve.	
55.	— *Williamsoniana*, Jones. (Page 48.) Left (small) valve.	× 18 „
56.	— — — Right (large) valve.	
57.	— — — Right valve, inside.	
58.	— — — Young. Right valve.	
59.	— — — Carapace, dorsal view.	
60.	— — — Carapace (younger), dorsal view.	
61.	— — — Carapace, ventral view.	
62.	— — — Carapace, anterior aspect.	
63.	— *Muensteri* (Römer). (Page 46.) Carapace, showing left valve.	× 18 „
64.	— — — Carapace (young), showing right valve.	
65.	— — — Left valve, inside.	
66.	— — — Carapace (cast), dorsal view.	
67.	— — — Carapace (cast), anterior aspect (oblique).	
68.	— *Williamsoniana*, Jones, var. *granulosa*, Jones. (Page 49.) Right valve.	× 20 „
69.	— — — — — — Dorsal view.	
70.	— *Chapmani*, sp. nov. (Page 49.) Right valve.	
71.	— *Williamsoniana*, Jones, var. *stricta*, nov. (Page 48.) Right valve.	
72.	— — — var. *granulosa*, Jones. (Page 49.) Right valve.	
73.	— *obliquirugata*, sp. nov. (Page 50.) Left (?) valve.	



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CRETACEOUS ENTOMOSTRACA (Supplement)

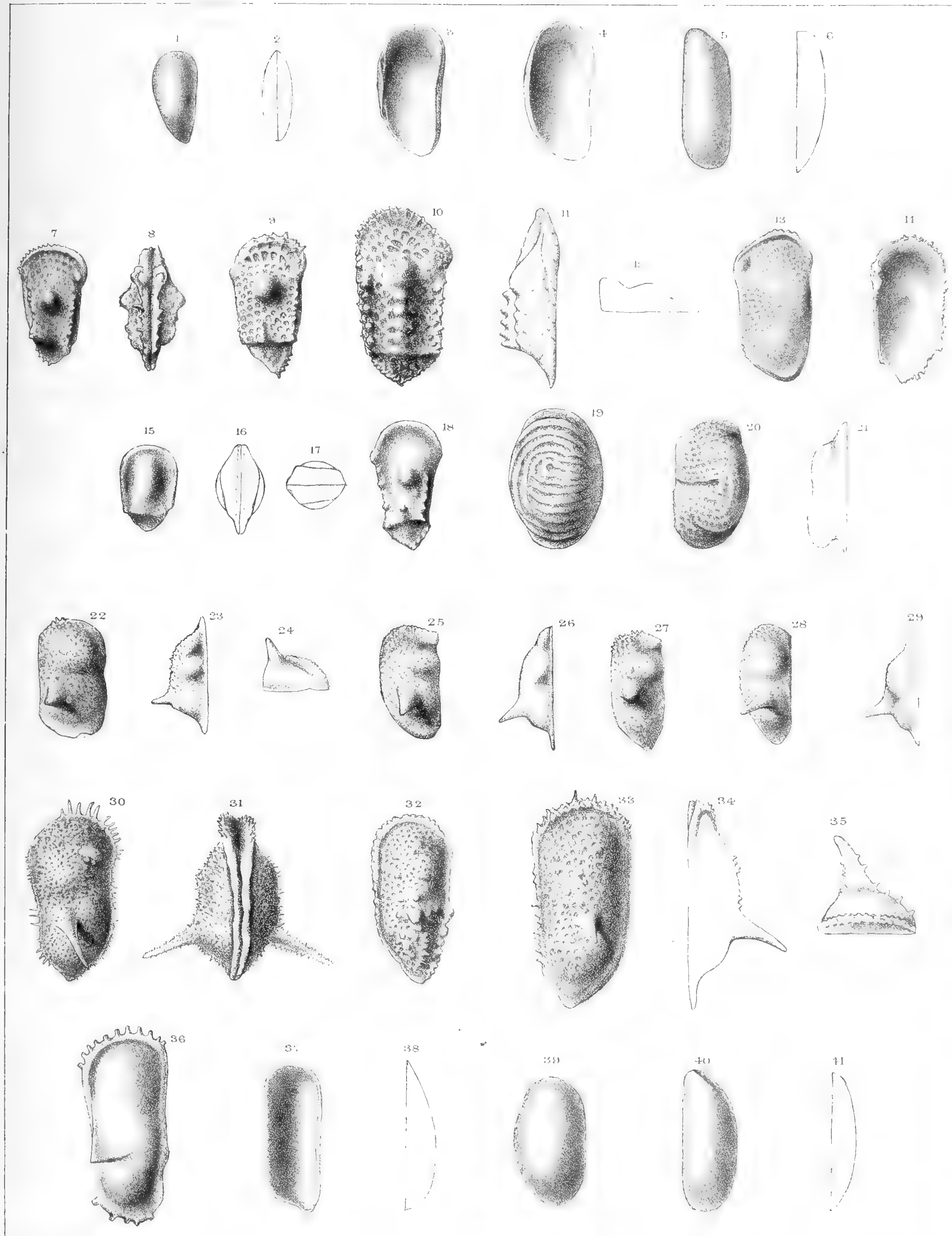
PLATE IV.

Fig.		
1.	*Pontocypris trigonalis*, sp. nov. (Page 3.) Carapace; right valve seen. (See also Pl. III, figs. 25 and 26.)	× 30 diam.
2.	— — — Edge outline. The translucent edges show the lines of the internal flanges.	
3.	— *Bosquetiana*, sp. nov. (Page 4.) Left valve, inside. Reproduced from pl. vi, fig. 18 *f*.	× 30 ,,
4.	*Bairdia Harrisiana*, Jones, var *amplior*, nov. (Page 8.) Left valve, inside.	× 30 ,,
5.	*Cytherideis parallela*, sp. nov. (Page 43.) Right valve.[1]	× 30 ,,
6.	— — — Edge outline.[1]	
7.	*Cythereis ornatissima* (Reuss), Young, in the *reticulate* stage. (Page 21.) Carapace; left valve shown. Reproduced accurately instead of pl. iv, fig. 11 *h*.	× 30 ,,
8.	— — — Dorsal edge. Reproduced for fig. 11 *h'*.	
9.	— — var. *reticulata*, nov. (Page 24.) Right valve.	× 30 ,,
10.	— — — — Beaded. Left valve.	× 25 ,,
11.	— — — — Dorsal view.	
12.	— — — — Posterior outline.	
13.	— — var. *radiata*, nov. (Page 25.) Right valve.	× 25 ,,
14.	— — var. *nuda*, nov. (Page 23.) Inside of left valve. To replace pl. v, fig. 13 *a*.	× 30 ,,
15.	— *Icenica*, sp. nov., var. *quadrata*, nov. With low ridges. (Page 27. See also Pl. I, fig. 62.) Carapace, showing left valve.	× 30 ,,
16.	— — — — Ventral view.	
17.	— — — — Posterior view.	
18.	— *Wrightii*, sp. nov. (Page 25.) Right valve.	× 25 ,,
19.	*Cytheropteron concentricum* (Reuss). (Page 31.) Showing the ornament in the advanced state with continuous ridges. (See also Pl. I, figs. 6—10.)	× 30 ,,
20.	— *Sherborni*, sp. nov. (Page 42.) Right valve.	× 25 ,,
21.	— — — Ventral view.	
22.	— *umbonatum* (Will.), var. *acanthoptera* (Marsson). (Page 41.) Left valve. (See Pl. I, figs. 11—13.)	× 25 ,,
23.	— — — — (Marsson). Dorsal view.	
24.	— — — — — Posterior view.	
25.	— — — — — Narrow form. Left valve.	
26.	— — — — — Narrow form. Dorsal view.	
27.	— — — — — Narrow form. Left valve.	
28.	— — — — — Narrow form. Left valve.	
29.	— — — — — Narrow form. Dorsal valve.	
30.	— — var. *longispinata* (Marsson). (Page 41.) Right valve. (The antero-ventral lump is adventitious. See also Pl. III, figs. 11—13.)	× 25 ,,
31.	— — — (Marsson). Carapace, ventral view.	
32.	— *pedatum* (Marsson), var. *salebrosa*, nov. (Page 39.) Left valve. (See also Pl. III, fig. 8.)	× 25 ,,
33.	— — — (Page 38.) Right valve.	× 25 ,,
34.	— — — Ventral view.	
35.	— — — Anterior view.	
36.	— *alatum* (Bosquet), var. *cornuta* (Bosquet). (Page 36.) Left valve.	× 50 ,,
37.	*Pseudocythere ? simplex*, sp. nov. (Page 30. See also Pl. II, figs. 58—60.) Inside of left valve.	× 25 ,,
38.	— — — Edge outline.	
39.	*Cytherella ovata* (Römer). (Page 44.) Oval variety. Right valve. Corrected for pl. vii, fig. 24 *h*.	× 25 ,,
40.	*Cytherideis acuminata* (Reuss). (Page 43.) Carapace (damaged at posterior end).[2]	× 25 ,,
41.	— — — Edge outline of a single valve.[2]	

[1] Figured with posterior end upwards by mistake.

[2] Figured with the hinder end upwards by mistake.

PLATE IV.



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CRETACEOUS ENTOMOSTRACA (Supplement.)

THE

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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. 4.

GASTEROPODA OF THE INFERIOR OOLITE.

Pages 193—224; Plates XII—XVI.

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"How and whence did they come, these curious cylindrical shells with their internal folds? Such a question must occur as a matter of course to everyone interested in Jurassic palæontology. . . . . Does the evidence at present in our possession lead us to suppose that they appeared almost simultaneously along the whole line, or earlier in one place than another? We may fairly believe that these shells originated in the calcareous shallows which succeeded the more sandy deposits of the *Cynocephala*-stage towards the base of the Inferior Oolite."

Since the above was written the attention of Mr. Witchell and others has been drawn to this very question, and I myself have had many opportunities for extending the investigations, which originally commenced in Yorkshire, into the Midland and South-western Counties. The following is a partial summary of the results.

There is no authentic evidence of the existence of *Nerinæa* in the British Lias, although the late Charles Moore enumerates four species.[1] In Yorkshire *Nerinæa* has not yet been detected below the *Nerinæa*-bed which occurs in the upper part of the Dogger at Blue Dyke. Here a well-known and well-developed form (*N. cingenda*, Phil.) suddenly appears in abundance, and a large variety of the same species appears with equal suddenness in the Northampton Sand. In the Cotteswolds several species of *Nerinæa* appear in the Pea-grit, mostly cylindrical forms belonging to the sub-genus *Ptygmatis*. These are undoubtedly in the *Murchisonæ*-zone. But in the shell-bed below the Lower Limestone at Crickley Hill, in what is perhaps the top of the *Opalinus*-zone, occurs a *Nerinæa* (*Ptygmatis*) to which I have given the specific name of *xenos*, possessing an internal structure considerably different from that of *N. cingenda*. This appears to be the oldest form of *Nerinæa* hitherto discovered in the Cotteswolds, and it serves to bear out the general conclusion that the genus, as far as this country is concerned, makes its first appearance on the confines of the zones of *Am. Murchisonæ* and *Am. opalinus*. In Dorsetshire, on the other hand, where a strong cephalopod facies characterizes all the zones, *Nerinæa* is as unknown in the Inferior Oolite as in the Lias.[2]

We owe much of our knowledge of the Nerinæas of the Cotteswolds to the ability and enthusiasm of the late Mr. Witchell, of Stroud, who literally died at the edge of his favourite quarry on Swift's Hill, whither he was in the habit of repairing for the purpose of extracting fossils. In his admirable paper "on the genus *Nerinæa* and its stratigraphical distribution in the Cotteswolds" Mr. Witchell enumerates twenty species from the Inferior Oolite of that region, these being classified under five groups according to their internal structure.

It is well known that many attempts have been made to subdivide this

[1] Some of these are founded on very imperfect fragments. "*Nerinæa*" *liassica* is stated by Mr. Walford to be a *Cerithium*, as proved by the section.

[2] For further information relative to the distribution of *Nerinæa* see Introduction, especially p. 61.

inconveniently large genus. For instance, in 1850 D. Sharpe divided *Nerinæa* into four sub-genera, of which *Trochalia* may be omitted as having no representative in our Inferior Oolite. There remain then (1) *Nerinella*—columella either simple or furnished with one fold, the outer lip with one internal fold; (2) *Nerinæa*—columella with two or three folds, outer lip with one or two folds, all simple; (3) *Ptygmatis*—columella usually with three folds, outer lip with one to three folds, one or two of the folds of a complex form, either dividing into two lobes or wider towards the edge than at the base. D'Orbigny objected to these sub-genera, mainly on the grounds that no definite line could be drawn showing where one ended and the other began; an objection which, if urged nowadays, would be applicable to most zoological divisions. Subsequently both Zittel and Cossmann have more or less recognised the value of these distinctions.

As a matter of fact, in our Inferior Oolite six sections or divisions of *Nerinæa* may be made out, the distinctions being based upon internal structure.

Section A (*Uniplicatæ*). Simple fold on the outer wall; *e. g. Nerinella gracilis*, Lycett.

Section B (*Biplicatæ*). Simple fold on the outer wall and on the columella; *e. g. Nerinella*, species unnamed from Weldon.

Section C (*Triplicatæ*). One well-marked fold on the outer wall, one on the lower part of the columella, and one about the junction of the columella with the posterior wall, all simple, *e.g. Nerinæa oolitica*, Witchell. This is a very numerous section, and includes most of the proper Nerinæas of our Inferior Oolite.

Section D. Outer wall with sometimes one and sometimes two folds, columella with two folds, all simple; *e. g. Nerinæa cingenda*, Phillips.

Section E. Five simple folds, in all, on the outer wall and columella; *e. g. Nerinæa* (? *Ptygmatis*) *Guisei*, Witchell. The above species is the only representative of this section, which appears to be a sort of connecting link between *Nerinæa* and *Ptygmatis*.

Section F. Outer wall and columella with several more or less complex folds, the result being a narrow and whimsical section; *e. g. Ptygmatis Oppelensis*, Lycett. This is the most numerous section of all. The contrast presented by the internal section almost entitles this to the rank of generic distinction.

General Features of the Nerinæas of the Inferior Oolite.—In most cases the columella is solid. If there be exceptions, they occur in the upper parts of the Lincolnshire Limestone, where a peculiar admixture of forms takes place. Where no mention is made to the contrary, it may be taken for granted that the columella is regarded as having been solid. Narrow, cylindrical forms are the most prevalent. The apical whorls differ greatly from the anterior ones (dimorphism). Owing to the indifferent preservation of the surface the original character of the ornamentation is somewhat difficult to determine.

Where the ornaments have been preserved we find very fine spiral lines, whose granulations can only be seen under a lens of some power; these lines have a tendency to die out in the more mature whorls. Rich tubercular ornamentation is rare, and would seem mainly confined to species from the highest beds of the Lincolnshire Limestone, which appear to have Bathonian affinities. The mature whorls sometimes show the curving lines of growth and the slight raised line on the posterior margins, but too often almost every surface feature is obscured.[1]

Although there is considerable uniformity in the section of an individual *Nerinæa*, that is to say, that the folds vary but little in the several whorls, yet there does seem a tendency in many cases for the mature whorls to be less restricted as to internal space. It may be that the folds of the body-whorl were more or less absorbed, so as to give the animal additional space. I have noticed, especially in *Ptygmatis*, this tendency of the folds to diminish, and indeed to become almost effete in the body-whorl. Mr. Witchell also noticed this feature, and attributed it to wear. It is not a little singular that when we obtain an unbroken shell, as is frequently the case in the Oolite Marl horizon, there is no trace of folds to be found, either on the lip or columella.

Definition and Range of Species.—When Lycett wrote 'The Cotteswold Hills,' in 1857, he enumerated no more than six species of *Nerinæa* in the Inferior Oolite of the Cotteswolds. In 1887 Witchell had brought up the number to twenty. In the present Monograph certain forms have been named provisionally, but not described as distinct species. Some of the forms described as species to a certain extent run into each other, and it may be predicted that future collectors are sure to find an increased number of intermediate forms. Moreover, many of the species appear to be local, and often limited in range. A few are useful as indicating horizon, but it would seem as though still fewer could be relied upon for any great distance. The most marked Nerinæan horizon known to me is that of *N. Guisei* in the *Clypeus*-grit. The varieties of *N. Cotteswoldiæ* also help to connect both the Pea-grit and Oolite Marl with certain horizons in the Lincolnshire Limestone.

Nerinæas of the Lincolnshire Limestone.—To a certain extent these require separate treatment, especially as regards specimens from Weldon and Great Ponton. The species at Weldon are extremely numerous, including examples of *Nerinella*, *Nerinæa*, and *Ptygmatis*, though *Nerinæa* greatly preponderates. Many are very small, and nearly all have suffered either before or since mineralization. There seems to be a great admixture, suggesting the possibility of some of the

[1] As regards ornamentation it is curious to note what different artistic treatment has been accorded to the same species. Thus, *N. funiculus*, Desl., *N. clavus*, Desl., *N. pseudocylindrica*, D'Orb., are represented in Deslongchamps' work as having fine *spiral* ornamentation, whilst in D'Orbigny's figures of the same species the spiral ornamentation is entirely ignored, and a very elaborate system of *growth-lines* is substituted.

fossils having been *remanié* from earlier beds destroyed by contemporaneous erosion. At Great Ponton only *Nerinæa* has been noticed by me; the specimens are less fragmentary than at Weldon, but their surface condition is sadly apt to mislead. When to these difficulties we add the prevalence of dimorphism, it must be allowed that the Nerinæas of the upper beds of the Lincolnshire Limestone (Weldon and Great Ponton) constitute about as undesirable a group as any one could have to investigate. One thing, I think, comes out pretty clearly, viz. a strong admixture of forms related to and nearly identical with those in Bathonian beds.

Section A (Uniplicatæ).

121. Nerinæa (*Nerinella*) gracilis, *Lycett*, 1857. Plate XII, figs. 12, 13 *a*, 13 *b*.

1853. Chemnitzia gracilis, *Lycett*. Proc. Cottesw. Nat. Field Club, vol. i, p. 79, pl. ii, fig. 3.
1857. Nerinæa gracilis, *Lycett*. Cotteswold Hills, p. 124, pl. ii, fig. 3.
1887. — — — Witchell, Proc. Cottesw. Nat. Field Club, vol. ix, p. 37, pl. ii, fig. 2.

Description:

Spiral angle	5°—8°.
Height of whorl to width	1 : 1·15.
Approximate length	60—140 mm.

Shell cylindrical, scarcely turrited. Whorls twenty-five or more, with a slight posterior prominence in the younger shells; flat or very slightly turrited in the more matured whorls. No sutural carina. Fine spiral lines mark the anterior portion of each whorl, of which the prominent portion is smooth. In the more advanced stage the whorls are smooth.

Aperture ovate-oblong, with a narrow and but slightly twisted canal. *Section* uniplicate, with one simple fold in the middle of the outer wall.

Relations and Distribution.—In order not to multiply specific names unduly a considerable breadth of variety as regards spiral angle has been admitted in this case. It is just possible that fig. 12 may represent a narrow variety, of which fragments representing very long shells are occasionally found. Lycett's type was from the Oolite Marl[1] horizon at Nailsworth Hill; the other specimens are from the Oolite Marl of Swift's Hill or Longridge, where *N. gracilis* is moderately plentiful in fragments. In the Lincolnshire Limestone, specimens of *Nerinella* not

[1] In referring to the Oolite Marl the horizon is meant, see p. 61, *antea*.

to be distinguished from this species are of occasional occurrence. Figs. 15 and 16, representing specimens from Weldon, might possibly be referred to as immature forms.

122. Nerinæa (*Nerinella*) conoidea, sp. nov. Plate XII, fig. 14.

(But see Witchell, vol. cit., p. 37, pl. ii, fig. 1.)

Description :

Spiral angle (slightly obtuse) . . .	12°
Height of whorl to width . . .	1 : 1·25
Approximate length	80 mm.

Shell cylindro-conical, apical whorls alone turrited. The whorls are about twenty in number, increasing by slight steps in the earlier stages, where, also, each whorl has a slight posterior prominence; the matured whorls are without any prominence in the neighbourhood of the sutures, and perfectly flat. No specimens showing apical ornaments have as yet been found.

Aperture as in the preceding species but less elongate; internal section similar.

Relations and Distribution.—If we are to allow that the differences in these very plain *Nerinellæ* justify us in making specific distinctions, it is chiefly in the relative proportions of the spiral angle and the whorls that we must look for the evidences. The difference between such shells as figs. 12 and 14, one having a spiral angle of 5° and the other of 12°, is most striking, and almost forbids us to include them under the same species.

Occurs on the Oolite Marl horizon, chiefly at Swift's Hill and Longridge.

123—126. Species of uniplicate Nerinella found in the Lincolnshire Limestone at Weldon. Plate XII, figs. 15—18.

A 1 (fig. 15). Spiral angle 8°, height of whorl to width 1 : 1·25, length of figured specimen 11 mm. Shell elongate and not turrited; whorls smooth; aperture oblong with a well-marked canal. *Section* uniplicate.

A 2 (fig. 16). Spiral angle 12°, height of whorl to width 1 : 1·35, length of figured specimen 18 mm. Shell elongate and slightly turrited; whorls smooth. Body-whorl somewhat constricted; aperture and *section* as in the preceding. These two forms might almost be taken to represent the early stages of *N. gracilis* and *N. conoidea* respectively.

A 3 (fig. 17). Spiral angle 16°, height of whorl to width 1 : 1·65, length of figured specimen 16 mm. Shell conical-elongate, scarcely turrited; whorls short and smooth; sutures rather open. Body-whorl slightly constricted posteriorly; *section* uniplicate.

A 4 (fig. 18). Spiral angle 16°, height of whorl to width 1 : 1·5, length of figured specimen (restored) 20 mm. Shell conical-elongate, strongly turrited. The whorls are smooth and marked posteriorly by a bevilled margin of considerable breadth. Body-whorl salient, and constricted in the middle. *Section* uniplicate.

The four specimens figured and partially described above clearly belong to at least three very distinct species of *Nerinella.* Like so many of the Weldon Nerinæas, there is an appearance as though the columella had been partially hollow, but in all cases the umbilicus is closed. The appearance of excessive smoothness is probably misleading.

Section B (Biplicatæ).

127, 128. Species of biplicate Nerinella found in the Lincolnshire Limestone at Weldon. Plate XIII, figs. 1 and 2.

B 1 (fig. 1). Spiral angle 13°, height of whorl to width 1 : 1·6, length of fragment 16 mm. Shell elongate, strongly turrited; whorls encircled by a wide posterior rim (slightly bevilled), otherwise smooth and constricted in the anterior third. *Section* biplicate; *i. e.* a simple central fold on the outer wall, and a very slight fold on the columella.

B 2 (fig. 2). Spiral angle 17°, height of whorl to width 1 : 1·8, length of fragment figured 22 mm. Shell conical-elongate, scarcely turrited. Whorls nearly flat, without visible ornament, and very slightly raised at each extremity, where they meet the sutures. *Section* biplicate and similar to the preceding, except that the fold of the lower part of the columella is even less developed.

Nerinellæ with two folds have not, as far as I know, been hitherto figured from the British Jurassic rocks. The group is more characteristic of Bathonian beds, whence fine specimens of *Nerinella Bathonica,* Rig. and Sauv., have lately been obtained in the Cotteswolds.

Section C (Triplicatæ).

129. Nerinæa parva, Witchell, 1887. Plate XIII, fig. 3.

1887. Nerinæa parva, *Witchell.* Vol. cit., p. 31, pl. i, fig. 5.

Description :

Spiral angle	12°
Height of whorl to width . . .	1 : 1·85
Approximate length . . .	45 mm.

Shell cylindro-conical, strongly turrited. Whorls about eighteen, very short and increasing by steps. In the earlier whorls the anterior portion is much excavated, a feature which accentuates the sudden volutional increase. The depth of the excavation continues to diminish until each whorl becomes nearly flat, but the step-like character is retained. In the later whorls the width is not quite so great in proportion to the height. The hollows are ornamented by fine spiral lines, of which there are no traces in the maturer whorls.

Body-whorl angular and short, with a squarish aperture and very short canal. *Section* triplicate; one blunt and wide fold a little below the middle of the outer walls, one rather wide fold on the columella considerably below the middle, and one on the posterior wall.

Relations and Distribution.—Distinguished from the succeeding species by the excessive shortness of the whorls, and by their strongly step-like character. It is also more free from dimorphism and of smaller growth. Somewhat rare on the Oolite Marl horizon of Swift's Hill and Longridge.

130. Nerinæa oolitica, *Witchell*, 1887. Plate XIII, figs. 4 *a*, 4 *b*, 4 *c*, 4 *d*, 6, and 7.

1887. Nerinæa oolitica, *Witchell.* Vol. cit., p. 30, pl. i, fig. 1.

Description :

Spiral angle	12°—16°.
Height of whorl to width . . .	1 : 1·45.
Length	80—120 mm.

Shell cylindro-conical, turrited. Whorls twenty to twenty-five, exhibiting much dimorphism. The apical whorls, as far as about the middle of the spire, are much thickened at the suture and strongly excavated anteriorly, so as to produce an appearance of excessive turriting; they are also ornamented with fine spiral lines. Presently the thickening at the suture ceases, the whorls become nearly flat and smooth, and the increase by steps less pronounced. The point where this change comes on varies in individual shells.

Body-whorl angular, smooth, and slightly projecting; aperture oblong, with rather a wide and moderately reflexed canal. *Section* triplicate; one acute fold near the centre of the outer wall, one rather wide shallow fold low down in the columella, one acute small fold in the posterior wall.

Relations and Distribution.—This species is essentially the common triplicate *Nerinæa* of the Oolite Marl horizon, and probably passes by gradations into *Nerinæa attenuata* on one side, and *Nerinæa expansa* on the other. Figs. 4 *a* and 4 *b* may be regarded as typical; figs. 6 and 7 seem to connect it with *Nerinæa expansa* of the Lincolnshire Limestone.

The chief localities are Swift's Hill and Longridge in the Cotteswolds, and similar forms may be traced in parts of the Lincolnshire Limestone. It is somewhat singular that so abundant a species should have escaped the notice of Lycett; but most species, even the commonest, are wont to be local in distribution.

131. Nerinæa Longfordensis, sp. nov. Plate XIII, fig. 5.

Description :

Spiral angle (obtuse)	10°.
Height of whorl to width . . .	1 : 1·4.
Length	90 mm.

Shell cylindro-conical, turrited. Whorls about sixteen. The apical whorls, as in *N. oolitica*, are thickened at the suture, though scarcely to the same extent. The whorls are much excavated, and this is continued throughout, the more mature whorls being much pinched in about two-thirds down, which gives this part of the spire a peculiarly constricted look.

The aperture is oblong, and the *section* is remarkable for the smallness of the folds.

Relations and Distribution.—The pinching in of the outer portion of the whorls gives this genus a superficial resemblance to *N. cingenda*, Phil. Rare in the Upper Pisolite of Longfords.

132. Nerinæa attenuata, *Witchell*, 1887. Plate XIII, fig. 6 *a*.

1887. Nerinæa attenuata, *Witchell*. Vol. cit., p. 32, pl. i, figs. 7 and 8; pl. ii, fig. 6.

Description :

Spiral angle	10°—12°.
Height of whorl to width . . .	1 : 1·35.
Approximate length . . .	60—70 mm.

Shell conical-elongate, strongly dimorphous. Whorls about twenty; those towards the apical end are excavated anteriorly, and the sutural prominence is excessive. Later on the sutural ridges disappear, and the whorls are quite flat and plain, increasing in the form of a regular cone. It is probable that the earlier whorls were ornamented with fine spiral lines, which disappear with the flattening of the whorl.

Body-whorl smooth and without salience; aperture widely ovate, canal rather wide. *Section* triplicate; an obtuse fold on the outer wall, one very low on the columella, and one on the posterior wall.

Relations and Distribution.—Although obviously related to *Nerinæa oolitica*, this species differs in its more marked dimorphism, and in the extremely conical figure produced by the lower whorls. The whorls are also relatively rather higher than in the majority of specimens of *N. oolitica*, and there are slight differences in the internal section.

It has been found in the Pea-grit of Longfords, in the Oolite Marl of Swift's Hill and Longridge, and possibly also in the Lincolnshire Limestone at Belmisthorpe.

133. Nerinæa expansa, sp. nov. Plate XIII, fig. 6 *b*.

Description :

Spiral angle	15°—17°.
Height of whorl to width . . .	1 : 1·30.
Approximate length . . .	90—100 mm.

Shell conical-elongate, the spire exhibiting a moderate amount of dimorphism. Number of whorls about eighteen, increasing by steps, but not much excavated, and with only a moderate sutural prominence; the subapical whorls show traces of fine spiral lines. The later whorls are smooth, nearly flat, and without prominence, whilst the suture is close or even depressed. The aperture is ovate-oblong, and *section* similar to that of *N. oolitica.*

Relations and Distribution.—These shells are found at one or two points in the Lincolnshire Limestone, and notably at Wakerly and Nettleham. Such specimens as fig. 6, from the Oolite Marl, seem to constitute a connecting link both with *N. oolitica* and *N. attenuata*.

In view of the undoubted fact that forms of *Nerinæa* do run into one another by easy gradations, some might prefer to regard *N. parva*, *oolitica*, *attenuata*, and *expansa* as varieties of one species; but if we accept this lumping view, it would be scarcely possible to constitute any species for triplicate Nerinæas with little or no ornament, as the similarities might be extended indefinitely. A form (Pl. XIV, fig. 6) which is not uncommon in the upper beds of the Lincolnshire Limestone at Great Ponton may be a narrow variety of this species. The chief difference appears to be that the columella is partly hollow. There are also some trifling differences in the section.

134. Nerinæa deducta, sp. nov. Plate XIII, fig. 8.

Description:

Spiral angle	6°.
Height of whorl to width . . .	1 : 1·35.
Approximate length	80 mm.

Shell subcylindrical, spire dimorphous. For about one-third the distance from the apex the sutural belts are very thick and prominent, with corresponding excavation of the whorls. From twelve to fourteen whorls present this phase. The change to a plain and flat whorl is rather sudden; there are about ten of these, fitting close so as to produce a very elongated cone. In the specimen figured the slightly raised rim on the posterior margin of each whorl is well preserved. No ornaments in the anterior whorls other than lines of growth, which seem to have been nearly straight.

Body-whorl not prominent, smooth, scarcely excavated; aperture oblong, with rather a wide and relatively long canal. *Section* triplicate, and closely resembling that of the *oolitica*-group generally.

Relations and Distribution.—As this form occurs in the Pea-grit horizon, it may be regarded, in a certain sense, as the precursor of the several forms of the *oolitica*-group, from which it is distinguished by its smaller spiral angle and more cylindrical figure. Not abundant.

135. NERINÆA PSEUDOCYLINDRICA, *D'Orbigny*, 1850, *fide* Lycett, 1857. Plate XIII, fig. 9 and ? fig. 11.

1842.	NERINÆA CYLINDRICA, *Deslongchamps.*	Mém. Soc. Linn. Norm., vii, p. 187, pl. viii, fig. 33.
1850.	— PSEUDOCYLINDRICA, *D'Orb.*	Prod., i, p. 298 (Ét. Bathonien).
1852.	— — —	Terr. Jurass., vol. ii, p. 86, pl. cclii, figs. 11—13.
1857.	— — —	Lycett, Cotteswold Hills, pl. ii, fig. 5.

Bibliography, &c.—Lycett makes no mention of D'Orbigny's species in the text of the 'Cotteswold Hills.' His specimen (in the Jermyn Street Museum) is much longer than the one now figured, and may indeed differ both from the forms hereunder described and also from the Bathonian species, originally figured and described by Deslongchamps, and renamed by D'Orbigny.

Description :

Spiral angle (very regular) . .	8°.
Height of whorl to width . . .	1 : 1.
Length	50—120 mm.

Shell subcylindrical, subulate. Whorls about sixteen in the specimen figured, but sometimes more, flat, about as high as wide and scarcely projecting; they are separated by an open and somewhat depressed suture. Numerous fine spiral lines ornament the whorls, but they become fainter in the more advanced whorls.

Body-whorl nearly smooth, not salient, aperture narrow. *Section* triplicate; a deep fold with a square head occupies the centre of the outer wall, one very small fold towards the base of the columella, one fold on the posterior wall.

Relations and Distribution.—Distinguished from the next species by its wider spiral angle. A few specimens have been found in the Oolite Marl horizon of Longridge. The fragment from Weldon (fig. 11) may represent the same species in a different state of preservation.

136. NERINÆA ALTIVOLUTA, *Witchell*, 1887. Plate XIII, figs. 10 *a*, 10 *b*, 10 *c*, 10 *d*.

1887. NERINÆA ALTIVOLUTA, *Witchell.* Vol. cit., p. 33, pl. i, figs. 11, 12.

Bibliography, &c.—This species was founded by Mr. Witchell on fragments of the posterior portion of a very cylindrical *Nerinæa.* It is believed that specimens (such as 10 *a* and 10 *d*) represent apical conditions of this species.

Description :

Spiral angle	3°—4°.
Height of whorl to width	1 : 1 nearly.
Approximate length	200 mm.

Shell cylindrical. Whorls numerous, high, with a very oblique suture. The extreme apical conditions are unknown. In the subapical stage (fig. 10 *a*) the spire can scarcely be described as turrited, although the posterior margin of each whorl shows a slightly raised rim. In this stage the whorls are slightly constricted, and ornamented by numerous very fine spiral lines. In the mature stage (fig. 10 *b*) the whorls are quite flat and smooth, and a simple line indicates the suture.

Body-whorl smooth and without salience; aperture narrow-oblong; canal relatively long. *Section* triplicate, one large obtuse fold occupying a considerable portion of the centre of the outer wall; a small acute fold very low down in the columella; a prominent fold at the junction of the columella with the posterior wall.

Relations and Distribution.—Differs from *N. pseudocylindrica* in having a smaller spiral angle and slightly higher whorls. It seems to be the most cylindrical of all the Nerinæas of the Inferior Oolite. Somewhat rare in the Pea-grit near Stroud and at Longfords; occurs also on the same horizon at Crickley. In the specimen from Weldon (fig. 10 *b*) the whorls are not quite so high.

137. Nerinæa Hudlestoniana, *Witchell*, 1887. Pl. XIV, fig. 1.

1887. Nerinæa Hudlestoniana, *Witchell.* Vol. cit., p. 31, pl. i, fig. 4.

Description :

Spiral angle	15°.
Height of whorl to width	1 : 1·5.
Approximate length	75 mm.

Shell subconical. Whorls about fifteen, deeply excavated in the centre and short. Sutural carina thick and very prominent. Apical condition and ornaments unknown. *Section* triplicate; one rather prominent fold on the outer wall, a small acute fold low down on the columella, and a very narrow fold on the posterior wall.

Relations and Distribution.—Regarded by Mr. Witchell as resembling a *Nerinæa* from the Inferior Oolite of Whitwell in Yorkshire (see 'Geol. Mag.,' dec. 3, vol. i, p. 112, pl. iv, fig. 7). The Yorkshire specimen has suffered so much from compression as to make the identification somewhat doubtful. Differs from the varieties of *N. Eudesii*, Mor. and Lyc., in having a smaller spiral angle and solid columella.

The specimen figured is the only one known; it is said to have come from the marly limestone of Longridge, but the matrix is not very characteristic of that bed. To be regarded as a doubtful species.

138. Nerinæa Eudesii, *Morris and Lycett*, 1851. Plate XIV, figs. 2 and 2 *a*.

1851. Nerinæa Eudesii, *M. and L.* Great Ool. Moll., p. 33, pl. viii, figs. 6 and 6 *a*.

Bibliography, &c.—Morris and Lycett appear to have had some doubts as to the generic[1] position of *N. Eudesii*, comparing it with *Cerithium Defrancii*, Desl. An examination of the specimens in the Jermyn Street Museum, where the types are kept, favours the notion that they really are triplicate Nerinæas. Moreover, a triplicate *Nerinæa* which answers to their figures and description is far from scarce in our Great Oolite. Hence Mons. Cossmann ('Ét. Bathonien,' p. 216) has been misled by the doubts of Morris and Lycett in regarding *N. Eudesii* as identical with *C. Defrancii*.

Description of Great Oolite varieties.—Spiral angle about 20°. Shell conical-elongate, turrited, and often of considerable length. Whorls ten or more, narrow, with numerous fine lines of unequal prominence, and much excavated; sutures carinated, the carinæ sharp. Columella ? hollow, but with closed umbilicus. Body-whorl short, and almost as much excavated as the whorls of the spire; base flattened, aperture subquadrate. *Section* triplicate (fig. 2); one shallow fold in the centre of the outer wall, two rather pointed folds on the columellar side, which shows a peculiar outline, only to be understood by reference to the figure.

Specimens from the Lincolnshire Limestone (fig. 2 *a*), owing to indifferent preservation, seldom show the fine spiral lines. They are, on the whole, less conical and shorter than these from the Great Oolite. The chief differences are in the internal section, especially in the outline of the columellar portion of each whorl.

Relations and Distribution.—N. Eudesii belongs to a group of Nerinæas with more or less deeply excavated whorls and prominent sutural carinæ, which are, on the whole, more characteristic of Bathonian beds. Modifications in the spiral angle, relative height of whorls, and slight differences in the internal section are almost the only points whereon specific differences can be founded, and the value of

[1] The sub-genus *Trochalia*, to which they also referred it, should be restricted to trochiform shells with an infundibular umbilicus, such as *N. pyramidalis* (Goldf., pl. clxxvi, 11).

these may be doubtful in some instances. It is evidently closely related to some of the species next to be described.

My own specimens of *N. Eudesii* are from Weldon, where it is by no means abundant.

139. NERINÆA WELDONIS, sp. nov. Plate XIV, figs. 3 *a*, 3 *b*, 4, and ? 5 (apical conditions).

Description:

Spiral angle (regular) . . .	12°—16°.
Height of whorl to width, average . .	1 : 1·4.
Approximate length . . .	45 mm.

Shell cylindro-conical, turrited. Whorls from fourteen to eighteen, moderately concave, the extreme depression being slightly anterior. The sutural belt is tolerably prominent, but in the narrower varieties (3 *a*) the posterior margin of each whorl constitutes the most marked prominence. Fine spiral lines may be traced on the apical whorls, two very slightly granulated ones showing a little above the others. These ornaments probably change with the age of the whorls, but the available specimens are for the most part much defaced. Columella ? hollow, with closed umbilicus.

The aperture is subquadrate. *Section* triplicate; one deep fold in the centre of the outer walls, the fold on the lower part of the columella very small, the fold in the posterior wall (upper columellar fold) deeply impressed.

Relations and Distribution.—Differs from *N. Eudesii* in the smaller spiral angle and less excavated whorl, although it undoubtedly approaches closely to the Lincolnshire Limestone variety of *N. Eudesii*, which may be regarded as forming the connecting link between *N. Weldonis* and the true Bathonian form. It also has affinities with some varieties of *Nerinæa oolitica*,[1] and probably with certain Bathonian Nerinæas described and figured by Cossmann from beds in the north and east of France.

Forms such as fig. 3 *a* and fig. 4 are abundant at Weldon, which is in the upper part of the Lincolnshire Limestone. These beds show some affinity to the Great Oolite, but less so than those of Great Ponton. Fig. 5 is believed to represent the apical conditions.

[1] There can be little doubt that these named forms are modifications, due to time and place, of other named forms, and that they pass into each other.

140. NERINÆA ZONOPHORA, sp. nov. Plate XIV, fig. 7.

Description :

Spiral angle (regular)	14°.
Height of whorl to width . . .	1 : 1·3.
Approximate length	50 mm.

Shell cylindro-conical, turrited. Number of whorls about fourteen, strongly concave, the principal depression median. Sutural carina prominent and extremely thick, the suture being in the centre of the carina. Columella ? hollow, with closed umbilicus. The apical whorls present fine and very slightly granulated spiral lines; two in the earliest whorls, and increasing to four, and possibly more, lower down. The *section* is triplicate, and differs but little from that of *N. Weldonis*.

Relations and Distribution.—Distinguished from *N. Weldonis* by the greater constriction of the whorls, which is median, and by the great thickness of the sutural belt; the whorls are longer and the spiral angle narrower than in *N. Eudesii.* It bears a certain resemblance to *N. tumentisutura*, Piette,[1] but the internal section is very different.

Rare in the Lincolnshire Limestone of Weldon.

141. NERINÆA SUBGLABRA, sp. nov. Plate XIV, fig. 8.

Description :

Spiral angle (nearly regular) . . .	12°—13°.
Height of whorl to width . . .	1 : 1·25.
Approximate length . . .	70 mm.

Shell cylindro-conical, subulate. Whorls probably fourteen, nearly flat; sutural varix not prominent, merely a rim on the posterior margins. The middle whorls are ornamented with four or five granulated spirals, which seem to die out gradually, the last two whorls being smooth. [The figured specimen shows the lines of growth in this portion of the shell.] Umbilicus closed; it is uncertain if columella be solid or not. *Section* triplicate, with one small anterior fold on the columella very low down.

Relations and Distribution.—Differs from such forms as Pl. XIV, fig. 6, in its greater smoothness of outline and freedom from turriting, and in some minor points. It approaches *N. Sharmanni*, Rig. and Sauv. ('Bathonien du bas Boulonnais,'

[1] See Cossmann, op. cit., p. 197, pl. xvii, figs. 49—51, where *N. tumentisutura*, though described in the text as a *Ptygmatis*, is figured as a triplicate *Nerinæa*.

p. 28, pl. ii, fig. 4), but M. Rigaux considers the differences too great for both to be placed under the same species. The figure (Pl. XIV, fig. 8) is composite. This form, and others not very dissimilar to it, are moderately abundant at Great Ponton. Some of these varieties may have been taken for *Nerinæa Voltzii*, which species I have not myself found, as yet, in any beds of the Lincolnshire Limestone.

142. NERINÆA cf. STRICKLANDI, *Morris and Lycett*, 1851. Plate XIV, fig. 9.

1851. NERINÆA STRICKLANDI, *M. and L.* Great Ool. Moll., p. 35, pl. vii, fig. 9.

Bibliography, &c.—The types, from the Stonesfield Slate on the borders of Minchinhampton Common, are fragmentary, and the character of the folds was unknown to the authors. The proportions of the whorls, moreover, are not quite the same as in the Lincolnshire Limestone fossil. Hence the identification is provisional.

Description :

Spiral angle (somewhat irregular) . .	10°.
Height of whorl to width (variable) . .	1 : 1·45.
Approximate length	110 mm.

Shell elongate, subulate, dimorphous. Whorls about twenty, flat, and increasing by steps, which become less salient and finally disappear. There is an irregularity in the development of the later whorls, some of which project more than others. Columella ? hollow ; umbilicus closed. The subapical whorls carry numerous fine spiral lines, which are slightly granulated ; the adult whorls are smooth.

Body-whorl short, smooth, and rather projecting; aperture subquadrate. *Section* triplicate, the anterior fold in the columella being low and very small, as in the two preceding species.

Relations and Distribution.—Specimens being fragmentary, no one specimen is available for showing all the characters. Fig. 9 is composite. The more apical portions have a strong resemblance to Morris and Lycett's figures, whilst the rest of the shell again reminds us of *N. Sharmanni*. From *N. subglabra* it is distinguished by its smaller spiral angle, more elongate form, and shorter whorls; also by the irregularity of its development, and the step-like character of the earlier whorls. Nevertheless, *N. Stricklandi* (as identified), *N. subglabra*, and the unnamed form (Pl. XIV, fig. 6) have an internal structure which is very similar, the columella apparently having been hollow with a closed umbilicus, whilst the anterior fold on the columella is low down and extremely small.

Not uncommon in the Lincolnshire Limestone at Great Ponton ; occurs also at Weldon.

143. Nerinæa, cf. pseudopunctata, *Cossmann*, 1884. Plate XIV, figs. 10 *a*, 10 *b*, 10 *c*.

Compare 1851. Nerinæa punctata, *Voltz*. Morris and Lycett, Great Ool. Moll., p. 35, pl. vii, fig. 10.
— 1884. Nerinæa pseudopunctata, *Cossmann*. Ét. Bathonien, p. 210, pl. i, figs. 18—20.

Bibliography, &c.—The type of Voltz and Bronn ('Jahrb.,' 1836, p. 559, pl. 6, fig. 23) is an Upper-Jurassic species from the "Portlandian" of the Haute-Saône. Mons. Cossmann considers that Morris and Lycett were in error in thus referring the Bathonian fossil, which he renamed *N. pseudopunctata*. The specimens from Great Ponton, whilst presenting many analogies with those from Minchinhampton, are more elongate, and apparently less disposed in steps. I am induced, therefore, to doubt the specific identity; but as the specimens from the Lincolnshire Limestone are much worn, a comparison of the ornaments cannot be instituted with certainty.

Description (partial).—The spiral angle is about 12° and regular; the whorls are short (1 : 1·5), and the approximate length about 90 mm. Shell conical-elongate. Whorls about twenty, the apical ones somewhat in steps, the later ones flat and without any turriting.

At an early stage (fig. 10 *c*) two granulated spiral lines occupy the space between the sutural varices, the lowest having the largest granules. In the next stage (fig. 10 *b*) there are three spirals, the middle one having the strongest granulations or tubercles; there are also finer intermediate lines not always visible. Some traces of the ornaments above described are noticed in the larger shells (fig. 10 *a*). The *section* is triplicate, and similar to that of the preceding species.

Relations and Distribution.—Differs from the Minchinhampton *N. punctata*, which has a spiral angle of 18°, in its more elongate form. The ornaments are well cut and almost like tubercles—not merely finely granulated lines, as is the case with most of the Nerinæas of the Inferior Oolite. Occurs sparingly at Great Ponton, where so many of the Gasteropoda resemble species from the Great Oolite.

144. Nerinæa, triplicate species. Plate XIV, fig. 11.

Specimens which may represent the apical conditions of the species referred to *N. Stricklandi* occur sparingly at Weldon, but the spiral angle is wider in this form. The granulations are finer than those of the *pseudopunctata*-group, and more like those of other species from the Inferior Oolite. The number of spirals is four. It probably represents apical conditions merely.

145. Nerinæa, cf. elegantula, D'Orbigny, 1850. Plate XIV, fig. 12.

1850. Nerinæa elegantula, *D'Orb.* Prodrome, i, p. 298.
1852. — — — Terr. Jurass, vol. ii, p. 88, pl. ccliii, figs. 5 and 6.

Description.—Spiral angle about 12°, length 22 mm. The number of whorls about fourteen, narrow, flat, and increasing by steps; the posterior margin of each whorl is occupied by a prominent belt, the suture lying in the depression immediately above. In the earlier whorls are two tuberculated spiral lines, the lower one being the stronger; these increase in number up to four, the one towards the centre having the largest tuberculations. *Section* triplicate. Rare at Great Ponton.

N.B.—This concludes the list of triplicate Nerinæas. The identification of the species from the upper beds of the Lincolnshire Limestone at Weldon and Great Ponton is far from satisfactory, and yet the fossils are too imperfect in the majority of cases for one to venture on making many new species. The forms clearly have Bathonian affinities, and yet are not exactly Bathonian species. The ornaments in two or three cases are more of the nature of tuberculations than is usual with species in the Inferior Oolite.

Section D (Quadriplicatæ).

146. Nerinæa cingenda, *Phillips*, 1829. Plate XIV, figs. 13 *a—f*, 14.

1829 and 1835. Turritella cingenda, *Sowerby.* Phillips, Geol. of Yorksh. Coast, p. 164, pl. xi, figs. 28 and 29.
1836. Nerinæa cingenda, *Phil.* Bronn, in Neues Jahrbuch for 1836, p. 558.
1875. — — — Geol. of Yorksh. Coast, 3rd edition, p. 258, pl. xi, figs. 28 and 29.
1884. — — — Hudleston, in Geol. Mag., dec. 3, vol. i, p. 110, pl. iv, figs. 3 and 4.

Description.—Since this species exhibits a considerable amount of dimorphism, both the proportions and external markings are subject to some variation.

Spiral angle (subapical) . . . 7°.

Height of whorl to width (mean about) . 1 : 1·25.
Approximate length . . . 100—140 mm.

Shell subcylindrical, turrited. Whorls numerous, and variable in relative proportions, but on the whole rather high. At first the sutural belt or carina is very prominent, and the whorl very concave (13 *b*). Presently the whorls are divided almost equally by a median belt, the anterior portion being excavated whilst the posterior portion is flat. Fine spiral lines with faint granulations are usually present, but appear to fail in the anterior whorls, where a considerable modification takes place, though, on the whole, the somewhat long whorl, the median varix, and the constricted anterior area are usually characteristic.

Available specimens rarely have a good aperture, and the actual body-whorl is seldom seen. Fig. 13 *a* shows a good aperture, with one wide fold rather below the centre of the outer wall, and two finer folds on the columella. It is probable, however, that this is not the real body-whorl, but merely the lowest whorl of an imperfect specimen.[1] The very small posterior fold on the outer wall may not have been developed in this particular case. The *section* is shown in figs. 13 *d* and 13 *e*, both from the Dogger of Blue Wyke. It may be described as triplicate to quadruplicate. The posterior fold on the outer wall is small, and not always present in every whorl of the same specimen. Fig. 14 represents a cast of a fragment of a large specimen from the ironstone of Irchester, where the posterior fold of the outer wall has been developed on one whorl and not on another.

Relations and Distribution.—In Yorkshire *Nerinæa cingenda* occurs abundantly in the upper part of the shell-bed towards the top of the Dogger at Blue Wyke, but has never yet been found in any part of the Dogger below that bed. It may also occur in the Millepore Bed, though I have not been able to identify it for certain.[2] From its proneness to dimorphism, and the variability of its internal section, it affords an excellent example of the instability of the genus, of which in Yorkshire it is the first representative. The two species, or sub-species, next described are its more immediate relatives.

As regards distribution in other parts of England, *N. cingenda* may usually be looked for on the Dogger-horizon in the counties of Lincoln, Rutland, and Northampton, although I only know of it myself in the last county. Many of the large casts in the Duston ironstone belong to this species. As we proceed south-westwards there seems to be an indication of it in the Inferior Oolite of Otley Hill. I have never seen genuine specimens from the Cotteswolds, although

[1] See *antea*, p. 195.

[2] Although I possess several interesting fragments from the Millepore-bed, one of which is a *Ptygmatis*, they are too imperfectly preserved for description. In the Scarborough Limestone, as is usual where a Cephalopod facies predominates, *Nerinæa* is hardly to be found.

the forms next described may be varieties, and the species described as *Longfordensis* (Pl. XIII, fig. 5) resembles it in the anterior constriction of the whorls.

147. Nerinæa, species or variety. Plate XIV, fig. 15.

Description.—From a fragment 20 mm. in length. Spiral angle about 5°. Shell cylindrical, turrited. Whorls moderately high with a deep median furrow, and separated by a wide suture; in the lower whorls a spiral line is seen in the furrow, but other ornaments, if any, are obliterated. *Section* triplicate or quadruplicate.

Relations and Distribution.—There may be a considerable amount of deception produced by mineralization in this case. This form possesses a certain degree of resemblance to the later stage of *N. cingenda*, such as fig. 13 *c*, but the central furrow occupies the position of the median belt in the Yorkshire species, hence I would give it the provisional term of "*pseudocingenda*." The specimen is of interest as coming from the Lower Limestone of the Cotteswolds near Holcombe Mill, which occupies a position below the Pea-grit and yet above the recognised *Opalinus*-zone.

148. Nerinæa subcingenda, sp. nov. Plate XIV, figs. 16 *a*, 16 *b*.

Description:

Spiral angle (regular) . . .	10°.
Height of whorl to width . . .	1 : 1·4.
Usual length	30—35 mm.

Shell cylindro-conical, strongly turrited. Whorls twelve to fourteen, much excavated anteriorly, flat and prominent posteriorly. Three spiral lines are conspicuous and rather wide apart in the anterior whorls; and finer intermediate spirals probably also exist. These decussate with lines of growth.

The body-whorl, in addition to the thin spiral raised lines, has a sharp anterior keel; the base is drawn out and ornamented with numerous fine spiral lines of rather unequal strength, partially decussating with lines of growth. Aperture rhomboidal, with a short and wide reflexed canal. *Section* unknown.

Relations and Distribution.—The peculiar mineralization of the Dogger fossils renders a close comparison almost impossible. This species or variety is of shorter habit and more conical than average specimens of *N. cingenda*, and the whorls are also shorter. There is also some difference in details of ornament, but the difference of mineralization may partly account for this. It is a good local variety, if not entitled to be regarded as a distinct species.

Rare in the Lincolnshire Limestone at Santon, but more common at Geddington Grange, where the specimens are usually weathered.

SECTION E.—Folds numerous, simple.

149. NERINÆA (? *Ptygmatis*) GUISEI, *Witchell*, 1880. Plate XV, figs. 1 *a—c*.

1880. NERINÆA GUISEI, *Witchell*. Notes on a Section of Stroud Hill, &c., Proc. Cottesw. Nat. Field Club, vol. for 1879-80, p. 128, pl. iv, fig. 2.
1887. — — — Proc. cit., vol. for 1887, p. 25.

Bibliography, &c.—In the original diagnosis Mr. Witchell says, "Columella with one fold, outer wall with two folds near the middle of the volution." Subsequently, having obtained better specimens, he described the species as possessing "two folds on the columella, two on the outer wall, and one on the posterior wall."

Description :

Spiral angle (regular) . . .	$3\frac{1}{2}°$.
Height of whorl to width about . . .	1 : 1.
Approximate length	150 mm.

Shell cylindrical, turrited. Whorls numerous, much excavated, and ornamented with closely-set fine spiral lines (rarely preserved, and probably not extending to the more mature whorls). The constriction of the whorls is slightly anterior, so that each sweeps up very sharply towards the raised anterior margin. Sutural girdles extremely prominent, sutural angle very oblique.

Aperture oblong, form and length of canal unknown. *Section*, five folds, with two wide but simple folds on the outer walls, two smaller V-shaped folds on the columella, and one small V-shaped fold on the posterior wall.

Relations and Distribution.—This singular and well-marked species appears to stand alone in the Inferior Oolite, and to be without near relations in any English beds. It is somewhat difficult to say whether it should be regarded as a *Nerinæa* or a *Ptygmatis*. The folds on the columellar side are small, so that the section is not deeply indented. The existence of species having the internal structure of *Nerinæa cingenda* and *Nerinæa Guisei* affords evidence of a bridge, as it were, between the triplicate *Nerinææ* and the more complex internal structure of *Ptygmatis*.

N. Guisei was first described from the *Clypeus*-grit of Rodborough Hill, where fragments are numerous, though well-preserved specimens are rare. North of these quarries no specimens have hitherto been discovered, but south of Rodborough it has been found at several localities, and always in the same part of the *Clypeus*-grit, *e. g.* (1) Road-side between Symonds Hall Hill and Wootton-under-Edge; (2) Horton Hill (Sodbury); (3) Freshford, in the Avon Valley; (4) Twerton Hill, near Bath; and (5) in the quarries about Radstock. At this latter locality, especially on Clan Down, *N. Guisei* occurs somewhat abundantly in the form of external casts. In this case the spiral lines have been well preserved, and we thus obtain an insight into the apical conditions of the shell.

It has already been indicated in the Introduction that Clan Down is the most southerly point whence specimens of the genus *Nerinæa* have hitherto been obtained from the Inferior Oolite, and it is worthy of remark that a form in many respects exceptional should be the first to reward the collector coming from the south.

SECTION F.—Folds numerous, complex.

150. NERINÆA (*Ptygmatis*) CAMPANA, sp. nov. Plate XV, figs. 2 *a*, 2 *b*.

Description:

Spiral angle (regular)	10°.
Height of whorl to width . . .	1 : 1·8.
Approximate length	65 mm.

Shell cylindro-conical, strongly turrited. Number of whorls about twenty-two, very short and deeply excavated anteriorly. The sutural carina, thick and prominent in the early stages, is sharp and even more prominent in the later ones, almost overhanging the preceding whorl. Ornaments unknown.

The *section* (fig. 2 *b*) is not perfectly clear, but the indications are those of a *Ptygmatis*, especially the large square-headed fold in the anterior portion of the outer wall.

Relations and Distribution.—Belongs to the more conical forms of the subgenus *Ptygmatis*, but easily separated from all by the salience of the sutural carinæ. It is just possible that a specimen figured by me from the Millepore-oolite of Whitwell, in Yorkshire ('Geol. Mag.,' dec. iii, vol. i, pl. iv, fig. 7), is a flattened representative of this species.

Rare in the Lincolnshire Limestone at Belmisthorpe, in company with *Ptygmatis Cotteswoldiæ*.

151. Nerinæa (*Ptygmatis*) pisolitica, *Witchell*, 1887. Plate XV, figs. 3 *a*—*c*, and Plate XVI, fig. 7.

1887. Nerinæa pisolitica, *Witchell*. Vol. cit., p. 32, pl. i, fig. 6.

Description:

Spiral angle	3°—5°.
Height of whorl to width . . .	1 : 1·25.
Approximate length . . .	80—200 mm.

Shell cylindrical, subulate. Whorls numerous, of moderate length, flat, sutural prominence scarcely marked. Assuming that fig. 3 *b* represents the apical conditions, there are numerous fine spiral lines in the earlier whorls, whilst the later ones appear to have been perfectly smooth.

In *section* the outer wall has two folds, the anterior of which is very large and complex; the posterior fold is small and flat-headed. On the columellar side the anterior fold is expanded and angulated, the middle fold is almost simple, the posterior fold is deep and bifurcated.

Relations and Distribution.—The internal structure easily distinguishes this species from any member of the *Oppelensis*-group, where the section exhibits seven folds; the whorls also are perfectly flat throughout, whilst in most of the members of the *Oppelensis*-group they are excavated, at least in the earlier stages.

It is described by Mr. Witchell as abundant in the pisolitic beds near Stroud, and at Longfords near Nailsworth. It occurs also in the Pea-grit at Crickley. There is a variety with rather shorter whorls, a rather wider spiral angle, and with the apical whorls slightly excavated, which occurs in a hard arenaceous rock about halfway between Seven Wells and Snow's Hill. This is said to be on the horizon of the Oolite Marl. Very long specimens showing the characteristic internal structure of *Ptyg. pisolitica* occur in the Inferior Oolite of Otley Hill (Mr. Walford's collection.) The fragment from Weldon (Pl. XVI, fig. 7) also greatly resembles this species, which, if this identification be correct, appears to possess a wide vertical range. The shell-bed at Weldon is undoubtedly high[1] in the Inferior Oolite series, but there is probably a mixture due to *remanié* forms.

[1] When I spoke of the Lincolnshire Limestone as being in the Lower Division of the Inferior Oolite an exception should have been made as regards the fossiliferous beds of Weldon and Great Ponton (see *antea*, p. 73).

152. Nerinæa (*Ptygmatis*) xenos, sp. nov. Plate XV, figs. 4 *a*, 4 *b*.

Description:

Spiral angle (regular)	4°.
Height of whorl to width (approximate) . .	1 : 1.

Shell cylindrical, slightly turrited. Whorls tolerably numerous, for the most part flat, but slightly constricted about three-fourths of the way down. The suture is situated in the middle of a sutural belt of moderate prominence, which becomes almost effete in the later whorls. Sutural angle oblique. The ornaments consist of numerous fine spiral lines, of which one, rather larger than the rest, occupies the hollow of the constriction; they seem to fade away in the later whorls.

The *section* shows five principal folds of a peculiar character. The anterior fold on the outer wall is much extended longitudinally; it is broad-headed, and develops slight subsidiary folds; the posterior fold is small and curved. Of the folds on the columellar side, the lowest is much extended longitudinally, the second is slight, the third (on the posterior wall) is narrow and deep.

Relations and Distribution.—The whorls are relatively higher than in *Ptyg. pisolitica*, and the peculiarly extended character of the lower folds of the section still further helps to differentiate it from that species, to which it is probably the most nearly allied. There seems also to be some slight differences of ornamentation, but the indications are obscure, even if they be of much specific value.

Ptyg. xenos is interesting as occurring on the lowest horizon of any *Nerinæa* yet discovered in the Cotteswolds. It is met with somewhat sparingly in the shell-bed below the Lower Limestone on Crickley Hill, which is on the border-land between the *Murchisonæ*- and the *Opalinus*-zone. Whether this species or *Nerinæa cingenda* is the oldest member of the genus in England remains yet to be determined; if the *Nerinæa*-bed of the Dogger is strictly on the Pea-grit horizon, as supposed by some, we must regard *Ptgy. xenos* as the oldest *Nerinæa* at present known in this country.

The following group of species has this much in common, viz. that each possesses, or is presumed to possess, an internal structure very similar to that of *Nerinæa Oppelensis*, Lycett. The section has seven folds, but although the folds are so numerous, they do not seem to restrict the space so much as is the case in some other species of *Ptygmatis* presently to be described. This group appears to be represented in the Bathonian of France by *Nerinæa bacillus*, D'Orb.

153. Nerinæa (*Ptygmatis*) bacillus, *D'Orbigny*, 1850. Plate XV, figs. 5 *a*, 5 *b*, 6 *a*—*c*, 7 *a*, and Plate XVI, fig. 12.

1850.	Nerinæa bacillus, *D'Orb.*		Prod., i, p. 298.
1852.	— — —		Ter. Jurass., ii, p. 84, pl. cclii, figs. 3—6.
1884.	— (*Ptygmatis*) bacillus, *D'Orb.*		Cossmann, Ét. Bath., p. 196, pl. i, figs. 25 and 26, and pl. xi, fig. 18.

Bibliography, &c.—The specimens from the Bathonian of Marquise figured by D'Orbigny are represented as having a whorl whose height and width are about equal. It is on the supposition that these figures are correct that the following comparisons are founded, as no measurements are given in the text of the *Paléontologie Française*. In our Inferior Oolite there are varieties of a species so closely resembling the *Nerinæa bacillus* of the *Terrain Jurassique* that I can hardly venture to give it a different name.

General Description:

Spiral angle . . .	3°—4°.
Height of whorl to width . .	from 1 : 1 to 1 : 1·1
Length estimated up to . .	150 mm.

Shell cylindrical and greatly elongated. Whorls numerous, about as high as wide, excavated, the chief constriction being rather below the centre and slightly increasing with age. Sutural belt prominent. In the young and the median stage the whorls are ornamented with about six spiral lines, which are somewhat unequally distributed, but, as is often the case, these have a tendency to disappear with age.

The *section* shows seven folds more or less complex (see figs. 5 *b*, 6 *b*, and 6 *c*), but the posterior fold on the columellar side, *i. e.* the fold on the posterior wall, is simple and very slight, and scarcely to be seen in some of the volutions. The two anterior folds on the outer wall extend about halfway up, and are flat-headed with two projections. The posterior fold on this side is at some distance from these, and is also flat-headed with two projections. The anterior fold on the columella is large, deep, and bifid, in some cases with three angles; the second fold is narrow and slightly bifid; the third is deep and very strongly bifid.

Relations and Distribution.—The interior structure differs but slightly from the description given by D'Orbigny of *N. bacillus*, and is very similar to that of *N. Oppelensis* presently to be described. Such differences as do exist may be partly the result of the conditions of preservation. Our Inferior Oolite varieties of *Ptygmatis bacillus* may be distinguished from *Ptyg. Oppelensis* by the greater length of the whorls, and by the absence of dimorphism; and from *Ptyg. Jonesii* by the absence of dimorphism and the more regular excavations of the whorls.

A variety, which may be known as "*Carnicotensis*" (figs. 5 *a* and 5 *b*), represents in part the earlier stages of the species. This form is not uncommon in the *Clypeus*-grit horizon of the neighbourhood of Radstock. A very cylindrical variety occurs in the upper *Nerinæa*-bed at Little Ponton (fig. 6 *a*), at Weldon (fig. 6 *b*), and in the highest part of the Freestone Series at Crickley (fig. 6 *c*). This may be known as var. "*cervicula.*" There is a third variety (fig. 7 *a*), which I would describe as var. "*crassicincta*" from the great thickness of the sutural belt; the whorls also are not quite so high. This occurs in the Pea-grit of Nailsworth Hill. The *section* is somewhat obscure, but is evidently on the same plan as in *Ptyg. bacillus* and *Ptyg. Oppelensis.* This form may ultimately prove to be worthy of stronger distinction. But, accepting it as a representative of the species now under description, we obtain a wide range from the Pea-grit to the *Clypeus*-grit. The case is exceptional, as there are but few species of *Nerinæa* which can be regarded as common to the upper and lower divisions of our Inferior Oolite. If I have been mistaken in referring our Inferior Oolite species to *Ptyg. bacillus,* I would propose for it the name of *Ptygmatis cervicula,* the two other names to stand as varieties.

154. Nerinæa (*Ptygmatis*) Jonesii, *Lycett*, 1857. Plate XV, figs. 9 *a*—*c*.

1857. Nerinæa Jonesii, *Lycett.* Cotteswold Hills, p. 124, pl. ii, fig. 4.
1887. — — — Witchell, vol. cit., p. 25.

Bibliography, &c.—Owing to the interior of the type specimen being filled with spar, there is no chance of getting a section. Hence Witchell (op. cit., p. 25) places *N. Jonesii* in the unclassified group. There can be little doubt that it is a true *Ptygmatis,* though its excessive dimorphism causes the fragments to be difficult of identification, as the two parts seldom occur on the same specimen.

Description:

Spiral angle (approximate)	4°—5°
Height of whorl to width nearly as	1 : 1.
Approximate length	150 mm.

Shell cylindrical, elongated, very dimorphous. Whorls about as high as wide. The posterior whorls are excavated and much thickened posteriorly, so as to form a strong sutural belt. The salience of this belt diminishes, the elevation of the whorls becomes less, and ultimately the whorls become quite flat and without any marked sutural prominence.

The *section* of the type is unknown; a specimen from the Pea-grit of Longfords, showing the posterior half (fig. 9 *c*), gives indications of a structure on the *bacillus* or *Oppelensis* plan. A section of the anterior half (fig. 9 *b*) gives faint indications of a similar character.

Relations and Distribution.—Owing to the fact that the two portions of this very dimorphous form are rarely found in one piece, a degree of uncertainty hangs about the species. Posteriorly its relations with *Ptyg. bacillus* are intimate, but the anterior portion is quite different. From *Ptyg. Oppelensis* it is separated by the height of the whorls and by its more elongate habit.

Rare in the Freestone, Nailsworth, and in the Pea-grit at Longfords.

A specimen from the Lincolnshire Limestone of Wakerly (figs. 8 *a* and 8 *b*), which I temporarily designate as *Ptygmatis* "*baccilloides*," reminds us of the posterior portion of *Ptyg. Jonesii*, though the whorls are a little shorter.

The section of the Wakerly fossil seems to be on the *bacillus-Oppelensis* plan, but it possesses considerable peculiarities of its own, which at present require the confirmation of other specimens.

155. Nerinæa (*Ptygmatis*) Oppelensis, *Lycett*, 1857. Plate XV, figs. 11 *a*—*e*.

1857.	Nerinæa Oppelensis, *Lycett*.	Cotteswold Hills, p. 123, pl. ii, figs. 6, 6 *a*.
1887.	— — —	Witchell, vol. cit., p. 30, pl. i, fig. 3, 3 *a*.

Bibliography, &c.—Originally described from a fragment found in the Oolite Marl of Selsley Hill. Witchell considered the section shown by Lycett to have been much worn. Accordingly he substituted another, which is again figured (fig. 11 *e*). This figure, he says, occurs with slight variations in four Inferior Oolite species. This number may be increased.

Description:

Spiral angle (mean)	6°.
Height of whorl to width . . .	1 : 1·4.
Approximate length	80 mm.

Shell conical to cylindrical, dimorphous. The spire has a bluntish apex, and the apical angle is nearly double the mean spiral angle, so that the general angle is very obtuse. Whorls twenty-five and upwards, short, with indications of spiral ornament in the earlier stages. The apical whorls are deeply excavated, the spiral belt being thick and prominent. These features gradually soften down until we reach the stage described by Lycett, where the whorls are "slightly tumid at the junctions," and the excavation is but slight. In specimens from the marly Limestone of Swift's Hill and Longridge, and in specimens from the Pea-grit horizon of Longfords (fig. 11 *d*), which are better preserved than those from Selsley Hill, a third stage is noted. The excavation of the whorls and the sutural prominence disappear, and the whorls become flat or very nearly so.

The body-whorl is short and angular, with an excavated base; aperture nearly square, with a short canal. In complete specimens possessing the true body-whorl there are no signs of folds either on the columella or lip.

The *section* is very complex; it has seven folds. Fig. 11 *e* (Mr. Witchell's type) may be regarded as showing the plan most completely. Fig. 11 *c* exhibits a somewhat curious divergence. The *section* of *Ptyg. Oppelensis* differs in no material respect from the *sections* of *Ptyg. bacillus* (figs. 5 *b* and 6 *c*) already described. The three angles in the head of the anterior columellar fold, mentioned by D'Orbigny as one of the characters of *Ptyg. bacillus*, are noticeable in Mr. Witchell's specimen, and also in the specimen of *Ptygmatis bacillus* (fig. 6 *c*) from the Upper Freestones of Crickley.

Relations and Distribution.—*Ptyg. Oppelensis* is a somewhat aberrant member of the *bacillus*-group. From D'Orbigny's species it is easily distinguished by the shortness of the whorls, the obtuse-angled subconical spire, and by its marked dimorphism. It has already been indicated in what way it differs from *Ptyg. Jonesii.*

The distribution of this species is somewhat local. The Pea-grit of Longfords, the Oolite Marl horizon of Selsley Hill, and, further north, of Swift's Hill and Longridge, are the only localities where it has been identified with certainty. There are so many species which possess this internal structure that strict identification is out of the question without reasonably good specimens. The fossil from the Lincolnshire Limestone of Wakerly (figs. 8 *a* and 8 *b*) has already been mentioned in this connection under *Ptygmatis Jonesii.*

156. NERINÆA (*Ptygmatis*) PRODUCTA, *Witchell*, 1887. Plate XV, figs. 10 *a*—*c*.

1887. NERINÆA PRODUCTA, *Witchell.* Vol. cit., p. 34, pl. i, fig. 13.

Description:

Spiral angle (regular) . .	3°.
Height of whorl to width .	1 : 1.
Estimated length . . .	150—200 mm.

Shell cylindrical, very narrow. Whorls about twenty-five, flat, sometimes higher than wide, in other cases slightly the reverse; suture without prominence and close-fitting; angle oblique. Faint traces of spiral ornament on the early whorls, later ones perfectly smooth. The only salience throughout the long and narrow spire is a slight spiral band on the posterior margin of each whorl.

Body-whorl smooth, angular, elongate; aperture oblong, with a canal rather long for the genus and slightly deflected. *Section* shows seven folds, arranged on the *bacillus*- or *Oppelensis*-plan.

Relations and Distribution.—In its narrow cylindrical outline and in the relative height of the whorls this species resembles *Ptyg. bacillus*, from which it is separated by the complete flatness of the whorls and the absence of any prominence at the sutures. Rare in the Pea-grit of Longfords.

157. Nerinæa (*Ptygmatis*) consobrina, *Witchell*, 1887.

1887. Nerinæa consobrina, *Witchell.* Vol. cit., p. 33, pl. i, figs. 10, 10 *a*.

As I have not seen the type, and never found a specimen which answers to this description, the species is inserted on the authority of Mr. Witchell alone.

He says that it differs very little in its internal structure from *N. Oppelensis*, but it has a more conical figure and the whorls are higher. Found at Longfords in the Pisolite.

158. Nerinæa (*Ptygmatis*) velox, *Witchell*, 1887. Plate XVI, fig. 1.

1887. Nerinæa velox, *Witchell.* Vol. cit., p. 34, pl. ii, fig. 3.

Description:

Spiral angle (slightly obtuse) . . .	10°.
Height of whorl to width . . .	1 : 1·5.
Average length	75 mm.

Shell cylindro-conical, dimorphous. Whorls about thirty, of which the posterior two-thirds are deeply excavated and much thickened at the sutures. Ultimately the whorls become flat and without any sutural prominence. The whorls are extremely short, and no trace of spiral ornament has been detected in the specimens, though it is probable that the posterior whorls of the spire were spirally striated.

The aperture is nearly square, with a short and not very reflexed canal. *Section*, seven folds, identical with that of *Ptyg. Oppelensis*.

Relations and Distribution.—From *Ptyg. Oppelensis* this species differs in its more conical form, and in the excessive flatness of the anterior whorls. Rare in the Oolite Marl horizon of Swift's Hill and Longridge.

159. NERINÆA (*Ptygmatis*) STROUDIENSIS, *Witchell*, 1887. Plate XVI, figs. 2 *a*, 2 *b*.

1887. NERINÆA STROUDIENSIS, *Witchell*. Vol. cit., p. 33, pl. i, fig. 9.

Description:

Spiral angle (slightly obtuse) . . .	8°.
Height of whorl to width . . .	1 : 1·4.
Length of full-sized specimen . . .	85 mm.

Shell cylindro-conical, turrited, scarcely dimorphous. Whorls about twenty-five, short and excavated towards the apex, and with a very thick sutural prominence. Lower down the whorls become almost flat and angular, increasing by steps. In some cases the anterior whorls are themselves slightly excavated. Traces of spiral ornament are observable in the earlier whorls (see enlargement of fig. 2 *b*). The *section* shows seven folds on the *Oppelensis* type.

Relations and Distribution.—Rather more conical than *Ptyg. Oppelensis*, this species further differs in the step-like character of the anterior whorls. *Ptygmatis velox*, as we have seen, varies from *Ptyg. Oppelensis* in an opposite direction. Internally all three are closely related, and some might be disposed to regard them as varieties of one species.

Rare in the marly Limestone of Swift's Hill and Longridge.

This terminates the *Oppelensis*-group.

160. NERINÆA (*Ptygmatis*) COTTESWOLDIÆ, *Lycett*, 1857. Plate XVI, figs. 3 *a*—*d*, and var. CONICA, *Witchell*, figs. 4 *a*, *b*, and ? 4 *c*, *d*.

1857. NERINÆA COTTESWOLDIÆ, *Lycett*. Cotteswold Hills, p. 124, pl. ii, fig. 2.

Description:

Spiral angle (regular) . . .	10°.[1]
Height of whorl to width . . .	1 : 1·75.
Full length	80—100 mm.

Shell cylindro-conical, slightly dimorphous, apex acute. Whorls from twenty to twenty-five, extremely short and flat, except towards the apex, where a few of the earlier whorls exhibit considerable sutural prominence, but there is much variety in this respect. The anterior whorls are flat or only very slightly excavated, and there is little or no prominence at the sutures, beyond traces of a

[1] The spiral angle varies considerably, and is usually below 10° in specimens from the Lincolnshire Limestone.

posterior marginal rim. No signs of spiral ornamentation have as yet been detected, though we should expect fine spiral lines in the apical whorls.

The body-whorl is short, flat or scarcely hollowed, and angular. The aperture is subrhomboidal, and where the specimens are complete or nearly so (fig. 3 *a*) there is no trace of the folds which are so conspicuous in the section of the spire.[1] Canal short and moderately reflexed. The *section* exhibits six folds, some of which are very complex. On the outer wall the anterior fold is very wide, and has three or four small angular indentations, whilst the posterior fold is small and deep, but almost simple. Of the three folds on the columella the lower one is the largest and square-headed; the fold on the posterior wall occupies a large space and bifurcates unequally. Altogether the space for the animal in the whorls of the spire must have been excessively small, and specimens, especially from the Lincolnshire Limestone, when cut longitudinally, exhibit very whimsical figures. There are indications, however, that this system underwent modification in the later whorls, and that possibly it was non-existent in the body-whorl. But other interpretations of these appearances have been suggested.

Var. CONICA, *Witchell.*

1887. NERINÆA CONICA, *Witchell.* Op. cit., p. 30, pl. i, fig. 2.

Description:

Spiral angle	13°.
Height of whorl to width . . .	1 : 1·85.
Length	75 mm.

In the apical whorls there is a thick sutural prominence, which gradually passes off into a step-like increase of the anterior whorls (well seen in figs. 4 *a* and 4 *b*), which are short and flat, and without ornament. The type specimen (fig. 4 *a*) did not enable Mr. Witchell to ascertain the internal structure of his "*Nerinæa conica*," but specimens since obtained by myself (fig. 4 *b*) show that the section is practically identical with that of *Ptygmatis Cotteswoldiæ*, from which it is distinguished by its more conical figure and by the strap-like arrangement of the lower whorls. The forms 4 *c* and 4 *d* represent short conical specimens of *Ptygmatis Cotteswoldiæ* without the strap-like arrangement of the anterior whorls, characteristic of the var. *conica*. Such specimens are very abundant in the Oolite-Marl horizon of Longridge, and may possibly be regarded as abraded specimens of the var. *conica*. At all events, they are short conical varieties of *Ptyg. Cotteswoldiæ* with very short whorls.

Relations and Distribution.—The peculiar internal character serves to dis-

[1] This seems to have been the case with other species of *Nerinæa*. See remarks, p. 195.

tinguish *Ptygmatis Cotteswoldiæ* from any species hitherto described in this Monograph, but it has affinities with some of the species that follow. The group of which it is the type is characterized by very short whorls, which are flat and unornamented in the anterior stage, and by a very restricted and whimsical section. Specimens from the Pea-grit and from the Lincolnshire Limestone are, as a rule, narrower than those from the Oolite-Marl horizon of the Cotteswolds.

This species and its varieties are widely distributed, both vertically and horizontally, but especially on the Oolite Marl horizon of the Cotteswolds. In the Lincolnshire Limestone it occurs in the lower bed of Little-Ponton cutting, at Wakerly, Belmisthorpe, and Geddington, and at the slate-pits of Kirby and Dene Lodge, and probably at many other places. Of late a more cylindrical variety, with some difference of internal structure, has been found in considerable numbers in the lower beds of the Lincolnshire Limestone at Hungerton Hall. On the other hand, the upper beds of the Lincolnshire Limestone show but doubtful traces, and in the Great-Ponton cutting there are none.

161. Nerinæa (*Ptygmatis*), species or variety. Plate XVI, fig. 6.

The spiral angle is about 14°, the relative height of the whorls the same as in *Ptyg. Cotteswoldiæ.* The whorls are slightly excavated, and the sutural prominence is the most conspicuous at the base of each whorl, which causes it to overhang the surrounding one. The internal structure only differs from *Ptyg. Cotteswoldiæ* in the presence of an incipient additional fold on the upper part of the columella.

This form diverges from Lycett's species more widely than the var. *conica*, and to a certain extent in an opposite direction. But it may have been a diseased or abnormal individual. A single specimen from the marly Limestone, Swift's Hill.

162. Nerinæa (*Ptygmatis*) Santonis,[1] sp. nov. Plate XVI, figs. 8 *a*—*c*.

Description:

Spiral angle (regular)	8°.
Height of whorl to width . . .	1 : 1·4.
Length	70—100 mm.

Shell cylindro-conical, slightly dimorphous. Whorls twenty to twenty-two in well-grown specimens. The subapical whorls are flat, and this portion of the

[1] *N. Santonensis*, D'Orb. (T. J., vol. ii, p. 156), is a "Portlandian" species of *Nerinæa.*

PLATE XII.

Fig.

1 *a*, 1 *b*. *Cerithinella Bajocensis*, sp. nov. "*Sowerbyi*-bed,"[1] Bradford Abbas. My Collection. (Page 186.)

2. *Cerithinella Bajocensis*, var. *drosera*. *Murchisonæ*-zone, Bradford Abbas. My Collection.

3. *Cerithinella Bajocensis*, var. *melitta*. Beaminster district. My Collection.

4 *a*. *Cerithinella Brodiei*, sp. nov. Freestones, Leckhampton. Brodie Collection. (Page 187.)

4 *b*. *Cerithinella Brodiei*, ? early stage. I. O., Nailsworth. Jermyn Street Museum.

5. *Cerithinella*, species or variety. Stoford. My Collection.

6 *a*. *Pseudalaria Etheridgii*, Tawney, in matrix. 6 *b*. Detached specimen. 6 *c*. Longitudinal section. "*Sowerbyi*-bed," Bradford Abbas. My Collection. (Page 189.)

7. *Pseudalaria Etheridgii*, var. from Beaminster district. My Collection.

8. *Pseudalaria granosa*, sp. nov. *Murchisonæ*-zone, Burton Bradstock. My Collection. (Page 190.)

9. *Pseudalaria jugosa*, Bean. Dogger, Blue Wyke. Bean Collection, British Museum. (Page 190.)

10. *Aptyxiella subconica*, sp. nov. *Parkinsoni*-zone, Over Harford. 11. Section of specimen from *Parkinsoni*-zone, Aston. My Collection. (Page 191.)

x. ? *Cerithinella* (the *Nerinæa cingenda*, Sow., *non* Phil. of the Leckenby Collection). Dogger, Blue Wyke.

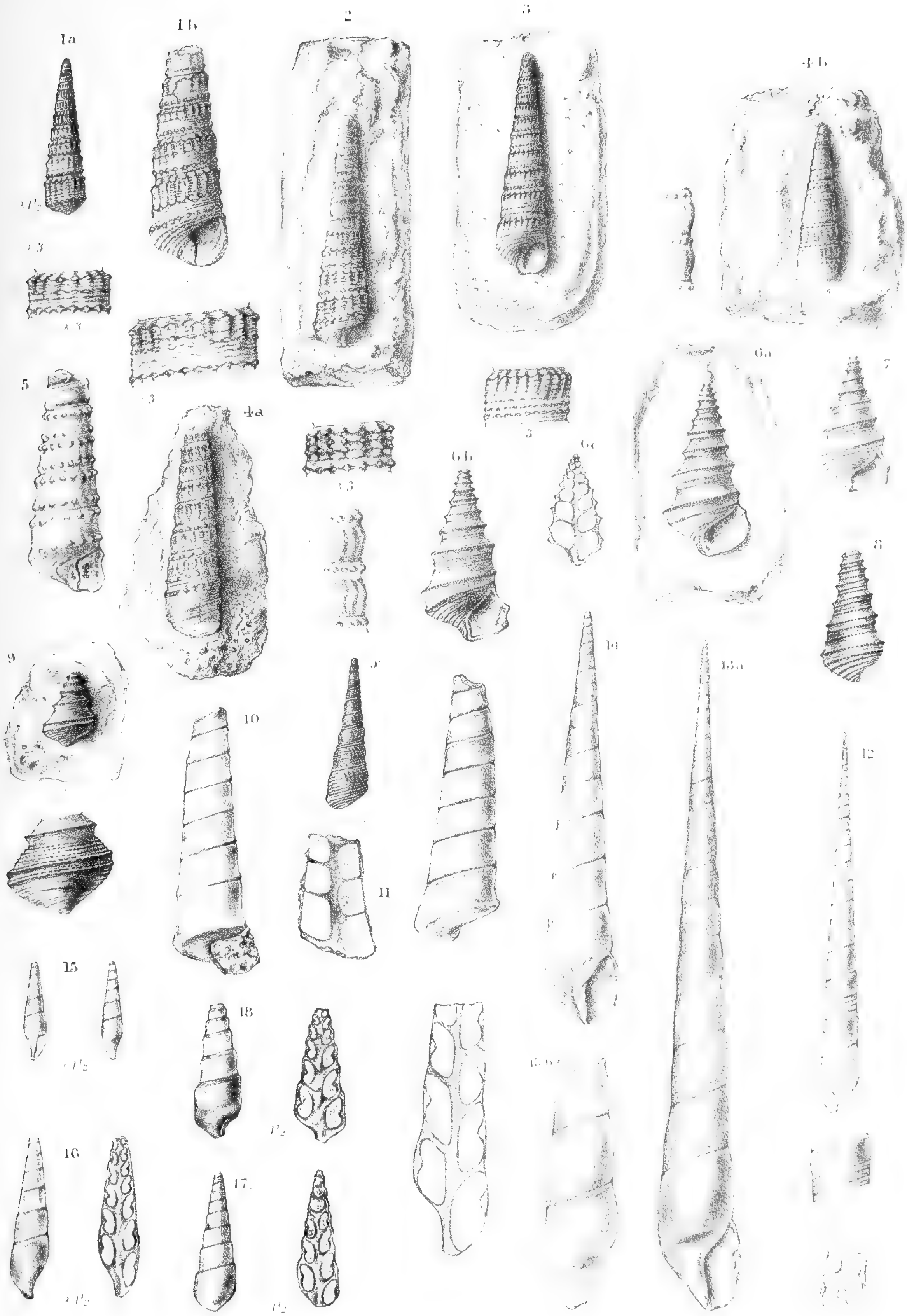
12. *Nerinella gracilis*, Lycett, slender variety. Oolite Marl, Longridge. My Collection. (Page 196.)

13 *a* *Nerinella gracilis*, Lycett; type refigured. Oolite Marl, Nailsworth. Jermyn Street Museum. 13 *b*. The same. Oolite Marl, Longridge. My Collection. (Page 196.)

14. *Nerinella conoidea*, sp. nov. Oolite Marl, Longridge. My Collection. (Page 197.)

15. *Nerinella* (A 1). 16. *Nerinella* (A 2). 17. *Nerinella* (A 3). 18. *Nerinella* (A 4). Lincolnshire Limestone, Weldon. My Collection. (Page 197.)

[1] As it is now generally admitted that this appellation is inapplicable, the so-called "*Sowerbyi*-bed" will in future be quoted as the "*concavus*-bed" or "*concavus*-zone." See p. 44 of this Monograph.



Foord del. et lith.

PLATE XIII.

FIG.

1. *Nerinella* (B 1). 2. *Nerinella* (B 2). Lincolnshire Limestone, Weldon. My Collection. (Page 198.)

3. *Nerinæa parva*, Witchell. Oolite Marl, Longridge. My Collection. (Page 199.)

4 *a*, 4 *b*, 4 *c*. *Nerinæa oolitica*, Witchell. Specimens showing different stages of growth. Oolite Marl, Longridge. My Collection. (Page 199.)

5. *Nerinæa Longfordensis*, sp. nôv. Pea-grit (upper bed), Longfords. My Collection. (Page 200.)

6 *a*. *Nerinæa attenuata*, Witchell (usual form). Oolite Marl, Longridge. My Collection. (Page 201.)

6 *b*. *Nerinæa expansa*, sp. nov. Lincolnshire Limestone, Wakerly. My Collection. (Page 201.)

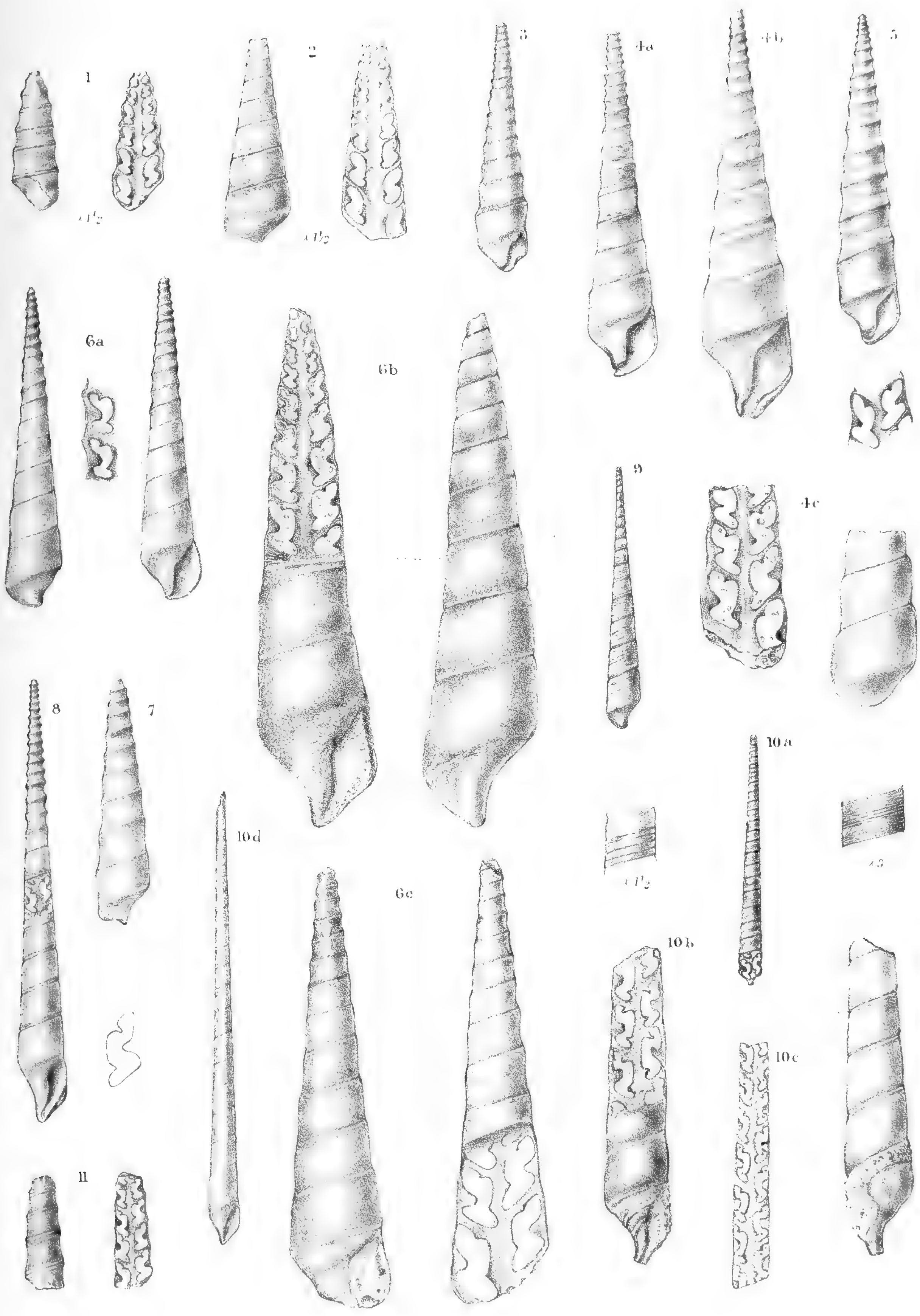
6, 7. *Nerinæa*, varieties of *N. oolitica* or *expansa*. Oolite Marl, Longridge. My Collection.

8. *Nerinæa deducta*, sp. nov. Pea-grit, The Knap. My Collection. (Page 202.)

9. *Nerinæa pseudocylindrica*, D'Orb. (*fide* Lycett). Oolite Marl, Longridge. My Collection. (Page 203.)

10 *a*. *Nerinæa altivoluta*, Witchell. Specimen showing the apical condition. Pea-grit (upper bed), Longfords. 10 *b*. The same. Fragment showing aperture. Lincolnshire Limestone, Weldon. 10 *c*. The same. Section of a fragment. Pea-grit, Crickley. 10 *d*. The same (in this case the apical ornaments are presumed to have been obliterated). Pea-grit, Longfords. My Collection. (Page 203.)

11. *Nerinæa*, fragment of species, ? allied to *pseudocylindrica*. Lincolnshire Limestone, Weldon. My Collection. (Page 203.)



S. Foord del. et lith.

Mintern Bros. imp.

PLATE XIV.

FIG.

1. *Nerinæa Hudlestoniana*, Witchell. Oolite Marl, Swift's Hill. Witchell Collection. (Page 204.)

2 *a*. *Nerinæa Eudesii*, Morris and Lycett. Lincolnshire Limestone, Weldon. 2. The same. Fragment from the Great Oolite for comparison. My Collection. (Page 205.)

3 *a*, 3 *b*. *Nerinæa Weldonis*, sp. nov. Lincolnshire Limestone, Weldon. My Collection. (Page 206.)

4. *Nerinæa Weldonis*, wide-angled variety. 5. ? Apical conditions of the same. Lincolnshire Limestone, Weldon. My Collection.

6. *Nerinæa*, ? variety of *N. expansa*. Lincolnshire Limestone, Great Ponton. My Collection. (Page 202.)

7. *Nerinæa zonophora*, sp. nov. Lincolnshire Limestone, Weldon. My Collection. (Page 207.)

8. *Nerinæa subglabra*, sp. nov. Lincolnshire Limestone, Great Ponton. My Collection. (Page 207.)

9. *Nerinæa* cf. *Stricklandi*, Morris and Lycett. Lincolnshire Limestone, Great Ponton. My Collection. (Page 208.)

10 *a*. *Nerinæa* cf. *pseudopunctata*, Cossmann. 10 *b*, 10 *c*. Apical conditions of the same. Lincolnshire Limestone, Great Ponton. My Collection. (Page 209.)

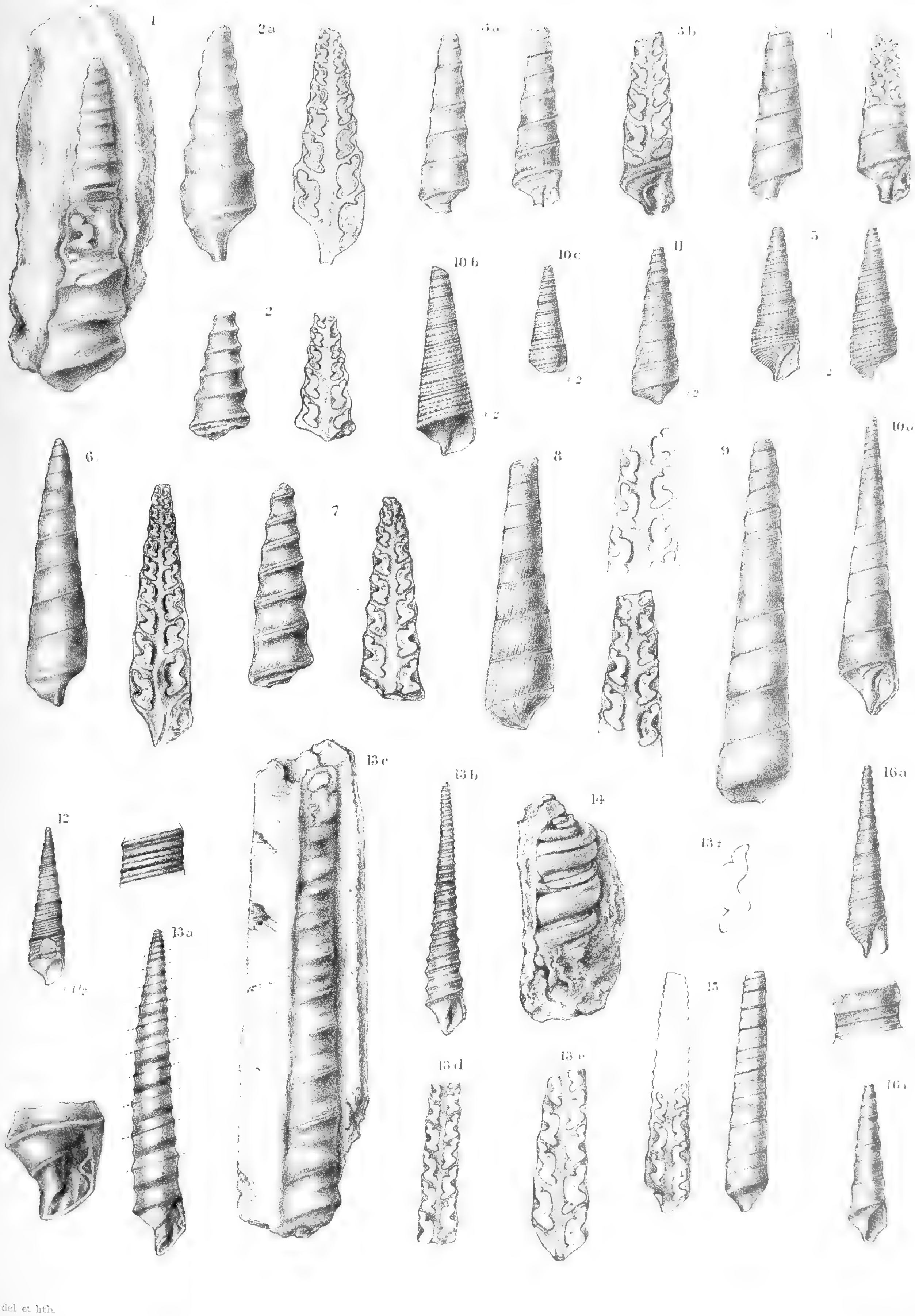
11. *Nerinæa* species, apical conditions. Lincolnshire Limestone, Weldon. My Collection. (Page 209.)

12. *Nerinæa* cf. *elegantula*, D'Orbigny. Lincolnshire Limestone, Great Ponton. My Collection. (Page 210.)

13*a*, 13 *b*. *Nerinæa cingenda*, Phillips. Dogger, Blue Wyke. Leckenby Collection. 13 *c*, *d*, *e*, *f*. The same. Dogger, Blue Wyke. My Collection. 14. The same. Cast from the Northampton Sand of Irchester. Crick Collection. (Page 210.)

15. *Nerinæa* "*pseudocingenda*." Lower Limestone, Holcombe Mill. My Collection. (x2). (Page 212.)

16 *a*. *Nerinæa subcingenda*, sp. nov. Lincolnshire Limestone, Santon. Jermyn Street Museum. 16 *b*. The same. Lincolnshire Limestone, Geddington. My Collection. (Page 212.)



A. S. Foord del. et lith.

PLATE XV.

Fig.

1 *a*. *Nerinæa* (*? Ptygmatis*) *Guisei*, Witchell. 1 *c*. Section of another specimen, both from the *Clypeus*-grit of Rodborough. 1 *b*. The same. Figure made up of two specimens from *Parkinsoni*-zone of Clan Down, near Radstock. My Collection. (Page 213.)

2 *a*. *Ptygmatis campana*, sp. nov. Lincolnshire Limestone, Belmisthorpe. 2 *b*. Section of a fragment from same place. My Collection. (Page 214.)

3 *a*. *Ptygmatis pisolitica,* Witchell. Pea-grit, Longfords. 3 *b*. The same, showing apical conditions. Pea-grit, Crickley. 3 *c*. The same. Fragment of adult shell, with section. Pea-grit, Longfords. My Collection. (Page 215.)

4 *a*. *Ptygmatis xenos,* sp. nov., fig. ×2. 4 *b*. The same. Section of a fragment, natural size. Shell-bed below Lower Limestone, Crickley. My Collection. (Page 216.)

5 *a*. *Ptygmatis bacillus*, D'Orbigny. Figure composed of two squeezes, the apical portion from Red Post Quarry, the other from Carnicot; both from the *Parkinsoni*-zone of the Radstock District. 5 *b*. The same. Section of partly dissolved shell fragment. Carnicot, ×2½. My Collection. (Page 217.)

6 *a*. *Ptygmatis bacillus*, var. *cervicula*. Little Ponton cutting (upper *Nerinæa*-bed). 6 *b*. The same. L. L., Weldon. 6 *c*. Section of ? same species, top of Freestones, Crickley, ×1½. My Collection. (Page 218.)

7 *a*. *Ptygmatis bacillus*, var. *crassicincta*. Pea-grit, Nailsworth Hill. 7 *b*. Section of same specimen. My Collection. (Page 218.)

8 *a*. *Ptygmatis* "*bacilloides*." Lincolnshire Limestone, Wakerly. 8 *b*. Section of same specimen. My Collection. (Page 219.)

9 *a*. *Ptygmatis Jonesii*, Lycett; type refigured. "Freestone, Nailsworth." Jermyn Street Museum. 9 *b*. The same. Fragment of lower portion. Pea-grit, Longfords. My Collection. 9 *c*. ? The same, showing sub-apical conditions. Upper Pisolite of Longfords. My Collection. (Page 218.)

10 *a*. *Ptygmatis producta*, Witchell, with section. 10 *b*. The same, showing earlier conditions. Both from Pea-grit of Longfords. My Collection. 10 *c*. The same; type refigured. Pea-grit, Longfords. Witchell Collection. (Page 220.)

11 *a*. *Ptygmatis Oppelensis*, Lycett. Oolite Marl, Selsley. Witchell Collection. 11 *b*. The same. Oolite Marl, Swift's Hill. 11 *c*. Section of the above. 11 *d*. The same. Pea-grit, Longfords. My Collection. 11 *e*. Section of specimen from Swift's Hill. Witchell Collection. (Page 219.)

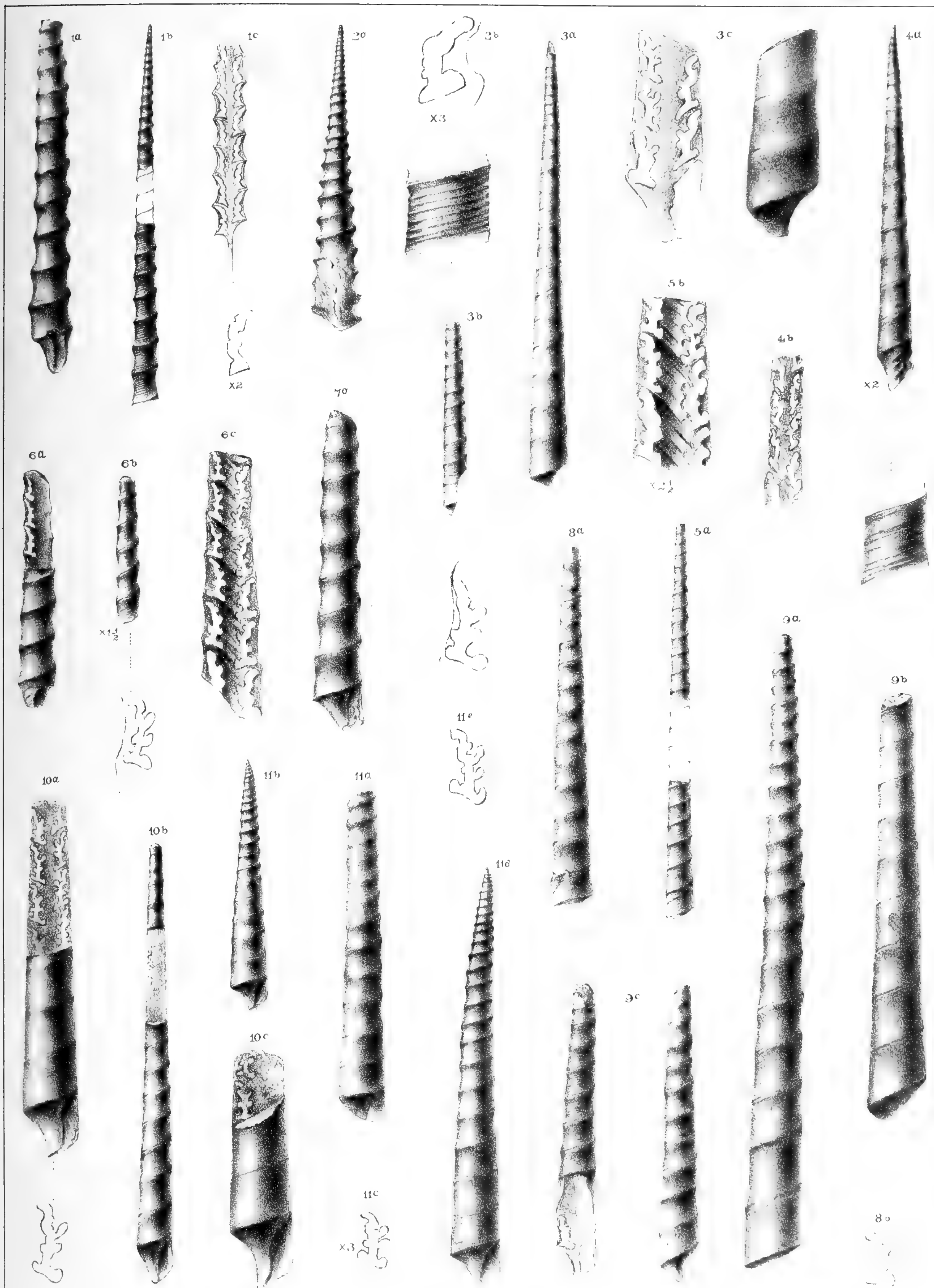

1a
1b
1c
2a
2b
x3
3a
3c
3b
x2
4a
5b
4b
x2
6a
6b
6c
7a
x1½
8a
5a
9a
9b
11e
10a
11b
11a
10b
11d
10c
9c
11c
x3
8b

PLATE XVI.

Fig.

1. *Ptygmatis velox*, Witchell. Oolite Marl, Longridge. My Collection. (Page 221.)

2 *a*. *Ptygmatis Stroudiensis*, Witchell. Oolite Marl, Longridge. 2 *b*. The same, Swift's Hill. My Collection. (Page 222.)

3 *a*, 3 *b*. *Ptygmatis Cotteswoldiæ*, Lycett. Pea-grit, Longfords. 3 *c*. The same. Fragment showing natural section. Lincolnshire Limestone, Dene. 3 *d*. The same. Lincolnshire Limestone, Belmisthorpe. My Collection. (Page 222.)

4 *a*. *Ptygmatis Cotteswoldiæ*, Lycett, var. *conica*, Witchell; type refigured. Oolite Marl, Swift's Hill. Witchell Collection. 4 *b*. The same, showing section of interior. Oolite Marl, Longridge. 4 *c* and 4 *d*. Possibly the same, with worn surface—a common form in the Oolite Marl, Longridge. My Collection. (Page 223.)

5. Specimen of *Ptygmatis* with the aperture and canal well preserved. Oolite Marl, Longridge. My Collection. N.B.—This probably represents the true form of aperture in this group.

6. *Ptygmatis*, species or variety. Oolite Marl, Swift's Hill. My Collection. (Page 224.)

7. *Ptygmatis ? pisolitica*, Witchell. Fragment from the Lincolnshire Limestone, Weldon. My Collection. (Page 215.)

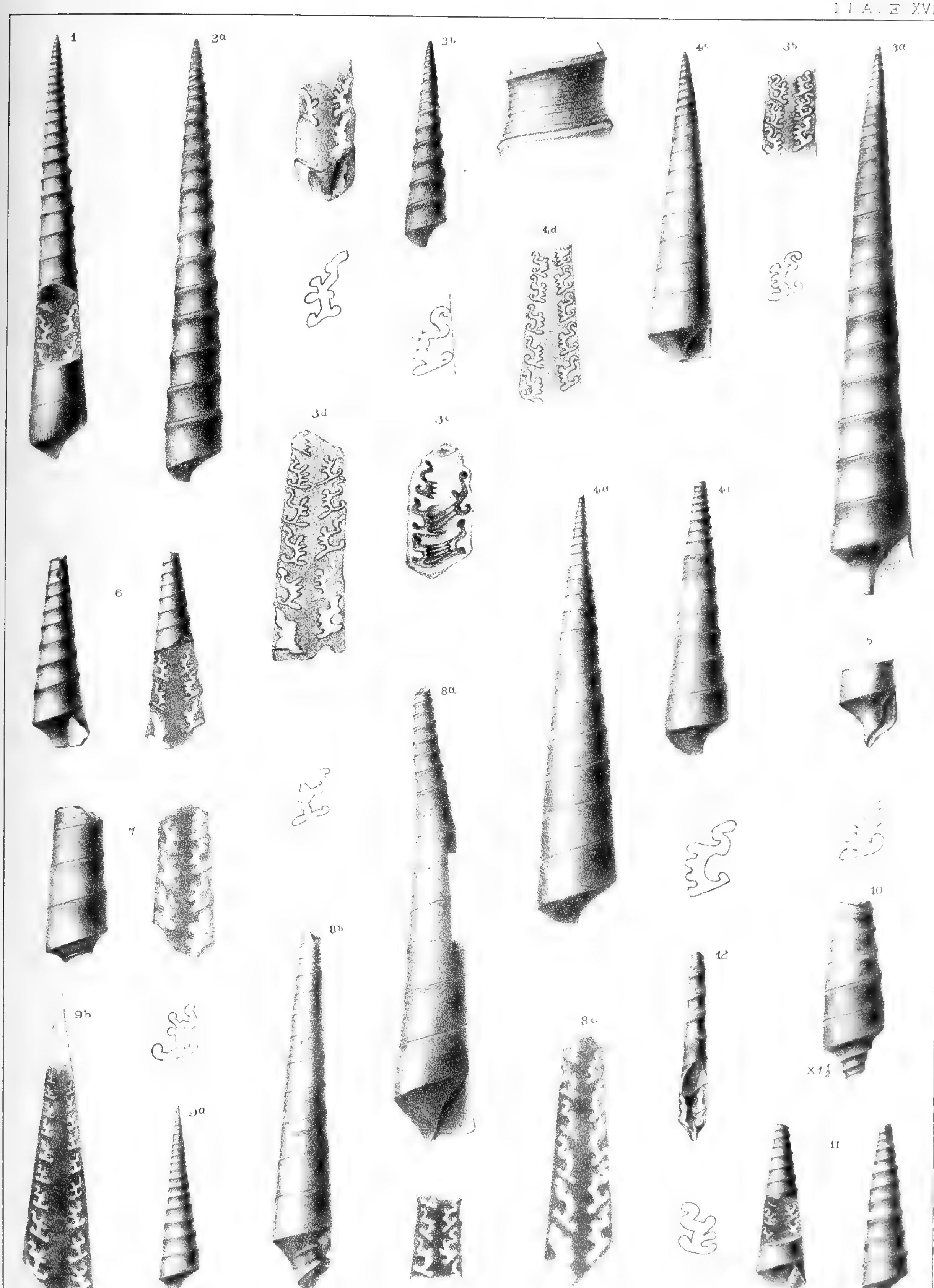
8 *a*. *Ptygmatis Santonis*, sp. nov. Oolite Marl, Longridge. My Collection. 8 *b*, 8 *c*. The same. Lincolnshire Limestone, Santon. Jermyn Street Museum. (Page 224.)

9 *a*. *Ptygmatis brevivoluta*, sp. nov. 9 *b*. The same; specimen cut longitudinally, × 2. *Clypeus*-grit, Barrington. My Collection. (Page 225.)

10. *Ptygmatis ? brevivoluta*, × $1\frac{1}{2}$. Lincolnshire Limestone, Weldon. My Collection.

11. *Ptygmatis* "*sub-brevivoluta*." Lincolnshire Limestone, Weldon. My Collection. (Page 226.)

12. *Ptygmatis ? bacillus*, D'Orb. (rolled fragment). Lincolnshire Limestone, Weldon. My Collection. (Page 217.)


1
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2b
3a
3b
3c
3d
4a
4b
4c
4d
5
6
7
8a
8b
8c
9a
9b
10
11
12
X2
X1½

THE

PALÆONTOGRAPHICAL SOCIETY.

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LONDON:

MDCCCXC.

A MONOGRAPH

ON THE

INFERIOR OOLITE AMMONITES

OF

THE BRITISH ISLANDS.

BY

S. S. BUCKMAN, F.G.S.

PART IV.

Pages 145—224; Plates XXIV—XXXVI.

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which nevertheless belong to two different genera, should be found located in almost the same horizon as the type-species of this genus. These species are *Hammatoceras insigne* (Schubler), and *Grammoceras dispansum* (Lycett), which occur together in the upper part of the *Striatulum*-subzone; while *Haugia variabilis* occurs, in the Cotteswolds, in the Sands below (see Section vi, p. 45). *Gramm. dispansum* was considered by Dr. Wright to be a variety of *Haugia variabilis;* on this point I shall have more to say presently.

The species of this genus all belong to the Upper Lias, and are mostly confined to Gloucestershire, where they are characteristic of the Cotteswold Sands and *Striatulum*-beds. The only reason for including them in the present work is that only one, *Haugia variabilis*—on which, too, I can give some additional information—has been figured and described by Dr. Wright in his 'Monograph on Lias Ammonites;' and that I have thought it an advantage to give a complete account of the species associated with it (see also p. 113).

Postscript.—At page 141 I suggested that *Haugia* was possibly descended from *Lillia*. The time which has elapsed since the publication of that page has enabled me to more fully consider this point; and I have concluded that my surmise is quite correct. The backward-directed ribs, noticeable in the immature *Haugia variabilis*, are to be seen in the mature *Lillia;* the broad ventral area and quadrangular whorls of the young *H. variabilis* are also characteristic of *Lillia;* the knobs on the inner margin, which are very irregular in *Lillia*, are more regular in *Haugia*,[1] and in the higher species die out only because the side becomes broader; finally the suture-line, which in the young (Plate XXVIII, fig. 3) has much resemblance to that of *Lillia*, exhibits, when adult (Plate A, figs. 34—37), a development in the ornamentation of the superior and inferior lateral lobes and the commencement of extension in the matter of auxiliaries. All the changes here enumerated are what we might expect to accompany the development of involute, high, compressed whorls instead of evolute, sub-quadrangular whorls. Practically no trace of the sulcate ventral area of *Lillia* remains in the young of *Haugia*—the uncarinate stage (Plate XXVIII, figs. 1, 2) passes into a carinate stage with flat ventral area—the sulcate stage is therefore omitted. A similar omission is seen in the higher forms of *Haugia*, where the tubercled stage is entirely wanting. We may sum up the development of *Haugia* as follows:—Increase of compression, increase of involution, decrease of ribs (almost to extinction), decrease of knobs to total extinction. Just as the young of *Haugia variabilis* exhibit the chief characters of the adult of *Lillia*, so even the

[1] The irregular ornamentation of the lower *Haugiæ*, namely, *H. navis* and *H. malagma*, which caused Dumortier to place them in his section *Podagrosi*—the chief members of which belong to the genus *Lillia*—should also be considered in this connection.

young of *Haugia Eseri* exhibit the characters of the senile stage of *Haugia variabilis.*

HAUGIA VARIABILIS (*d'Orbigny*). Plate XXV, fig. 2; but not Plate XXIII, figs. 11—15 (see *H. jugosa*).[1]

1844. AMMONITES VARIABILIS, *d'Orbigny.* Pal. franç., Céph. jurass., pl. cxiii, figs. 1—4 (not 5, 6).
1853. — — *Chapuis et Dewalque.* Foss. Luxembourg; Mém. cour. et Mém. des savants étrang., tom. xxv, pl. ix, fig. 2.
1856 — — *Oppel.* Juraformation, p. 250.
1867. HAMMATOCERAS VARIABILE, *Hyatt.* Bulletin Mus. Comp. Zool., No. 5, pp. 89, 98.
1874. AMMONITES VARIABILIS, *Dumortier.* Études pal. Bassin du Rhône, iv, p. 77.
1878. HAMMATOCERAS OGERIENI, *Bayle* (*non* Dumortier). Explic. carte géol. France, pl. lxxxii, fig. 2.
1882. HARPOCERAS VARIABILE, *Wright.* Lias Amm.; Pal. Soc., vol. xxxvi, pl. lxviii, pl. lxvii, figs. 5, 6[2] (not pl. lxvii, figs. 1, 2, 3, 4).
1885. HAMMATOCERAS ? VARIABILE, *Haug.* Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., iii Beil.-Bd., p. 656, pl. xi, fig. 13.
1887. AMMONITES (HAMMATOCERAS) cf. VARIABILIS, *Denckmann.* Fauna ober Lias; Abh. z. geol. Specialkarte Preussen und thüringischen Staaten, Bd. vii; Heft 2, pl. v, fig. 3.

Discoidal, compressed, with large hollow carina. Whorls flattened, with slightly convex sides, ornamented with arcuate ribs directed, in the young, somewhat backwards, and, during the immature stage, springing from knobs

[1] The reader is requested to alter the explanation of Plate XXIII, figs. 11—15, as follows:—For "*variabilis* (d'Orbigny)" read "*jugosa* (Sowerby)." Erase the whole sentence beginning "But as neither . . . ." Also the explanation of Plate A, fig. 35, should be altered from "*variabilis*" to "*jugosa.*"

[2] There are discrepancies with regard to the length of aperture and other points between the two figures of this fossil. Mr. G. C. Crick, F.G.S., who has charge of the Cephalopoda in the British Museum, and to whom I am much indebted for invariable courtesy, wrote to me as follows about them:—"The aperture of the original of pl. lxvii, figs. 5, 6, is scarcely as perfect as one would expect to see, but I consider the length of the aperture to be more correctly represented in fig. 6. The same figure indicates more correctly the distance from bottom of whorl to place of re-entry."

on the top of the inner margin. Ventral area ill-defined, convex, and carrying a large hollow carina, slightly sulcate laterally. Inclusion variable.

No specific name has been more misused than this. It may truly be said that under it have been included all the species of *Haugia*, several of *Grammoceras*, and even some other species belonging to genera still more remote. As now restricted in this Monograph, the species is but little variable; but there are two chief forms which are easily separable from one another. They may be mentioned as follows:

I. The type as figured by d'Orbigny and Chapuis et Dewalque, loc. cit.

II. Var. *a* has very coarse, irregular ornamentation (Wright's 'Lias Ammonites,' pl. lxviii, but sometimes more involute).

Specimens agreeing exactly with the type have not apparently been found in England, unless Dr. Wright's figs. 5, 6 in pl. lxvii belong to it.[1] The form *a*, so well delineated in that author's pl. lxviii, is remarkable for its coarse irregular knobs, and for the absence of a well-marked space between the inner margin and the knobs, as seen in d'Orbigny's figure; in one of my specimens this is much more marked than in Dr. Wright's—in fact the knobs almost touch the inner margin in the inner whorls.

When I wrote the explanation of Plate XXIII I included in this species certain specimens which should come under the designation *Haugia jugosa* (see that article, p. 149). I made this mistake because they are so much commoner than the true *Haugia variabilis*, of which I had not thoroughly learnt the peculiar characters. I consider that the chief points peculiar to *Haugia variabilis* are—

1. The ribs directed backwards until an advanced age.
2. The narrow whorls.
3. The open umbilicus.
4. The slow increase in diameter.
5. The more irregular ornamentation.

The backward direction of the ribbing is a fact upon which particular stress may be laid. The same feature may be noticed in *Lillia erbaënsis* and *Lillia tirolensis* (Dumortier, 'Bassin du Rhône,' pls. xxiii and xxiv), and certainly suggests the connection between *Haugia* and *Lillia* (see p. 145).

Many species have passed under the name *Am. variabilis*, and one of the best known is *Grammoceras dispansum*. For the differences which separate it from *H. variabilis* see the articles on the genera *Haugia* and *Grammoceras* (pp. 144, 161), and also the article on *Gramm. dispansum* (p. 212).

The species from the Bradford-Abbas Inferior Oolite which were quoted as *Amm. variabilis* belong to the genus *Sonninia*.

[1] See previous page, footnote 2.

D'Orbigny's figures (loc. cit., excluding figs. 5, 6) of this species are very good; but figs. 1, 2, being drawn only half-size are apt to mislead unless care be exercised. Especially is this the case with fig. 2, which is of course thinner than an actual specimen of that diameter would be; because the thickness of the shell decreases proportionally from youth upwards, as may be learnt from figs. 3, 4, which represent the young stage. Figs. 5, 6, although included in this species by d'Orbigny, cannot be allowed to remain here, but probably belong to *H. illustris* (p. 153).

The figure 2 of Chapuis and Dewalque (*loc. cit.*) is of natural size, and represents a specimen without any of the senile—smooth—character. It is more useful for obtaining a correct idea of the species than d'Orbigny's figure, and shows the characteristic spaces between the bunches of ribs. I cannot, however, understand the extreme thinness of the front view (fig. 2 *b*). This does not agree with my specimens, nor with d'Orbigny's, if his figure be enlarged twice every way.

The drawing of the species by Bayle under the name *Hammatoceras Ogerieni* is of rare execution. The backward direction of the ribs is very apparent, but not so the interspaces between the bunches; the ribs, too, appear thicker. Apparently the condition of the specimen is excellent.

Gottsche[1] quotes a species from the Cordilleras of the Argentine Republic as *Harp.* aff. *A. variabilis;* but, as he gives no suture-line, it would not be safe to venture an affirmative opinion on the point. To find a species even of this genus in so distant a locality would be very interesting.

The grand specimen figured by Dr. Wright (*op. cit.*, pl. lxviii) conveys a good idea of the variety *a*.

When I selected this Ammonite to give its name to the Cotteswolds Sands under the title *Variabilis*-subzone I had included *H. jugosa* in this species. Now that the separation of *H. jugosa* has been effected, the name *Variabilis*-subzone is not quite so appropriate, because the species is really rare. On the other hand, the commoner *H. jugosa* cannot be considered to have been known, and could not therefore have been used.

Haugia variabilis occurs in the Cotteswold Sands at Coaley Wood (Bed 16) and at North Nibley (Bed 30). Wright quotes his grand specimen from Nailsworth. The species is very scarce.

Plate XXV, fig. 2, represents a young example of the species. For a good delineation of a grand adult specimen (var. *a*) I must refer the reader to Dr. Wright's 'Monograph on Lias Ammonites,' pl. lxviii. As neither this author nor myself happen to have given a front view it should be remembered that the

[1] "Ueber jurassische Versteinerungen aus der argentinischen Cordillere," 'Palæontographica,' Suppl. iii, Lief. ii, Heft 2, pl. i, fig. 9; Cassel, 1878.

aperture of this species is thicker and more quadrangular, more especially when immature, than that of *H. jugosa.*

HAUGIA JUGOSA (*Sowerby*). Plate XXIII, figs. 11—15[1] (not 16, 17); Plate XXIV, Plate XXV, fig. 1; Plate XXVI, fig. 6; Plate XXVIII, figs. 1—3; Plate A, fig. 35.

1815. AMMONITES JUGOSUS, *Sowerby.* Mineral Conchology, pl. xcii, fig. 1.
1874. — OGERIENI, *Dumortier.* Études pal. Bassin Rhône, iv, pl. xix, figs. 3, 4.
1882. HARPOCERAS VARIABILE, *Wright* (*non* d'Orbigny). Lias Amm.; Pal. Soc., pl. lxvii, figs. 1 & 2, only.[2]
1885. HAMMATOCERAS [SONNINIA] OGERIENI, *Haug.* Beiträge Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, iii Beil.-Bd., p. 658.
1885. HARPOCERAS VARIABILE, *Quenstedt.* Amm. Schwäbischen Jura, pl. lii, fig. 11 (12 ?), not 13.

Discoidal, compressed, hollow-carinate. Whorls flattened, very little convex, ornamented when immature with very regular arcuate ribs, which, rising in twos and threes from small tubercles on the inner margin, cross the lateral area, and bend slightly forwards on the ventral area. Ventral area very narrow, carrying a fairly large hollow carina. Inner margin convex, smooth. Termination (Plate XXVI, fig. 6) a subsigmoidal bend with long outer arc not greatly projected on the ventral area.

When I wrote the explanation of Plate XXIII I had mistaken Dumortier's *Am. Ogerieni.* In consequence, I described certain specimens (figs. 11—15) under the name "*variabilis.*" Just before the issue of Part III, but too late to make any alteration, I discovered my error. In order to be quite sure I wrote to my friend Dr. Haug upon the subject. He informed me that he had no doubt of the identity of *Haugia jugosa* (as figured in my Plate XXIII, figs. 11, 12) with *Am. Ogerieni*, and he also considered that the species should be called by Sowerby's name on account of the law of priority.

Dumortier points out the difference between his species and *H. variabilis* very clearly. He says (p. 79) "L'*A. Ogerieni* se distingue . . . de l'*A. variabilis* par ses tours plus renflés, la régularité et la direction de ses côtes, sa carène moins

[1] Alter description of Pl. XXIII, figs. 11—15, in accordance with this. Erase in explanation of fig. 11 from "But as neither" to end of sentence.

[2] If the backward direction of the ribs be correct, the specimen here delineated is a form exactly intermediate between *Haugia variabilis* and this species.

enfilée et moins haute, par ses lobes et par l'absence d'ornaments sur ses premiers tours."

The regularity and direction of the ribs are the chief characters. The nearly equidistant ribs are close together and are not bunched as in *H. variabilis;* but the especial distinction is that they proceed from the tubercles in the same direction as a line would, if drawn from the centre; while the ribs of *H. variabilis* would fall behind such a line. As regards the carina, I cannot say very much, since I have not had sufficient material of *H. variabilis* to compare; and the absence of ornaments on the first whorls seem also to be found in *H. variabilis*, though it is, perhaps, not so noticeable. However, there is one great difference between the two species which was not mentioned by Dumortier, and this is in the coiling of the umbilicus. All my specimens of this species show a quickly-coiled umbilicus; that is, they reach a given diameter with fewer turns than does *Haugia variabilis.* A comparison of d'Orbigny's reduced figure (all measurements doubled) and the large specimen of *Haugia jugosa* (Pl. XXIV) shows that the latter has reached the same diameter as the former in about half a turn less. The following table will show the difference between the two.

	H. variabilis. Inches.		*H. jugosa.* Inches.
Diameter	7·4	...	7·4[1]
Width of total umbilicus . .	2·7	...	2·6
Width of umbilicus, one whorl back .	1·4	...	1·05
Width of umbilicus, two whorls back .	0·7	...	0·45

A comparison of figs. 11, 14 in Plate XXIII, with fig. 2 in Plate XXV, will show the difference in the umbilicus of the young forms; singularly enough, the umbilici of the adults become more nearly equal in size if the same diameter be considered, but not if the same number of turns be taken.

It seems probable that the species is a mutation of *Haugia variabilis*—a descendant assuming the senile stage at an earlier period; but I cannot say if this be correct without an extended study of the suture-lines, which my material does not allow. Dumortier says (p. 79) that the lobes are coarser and not so much branched as in *H. variabilis.* If this be so in similar-sized specimens it would tell against this idea of their relationship, and we should have to seek for the ancestor of this species in *H. navis* or *H. malagma.* On the other hand, however, the specimen figured by Wright, pl. lxvii, figs. 1, 2, appears, from its ribs being directed slightly backwards, as if it might be an intermediate form between *H. variabilis* and the true *H. jugosa*, in fact, the parent of the latter and the descendant of the

[1] For the sake of comparison the same amount has been measured off on the specimen of *H. jugosa.*

former, and the usual rules of development are carried out in supposing this relationship.

The identification of Sowerby's *Am. jugosus* would have been a practically impossible task without an examination of the type specimen; and this arises from the incorrectness of his delineation—an incorrectness which is not observable in the Ammonites of the "Mineral Conchology" taken as a whole. A comparison of his plate xcii, fig. 1, with the figure which Mr. Gawan has drawn in this Monograph (Plate XXIII, fig. 11) will, on account of the broken portion, &c., show at once that the same specimen has been the subject in both instances, But Sowerby's[1] figure shows whorls much too narrow, and without the faint tubercles; also it exhibits an umbilicus considerably too large, and with too many whorls over much exposed.

It is unfortunate that Dumortier's *Am. Ogerieni,* which is both well delineated and described, should have to yield to Sowerby's *Am. jugosus.* Still, before Dumortier had given this name Waagen had announced the relationship of Sowerby's species when he wrote concerning the shell which Oppel had called *Am. jugosus,* "Nachdem ich nach Besichtigung des Sowerby'schen Originalexemplars mich veranlasst sehe, der Ansicht der Englischen Paläontologen beizutreten, und *A. jugosus,* Sow. 92 für eine Species des Oberen Lias, dem *A. variabilis,* Orb. nahestehend, zu erklären, ist es nöthig den Ammoniten der Sowerbyi-Schicht, den Oppel hier in Auge hatte, neu zu benennen."[2]

H. jugosa is really the species most characteristic of the harder beds of the Cotteswold Sands, and not *H. variabilis* as my term *Variabilis*-subzone might imply (p. 148). Dumortier also says of this species (*Ogerieni*), (*op. cit.*, p. 79), "Cette jolie espèce est plus répandue que l'*A. variabilis,* avec laquelle elle paroit avoir été toujours confondue."

Since the Cotteswold Sands are not utilised for any economic purpose, exposures of these strata are limited, and are only to be found where old cart-tracks have worn a deep road through the soft beds on the hillside. The consequence is that specimens of this species are hard to obtain, and, even then, are not unfrequently crushed and worthless. Judging however from the specimens obtained from such limited exposures the species must have been fairly abundant. It is found at Coaley Wood (Bed 16—p. 45) and North Nibley (Beds 28 and 30—p. 46).

Plate XXIII, figs. 11, 12, represent the type specimen of this species—being the original *Am. jugosus* figured by Sowerby; but, as a comparison with his work will show, his figure was most inaccurate and misleading: fig. 13 is the suture-line of this specimen as nearly as the artist was able to trace it. Figs. 14, 15 exhibit

[1] On account of the state of preservation of the specimen these tubercles might easily have escaped the observation of anyone not acquainted with Ammonites of this species.

[2] "Zone *Amm. Sowerbyi,*" 'Geogn. Pal. Beiträge,' p. 595 (*Amm. Gingensis*), 1867.

two views of a very well-preserved specimen of this species from Coaley Wood, which help to elucidate the poorer type-specimen.

In Plate XXIV is depicted the side view of a magnificent adult specimen, which I obtained at Coaley Wood on the top of Bed 16. This giant specimen has all its test on this side in good and complete preservation; and it shows, round a considerable portion of its whorl, the large trenchant carina. Plate XXV, fig. 1, gives the front view.

Plate XXVIII, figs. 1, 2, exhibit the inner whorls extracted from a large specimen of this species. The figures are of natural size and the top of fig. 2 gives just an indication of a keel; but no ribs are visible. Fig. 3 shows the suture-line taken from the same specimen, but considerably enlarged. Plate XXVI, fig. 6, gives an outline of the termination taken from a broken specimen; the arrow points towards the centre of the specimen. In Plate A, fig. 35, the suture-line, taken from a medium-sized specimen of this species, is depicted.

HAUGIA DUMORTIERI, *S. Buckman.* Plate XXIII, figs. 16, 17; Plate A, fig. 36 (under the incorrect name of *Haugia Ogerieni*[1]).

Discoidal, compressed, hollow-carinate. Whorls elliptical, ornamented with subsigmoidal ribs moderately projected on the ventral area and springing from a few ill-defined tubercles on the inner margin. Ventral area not defined, carrying a rather small hollow carina. Inner margin sloping, smooth. Inclusion two-thirds; umbilicus small and deep, quite smooth in the middle. Suture-line (Plate A, fig. 36) possesses an inferior lateral lobe larger than is usual in the genus, and two small auxiliary lobes.

The ribs turned so distinctly towards the front and the carina smaller than in the other species of *Haugia* and not laterally sulcated,—these are the features which seemed to agree so exactly with Dumortier's description of his *Am. Ogerieni* that I mistook this species for it. Now I see that, although *Haugia jugosa* (*Ogerieni*) possesses these characters separating it from *H. variabilis*, yet this species possesses the same characters much more strongly marked. In particular the much smaller carina separates it from *H. jugosa* (compare Plate XXIII, figs. 14 and 16), while the ribs not only possess a much stronger forward sweep, but have on the lateral area a slight bend which gives them a subsigmoidal, instead of a sub-arcuate, appearance. Furthermore the species possesses a smaller umbilicus, and is, if anything, rather thicker; while its tubercles are much less distinct.

[1] The reader is requested to alter the explanation of these plates in accordance with the above.

From *H. variabilis* its small carina, small umbilicus, and ventrally projected ribs easily separate it.

Plate XXIII, fig. 16, gives the side view of a nicely-preserved small specimen obtained from the Cotteswold Sands, North Nibley (Bed 18). This side view shows the characteristic subsigmoidal ribs, differing from those of fig. 14. Fig. 17 illustrates the front view, and the size of the carina. In Plate A, fig. 36, is depicted the suture-line of this specimen; and it is noticeable that the inferior lateral lobe is larger in proportion than in the suture-line of *H. jugosa.* All the figures of this species in these two plates were alluded to under the incorrect name of *H. Ogerieni.*

HAUGIA ILLUSTRIS (*Denckmann*). Plate XXVI, figs. 3—5.

1844. AMMONITES VARIABILIS, *d'Orbigny*. Pal. Franç., Ceph. Jurass., pl. cxiii, figs. 5, 6 (*non* 1—4).

1887. — (HAMMATOCERAS) ILLUSTRIS, *Denckmann*. Fauna Ob.-Lias Dœrnten; Abh. geol. Specialkarte von Preussen und den thüringischen Staaten, Band viii, Heft 2, pl. v, fig. 2; pl. vi, fig. 1; pl. x, fig. 5 (pl. iii, fig. 6 ?).

Discoidal, compressed, hollow-carinate. Whorls much compressed, ornamented with arcuate ribs which spring from tubercles on the edge of the inner margin. Ventral area not defined, bearing a large hollow carina. Inner margin distinct, slightly sloped. Inclusion nearly two-thirds. Umbilicus small.

The material at present in my possession is so very scanty and poorly preserved that the characters of this form cannot be set forth in detail. It is obvious that it is nothing more than a mutation of *H. jugosa*, and its position—one stage higher, namely, in the *Striatulum*-beds—fully accords with this idea. As a mutation of *H. jugosa* it has acquired greater compression and a smaller umbilicus, but retains the knobs; and thus it differs from *H. Eseri*, which has acquired greater involution but not so much compression, and has lost the knobs.

Haugia illustris is extremely scarce. It occurs in the *Striatulum*-beds, that is, a stage later than the other tubercled species of the genus. I have collected it at Penn Wood and Coaley Wood, Gloucestershire. Denckmann says (*op. cit.*, p. 75), "*Am. illustris* tritt ausserordentlich häufig in den Geoden unter der Bank mit *Am. striatulus* auf, und ist für dieselbe leitend."

Some specimens collected from Coaley Wood (Bed 13, p. 45) and from North Nibley (Bed 20, p. 46) should possibly be referred to this species, but their preservation is too poor to admit of thorough identification. They exhibit a somewhat smaller umbilicus.

Plate XXVI, fig. 3, represents the side view of a poorly-preserved specimen, to show the general proportions. Fig. 4 shows a fragment somewhat better preserved; while fig. 5 illustrates a sectional view of the same.

HAUGIA OCCIDENTALIS (*Haug*). Pl. XXVII, figs. 1, 2.

1884. HAMMATOCERAS OCCIDENTALE, *Haug*. Nouvelles Amm. Lias supérieur; Bull. Soc. Géol. France, 3e série, t. xii, pl. xv, fig. 3.

1885. HARPOCERAS OCCIDENTALE, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 617.

Discoidal, compressed, with a large hollow-carina. Whorls ornamented with inconspicuous subsigmoidal ribs, which soon disappear, leaving the test quite smooth. Ventral area not defined—the two sides of the whorl sloping gradually towards a strong hollow-carina. Inner margin very distinct, flat, little sloped. Inclusion about one-half.

From all the preceding species of this genus this one is distinguished by the absence of tubercles on the inner margin. It shares this character with *Haugia Eseri*. I was at first inclined to consider these two species synonymous; but, at my request, Dr. Haug very kindly wrote to me concerning the differences which he had observed between them. I extract the following from his letter: "*H. Eseri*:—Ombilic limité par une surface perpendiculaire aux flancs de la coquille ('steile Nahtflache'). Côtes peu flexeuses, assez grossières et non fasciculées, persistant jusque dans une âge assez avancé. *H. occidentalis*:—Ombilic limité par une surface oblique par rapport aux flancs de la coquille ('geneigte Nahtflache mit stumpfe Nabelkante'). Côtes flexeuses, peu saillantes, fasciculées, disparaissant entièrement à une diamètre de 1 decimètre[1] environ."

Unfortunately my specimens do not seem to altogether bear out my friend's remarks; and, apparently, these characters do not hold good in all cases. The inner margin of *H. Eseri* is sometimes as oblique as in *H. occidentalis;* the ribs are not always fascicled in *H. occidentalis*,—on the contrary they are fascicled in a variety of *H. Eseri*, Plate XXV, fig. 7, and incline to that way in other specimens; the ribs, also, sometimes die out in *H. Eseri* at a very early age, and are sometimes stronger in *H. occidentalis* than in *H. Eseri*. The chief differences, to

[1] About four inches.

my mind, between *H. Eseri* and *H. occidentalis* are the narrower, more quadrangular whorls with broader ventral area of the latter, accompanied by a larger umbilicus and a deeper inner margin.

At the same time while the specimen figured in Plate XXV, fig. 7, agrees in the size of its umbilicus with *H. occidentalis*, in its compressed form and sharpened ventral area it agrees with *H. Eseri*. After all I cannot consider the differences between the two species as very clearly pronounced (see p. 157).

H. occidentalis is scarce and I have only met with it at Little Sodbury in the yellow Sands (*Striatulum*-beds, *Jurense*-zone, section xi, Bed 12, p. 165). The specimens are generally fairly preserved. Plate XXVII, fig. 1, illustrates the side view of a good specimen; fig. 2 is the outline of the aperture.

HAUGIA ESERI (*Oppel*). Plate XXV, figs. 3—7; Plate XXVI, figs. 1, 2; Plate A, fig. 37.

1846. AMMONITES RADIANS COMPRESSUS, *Quenstedt*. Cephalopoden, pl. vii, fig. 9, p. 112.
1856. — ESERI, *Oppel*. Juraformation, p. 245.
1858. — RADIANS COMPRESSUS, *Quenstedt*. Jura, pl. xl, fig. 13.
1862. — ESERI, *Oppel*. Palæont. Mittheilungen, pl. xliv, fig. 3 *a*, *b*.
1874. — EXARATUS, *Dumortier* (*non* Young and Bird). Depôts jurass. du Bassin du Rhône, pt. iv, pl. xii, figs. 1, 2, 4 (*non* fig. 3) (pl. xi, fig. 11 ?).
1885. HARPOCERAS ESERI, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 623.
1885. AMMONITES RADIANS COMPRESSUS, *Quenstedt*. Amm. Schwäbischen Jura, pl. li, figs. 6—8; pl. lii, fig. 4.
1885. — cf. LYTHENSIS, *Quenstedt*. *Ibid.*, pl. liii, fig. 14.

But NOT—
1874. AMMONITES ESERI, *Dumortier*. *Op. cit.*, pl. xii, fig. 3 (see later, *Grammoceras*, p. 204).
1878. GRAMMOCERAS ESERI, *Bayle*. Explic. carte géol. Franç., pl. lxxviii, fig. 6 (see later, *Grammoceras*, p. 204).
1886. HARPOCERAS ESERI, *Vacek*. Oolithe Cap San Vigilio; Abh. k. k. geol. Reichsanstalt, Bd. xii, No. 3, pl. ix, fig. 6 (*Hammatoceras*).

Discoidal, compressed, hollow-carinate. Whorls broad, ornamented with irregular, often towards the inner margin slightly fascicled, sigmoidal ribs which die away in old age. Ventral area carrying a large hollow-carina. Inner margin distinct, fairly steep, slightly convex, but in some old specimens showing a decided tendency to become concave.[1] Inclusion rather more than one-half; but showing a tendency to decrease in the adult. Umbilicus small and in youth somewhat deep; shallower in the adults. Aperture more or less acutely sagittate.

The species was first figured by Quenstedt (*loc. cit.*) who, then and since, has regarded it as a compressed involute variety of *Am. radians* (see later, p. 188). Subsequently Oppel, quoting Quenstedt's original figure, gave the species the distinctive name of *Am. Eseri;* and afterwards he figured a specimen in the 'Palæontologische Mittheilungen.' This figure is perfectly accurate except in one respect, namely, that the carina is drawn much too small. Oppel evidently had to deal with a cast which possessed a carina chipped and imperfect—as is the case in many specimens—all round the whorl. This fact, however, is not shown in the figure—the carina has been drawn with a perfect edge—and sufficient allowance has not been made for height. Quenstedt's figure in "Die Cephalopoden" is far more accurate in this respect, and indicates the partition-band and the correct position of the siphuncle with regard to the hollow-carina. My figures, which show the chipped carina drawn as it actually is, will explain how the mistake in Oppel's figure could have arisen.

Oppel's figure represents a much more compressed specimen than Quenstedt's; yet presumably, as the latter was first quoted by this name, we must regard it as the type of Oppel's species. These two forms—the thick (α) and thin (β)—are the two usual varieties of the species; but we also have (γ) a compressed form with large umbilicus (Plate XXV, fig. 7), and (δ) a form with unusually coarse irregular ribs (Plate XXVI, figs. 1, 2).

The form α approaches *H. occidentalis*, but has a sharper ventral area and a smaller umbilicus.

The form γ, on the other hand, agrees in the size of its umbilicus with *H. occidentalis*, but is much more compressed, and has a sharper ventral area.

The form δ is distinguished by its very coarse ribs.

A fragment of this species was figured by Dumortier as *Ammonites exaratus* (*op. cit.*, pl. xii, fig. 4). Figs. 1, 2 on the same plate appear to me to be the form β of this species without any test, and with the ventral area deprived of its hollow carina. The species which he has figured as *Am. Eseri* is not this species at all, but is a variety of *Grammoceras fallaciosum* (p. 204).

Bayle (*loc. cit.*) has also figured a variety of *Gram. fallaciosum* under the name *Grammoceras Eseri.* Vacek, too, has failed to correctly interpret this species. His *Harpoceras Eseri*[2] belongs, as the strongly-drooping inner part of the suture-

[1] This is an interesting fact, especially in connection with my remarks at p. 90.

[2] "Oolithe von Cap San Vigilio;" 'Abh. der k. k. geol. Reichsanstalt,' Band xii, No. 3, pl. ix fig. 5.

line distinctly tells us, to the genus *Hammatoceras*;[1] and it is, like *Hamm. amaltheiforme*, *Hamm. climacomphalum*, &c., one of the species of that genus which has lost the characteristic inner-marginal knobs.

That this species is descended from *H. occidentalis* appears most probable; and yet the fact that often—but not always—the ribs disappear in the latter at an earlier age and are also less conspicuous, is not correct from this point of view. If *H. Eseri* then is descended from one species of tubercled *Haugia*—say *H. jugosa*—and *H. occidentalis* from another—say *H. variabilis*—we should be justified in keeping the two forms separate.

That both *H. Eseri* and *H. occidentalis* represent the further development of the senile stage of a species of tubercled *Haugia* is very plain from their suture-line; but more than this the fascicled ribs of the instructive specimen figured in Plate XXV, fig. 7, are an exact reproduction of the ribbing of *H. variabilis* with an appearance of very rudimentary knobs.

Fascicled ribbing is to be observed not only in this specimen but more or less in many others. On the inner whorls of the umbilicus of the specimen depicted in Plate XXVI, fig. 1, the ribs are distinctly gathered into bunches. (This has not been sufficiently brought out in the figure.)

Practically speaking, what may be called the tubercled stage has ceased to be reproduced in consequence of the earlier assumption of senile characters. It is very important that the reason for the loss of tubercles should be correctly understood; because otherwise it might be supposed—as it has been already—that *Haugia occidentalis* and *H. Eseri* were allied to *Grammoceras*, or to the group which I have placed in the genus *Pseudolioceras*. There is no doubt that in shape they both converge towards various members of those genera. For the differences between *Haugia Eseri* and *Pseudolioceras* and between it and *Grammoceras* see generic description, pp. 143, 144.

An interesting fact in connection with this characteristic Cotteswold Ammonite is that a species very nearly allied to, if not practically identical with it, is mentioned by Gottsche[2] as occurring in the Cordilleras of the Argentine Republic. Of his *Harpoceras Andium* Gottsche says:—"*H. Andium* . . . steht . . . keiner Art naher als dem *H. Eseri*, Oppel . . . ., indessen ist unsere Art durch den Querschnitt, die weniger geschwungenen Rippen, und das Fehlen einer wirklicher Nabelkante genügend unterschieden." Fig. 8 in his pl. i appears most like *H. Eseri*; but the specimen depicted in pl. ii, fig. 2, has a peculiar aspect of ribbing which excites my suspicion, and causes me to think it

[1] Haug, "Ueber *Polymorphidæ*," 'Neues Jahrbuch für Mineral., &c.,' Bd. ii, p. 91, footnote, 1887.

[2] "Ueber jurassiche Versteinerungen aus der argentinischer Cordillere," 'Palæontographica,' Suppl. iii, Lief. ii, Heft 2, Cassel, 1878.

a nearer ally of his *Harp. proximum* and *Harp. Zitteli*, which do not belong to the family *Hildoceratidæ*.

Haugia Eseri is a characteristic species for the *Striatulum*-beds (*Jurense*-zone) in Gloucestershire. Its exact horizon is the lowest band of the limestone-capping of the yellow Cotteswold Sands; and I have collected it at Buckholt Wood, Coaley Wood (Bed 8), Cam Down, Stinchcombe, North Nibley (Bed 15), Wotton-under-Edge and intermediate exposures on the flanks of the Cotteswold Hills. Plate XXV, figs. 3, 4, exhibit the two views of a young specimen of the form α from Coaley Wood; figs. 5, 6, show two views of form β from North Nibley; fig. 7 illustrates the side view of form γ with its wide umbilicus and fascicled ribs—in front view this form is if anything more compressed than fig. 6. Plate XXVI, fig. 1, represents a well-preserved fragment of form δ from North Nibley; fig. 2 is its aperture. Plate A, fig. 37, shows the suture-line.

Hildoceratidæ (*continued*).

Genus—Grammoceras,[1] *Hyatt*, emended.[2]

(*Type*—Grammoceras striatulum, *Sowerby* sp.)

1867. Grammoceras, *Hyatt*. Cephalopoda, Bulletin of the Museum of Comp. Zoöl., No. 5, p. 99.

1869. Harpoceras, *Waagen*. Die Formenreihe des *Amm. subradiatus*, Geogn.-Pal. Beiträge, Bd. ii, Heft 2, p. 245, *pars*.

1879. Grammoceras, *Bayle*. Explic. carte géol. France; Explanation of Pl. lxxviii.

Discoidal, compressed, mostly evolute. Whorls ornamented with ventrally projected, generally subarcuate[3] ribs. Ventral area sometimes broad and sulcate, sometimes narrow and flat or sloping. Carina sometimes hollow, sometimes solid. Termination, in youth with lateral lappets and a ventral projection; in adult age, plain sigmoidal bend. Suture-line:—Siphonal, superior-lateral, and inferior-lateral lobes short and little ornamented, the superior-lateral but little, if at all, longer than the siphonal lobe; the auxiliaries practically undeveloped.

[1] Γραμμή, a line.

[2] Of the five species placed by Hyatt in this genus "*Gramm. serpentinum*" (= *Am. falcifer*) belongs to *Harpoceras, sensu stricto*; while concerning "*Gramm. radians*" see p. 188. The original definition also requires emendation.

[3] This term is used to denote ribs which are not truly arcuate, first, because of the long ventral projection; and secondly, because of a slight curve on the lateral area (see Pl. A, fig. 45).

The progressive development of the genus *Grammoceras* may be divided into four stages.

1st. The Goniatite-stage (Pl. XXVIII, figs. 11—13) seen in the interior whorls of all species.

2nd. The remains of an Arietan-stage (the sulcate stage) seen in young *Gramm. quadratum*, *Gramm. Sæmanni*, *Gramm. toarcense*, &c., but more frequently omitted.[1]

3rd. Grammoceratan-stage. Examples: *Gramm. striatulum*, *Gramm. doernense*, *Gramm. Orbignyi*, *Gramm. fallaciosum*, &c.

4th. The Lioceratan-stage. Examples: *Gramm. subserrodens*, *Gramm. leurum.*

The distinctive features of the genus *Grammoceras* are the shape of its ribbing —*subarcuate*[2] *with a long ventral projection meeting the carina at an acute angle*— and the simple lobe-line with mere rudiments of auxiliary lobes.

In his definition of this genus Hyatt said, "Abdomen keeled, but not channeled." It is, however, impossible to limit the genus in this manner. The ventral channels, which are well marked in *Gramm. ovatum* and *Gramm. quadratum*, and are rudimentary in *Gramm. toarcense* and *Gramm. Sæmanni*, are merely the marks of descent from an Arietan ancestor. These species possess the other features of the genus *Grammoceras;* and as we follow the development of the genus upwards we find that all traces of the Arietan-stage are omitted, and that the compressed carinate whorl with narrow ventral area succeeds directly upon the Goniatite-form.[3]

[1] The omission of a stage of development may be formulated as a general rule. The accession of a stage dissimilar to its predecessor, but approximately similar to any previously existing stage, causes the gradual extinction of the intermediate stage or stages by the law of earlier inheritance (Rule III, p. 134). The changes observable in the ventral area will fully explain this. Its development is from (1) rounded to (2) bevelled, then (3) carinate, then (4) sulcate and carinate; to the latter succeeds a (5) carinate stage with the sulci becoming obsolete and merging into (6) the bevelled stage. The omission of 4 and the merging of 3 and 5 into one longer stage, is exactly what would be expected because it obviates a useless change. But 3 and 5 are in turn omitted for the same reason, and if the form still continues to exist, a 7th stage—rounded—is added, and in the process of time the omission of the intermediate stages causes 1 to pass directly into 7, and a rounded ventral area again becomes the permanent feature. *Grammoceras* does not reach this state. The specimen of *Gramm. mactra* (Pl. XXXI, figs. 3, 4) shows the greatest reversion in the shape of its ventral area, and the changes here are expressed as rounded, bevelled, to almost rounded.

[2] Subsigmoidal in the involute species only.

[3] It is much easier to obtain the inner whorls of these species than those of *Lioceras*, *Hyperlioceras*, &c., which often will not break up properly, and at other times are nothing but a mass of crystal in which all structure of the inner whorl is obscured. When I wrote my remarks on the evolution of the *Hildoceratidæ* (pages 128 *et seq.*) I was quite unacquainted with what Prof. Hyatt had written upon the evolution of other families. Although regretting that I had not before become acquainted with such valuable and thoughtful work, yet I cannot but feel pleased that the conclusions I arrived at concerning the mode of evolution among such Ammonites should agree so closely with

Some of the species with sulcate ventral area were placed by Haug in the genus *Hildoceras* (group of *Hild. Mercati*), presumably on account of these sulci.[1] It is true that many of the less-developed members of the genus *Grammoceras* are like such members of the genus *Hildoceras* as happen to be more developed,[2] not only on account of these sulci but also on account of their suture-line and general shape. However, the siphonal saddle of *Hildoceras* is generally much broader than in *Grammoceras*, while the inner part of the suture-line—especially the inferior lateral lobes—is less developed. In addition to this, however, there is the distinction in ribbing—the lateral bend in *Grammoceras* being so much less conspicuous than in *Hildoceras*, a difference well shown in figs. 30 and 45 of Plate A. In spite of their sulcate ventral area I do not think these species of *Grammoceras* have anything to do with *Hildoceras* genetically.

Some species of *Grammoceras*—as, for instance, *Gramm. aalense*—possess ribs which become more or less united on the inner area, and this gives them the appearance of *Ludwigia*. But the ribbing differs, in reality, essentially from that of *Ludwigia*, because, not only is this junction of ribs so irregular—no well-marked primary ribs, extending half across the side, being found as in *Ludwigia*—but the ribs on the outer area are not placed at an angle to those on the inner area. Again, the forward ventral sweep is much more pronounced in *Grammoceras;* and the suture-line is less developed. In Plate A figs. 8 and 45 will show the difference in the ribbing of *Ludwigia* and *Grammoceras*.

What may be considered as a very high-developed form of *Grammoceras*, that is, a species which has made great advance in the matter of involution, is *Grammoceras subserrodens*, which converges in shape to *Lioceras opalinum* most remarkably, and illustrates the tendency of the species of the different branches of the family *Hildoceratidæ* to pass, sooner or later, through the same changes, and so become similar in shape. Fortunately, we have in this case the fact of the suture-line to guide us, and we can see (Pl. XXXI, figs. 9, 12, 14) that the simple suture-line of *Gramm. subserrodens* differs from that of *Lioceras opalinum* (Fig. 1,

what he has found to obtain among other families. Among his papers on the subject, the following especially may be consulted with advantage, and will show how much more deeply his investigations have penetrated.

1874. "Genetic Relations of the *Angulatidæ*," 'Proc. Boston Soc. Natural History,' vol. xvii, pp. 15—33.

1874. "Biological Relations of the Jurassic Ammonites," ibid., vol. xvii, pp. 236—241.

1876. "Genetic Relations of Stephanoceras," ibid., vol. xviii, pp. 380—401.

1883. "Genera of Fossil Cephalopoda," ibid., vol. xxii, pp. 253—338.

1884. "The Evolution of the Cephalopoda," 'Science,' vol. iii, Nos. 52, 53.

[1] "Beiträge Monogr. Harpoceras," 'Neues Jarbuch für Mineralogie,' &c., Beil.-Bd. iii, p. 638.

[2] It may be better to explain that I use this word in reference to those species which have passed through the most changes, even though the later changes may appear to indicate decadence.

p. 36, Plate A, fig. 10) in the fewer number of auxiliary lobes, the less developed accessory lobe in the siphonal and superior lateral saddles, and in less ornamentation altogether. In general outward shape and ornamentation the two species are very similar; but in *Gramm. subserrodens* the ribs are not quite so sigmoidal as in *Lioc. opalinum*, the umbilicus is generally more open, and the ventral area is sharper.

To some members of the genus *Haugia* certain *Grammocerata* bear resemblance —*Grammoceras dispansum* (Lycett) and *Grammoceras fallaciosum* having at times been considered as varieties of *Haugia variabilis;* but *Grammoceras* may be distinguished from *Haugia* by the much longer ventral projection of the ribs, the more acute angle which those ribs form with the carina, and the simple character of the suture-line. *Gramm. dispansum* has no rounded knobs on the inner area like *Haugia variabilis*, but short club-like protuberances due to the fasciation of the ribs.

We need not be surprised at *Grammoceras* presenting some features causing it to converge towards certain members of any of the above-mentioned genera; because they all belong to the same family *Hildoceratidæ*, and having sprung from a common, and practically speaking, not very remote ancestor (p. 133) are the inheritors of similar characteristics destined to manifest themselves when conditions may be favourable. It is otherwise, however, with the genus *Dumortieria*, which has, in point of descent, had nothing to do with the *Hildoceratidæ* nor with their forerunner *Arietites*—in fact it has been perfectly distinct, at any rate from the lower portion of the Lower Lias onward.

Dumortieria and its ancestors have been placed by Dr. Haug in a family, *Polymorphidæ;* and it is very singular to find that, in the *Jurense*-zone, some of the species of *Dumortieria* begin to exhibit such a marked convergence towards *Grammoceras.*

In the *Jamesoni*-zone we meet with *Grammoceras antiquum* with its compressed sides and large carina. About the same horizon, or a little lower, we meet with the small species *Polymorphites polymorphus* (Quenstedt, not Wright) a shell with small, evolute, uncarinate whorls, and a very simple suture-line. No two Ammonites could be more dissimilar. From *Polymorphites* comes *Dumortieria Jamesoni* (Sow.); while another branch gives rise to *Dumortieria Vernosæ* (Zittel) in the zone of *Amaltheus margaritatus.* A slight compression of the sides of this species, a slight decrease in evoluteness, and the advent of a very small carina on the ventral area, gives us *Dumortieria Levesquei* in the *Jurense*-zone.[1]

[1] For working out the descent of the genus *Dumortieria* we are indebted to my friend Dr. Haug ("Polymorphidæ," 'Neues Jahrbuch f. Mineral.,' Bd. ii, 1887). It appears to me that Dr. Haug derives *Dum. Levesquei* directly from *Dum. Jamesoni;* but I do not see how or why in that case the complex suture-line of *Dum. Jamesoni* should have become reduced to the simpler suture-line of *Dum. Levesquei.* I do not know the suture-line of *Dum. Vernosæ,* which might throw some light on the

Now, *Dumortieria Levesquei* is in general shape and appearance not unlike *Grammoceras striatulum*,—an extraordinary fact when we remember how dissimilar are the representatives of these two in the *Jamesoni*-zone. The gradual passage from *Dumortieria Levesquei* into *Dum. Moorei* (Lycett), which may be expressed by a compression of the sides, and a decrease in the coarseness of the ribs, is parallelled exactly by the gradual mutation from *Gramm. striatulum* to *Gramm. mactra*—a mutation which is accompanied by a similar decrease in the coarseness of the ribbing, and also by a decrease in the size of the carina. Thus the convergence between *Grammoceras* and *Dumortieria*, which is close in the *Jurense*-zone, becomes in the *Opalinum*-zone—between *Grammoceras mactra* (Dumortier) and *Dumortieria Moorei* (Lycett)—a truly extraordinary instance of the ultimate resemblance of two species sprung from different ancestors.

To distinguish *Grammoceras* from *Dumortieria* is never an easy matter; while to distinguish *Grammoceras mactra* from *Dumortieria Moorei* is a task requiring the very greatest care, so extreme is the convergence. However, the following general rules will be found to hold good in the separation of the two genera:

Grammoceras.	*Dumortieria.*
Ribs with a slight bend on the lateral area, and with a very pronounced forward sweep on the ventral area.	Ribs with a general forward inclination, without any bend on the lateral area, and with only a short forward projection on the ventral area.
Suture-line with short lobes and shallow saddles, with a well-marked inferior lateral lobe, and with the inner portion of the suture-line level with the rest.	Suture-line with a fairly deep siphonal saddle, with a superior lateral lobe, generally longer than the siphonal, with practically no inferior lateral lobe, but with the inner portion of the suture-line brought down very obliquely.

The above rules will serve our purpose for the present, but they will receive elaboration when I treat of *Dumortieria*. The reader must remember that only by constant practice will he become expert enough to separate the two genera at a glance.

The genus *Grammoceras* is interesting for its geological range, during which its progression in the matter of development is very slight. The earliest species known at present is *Grammoceras antiquum* (Wright) in the *Jamesoni*-zone; but as this shows in its flattened sides and absence of ribbing more development than many of the later forms, we can easily come to the

matter, and, as Dr. Haug has done much work with these forms, my remark must be received with caution. The suture-line of *Dum. Levesquei* agrees fairly with the sutures of young *Dum. Jamesoni*, as shown by Haug, and points to their being descended from a common stem, but I prefer to imagine, unless the evidence to the contrary is very conclusive, a gradual increase in the suture-line from *Polymorphites* to *Dumortieria Levesquei*, and not a quick increase to *Jamesoni* and a subsequent reduction to *Levesquei* unaccompanied by whorl-changes sufficient to account for it.

conclusion that it is in reality not the earliest species of the genus. Such a species we should expect to find possessed of evolute quadrate whorls, coarse ribs, and a sulcate ventral area.

Until we reach the *Jurense*-zone the appearance of *Grammoceras* is little more than fitful. Some of the better known species of the genus are *Grammoceras Normanianum* (d'Orbigny) and *Gramm. Kurrianum* (Oppel) in the *Margaritatus*-zone, *Grammoceras acutum* (Tate) in the *Spinatum*-zone, *Gramm. ovatum* (Young and Bird), and *Gramm. capillatum* (Denckmann) in the *Commune*-zone.

With the advent of the *Jurense*- and *Opalinum*-zones a large number of species of *Grammoceras* are found; in fact, the genus may be said to dominate that period exclusively. At the end of the *Opalinum*-zone it dies out abruptly, and only one dwarf species is found in the *Murchisonæ*-zone. Some of the species which are found in the *Jurense*-zone, such as *Gramm. toarcense*, *Gramm. quadratum*, &c., are less developed—have more resemblance to the supposed parent form—than those that are met with earlier. This is a curious fact; and we must either suppose that these species have reverted, or else that the immediate ancestors of some of the later forms have not yet come to light. I prefer this latter theory, because we find no trace of any reversion in the young of the later forms, and we see that the species develop normally during the *Jurense*- and *Opalinum*-zones. I do not therefore consider that *Gramm. antiquum* is the actual ancestor of *Gramm. toarcense*, nor that—in spite of their resemblance in shape—*Gramm. Kurrianum*, with its knife-like, carinate, ventral area, is the parent of the later *Gramm. fallaciosum* with its well-marked ventral area and high hollow carina.

The species of the genus with which I have to deal may be divided roughly into two groups: (1) the *Striatulum*-group—the species with a solid carina; (2) the *Fallaciosum*-group—the species with a hollow carina. Whether the difference in the carina indicates a different origin for the members of the two groups I am not in a position to say. In the horizon with which I have to deal at present the two groups are certainly clearly defined; but my difficulty consists in not having been able to obtain specimens of the earlier species showing the structure of the carina.

I have said that *Grammoceras* dominates the *Jurense*- and *Opalinum*-zones; and what is more, its geological range in this country is practically limited to the district of the South Cotteswolds, which lies between Haresfield Hill on the north and Sodbury on the south. I do not say that *Grammoceras* occurs nowhere else, but that the above-named district may be considered its headquarters. I have previously given several sections of this district (pp. 43, 44); but further research has shown that the strata are capable of more minute division, and that their correlation with the Dorset-Somerset strata—a point at that time in much obscurity—is thereby more easily explained. In addition, further work in the

Dorset-Somerset district has enabled this correlation to be undertaken with certainty.[1]

The following sections will exhibit this more minute mode of division founded solely upon the occurrence of the Ammonites; and they will also show the different lithological conditions which belong to the same palæontological horizon. The different positions which the same species occupy in different districts with relation to deposits of yellow sands is a point of importance.

X. *Section in Buckholt Wood (ten and a half miles from Gloucester, south by west).*

		Ft.	In.
Moorei-beds.	1. Brownish stone, darker brown grains. *Dumortieria Moorei* (Lycett), *Gramm. mactra* (Dumortier), *Rh. cynocephala, Tereb. haresfieldensis* .	1	9
Dumortieria-beds.	2. Dark-grey and sometimes brownish stone with dark-brown grains. *Dum. radians* (Rein.), *Rhynch. cynocephala, Tereb. haresfieldensis* . .	2	0
Dispansum-beds.	3. Reddish-yellow sticky marl; in places numerous *Belemnites* . .	0	6
	4. Dark-grey, ironshot stone, soft, breaking up into shales. *Gramm. dispansum, Hamm. insigne*	1	0
Striatulum-beds.	5. Marl	0	2
	6. Light-yellow soft stone. *Gramm. dœrntense, Gramm. striatulum* .	0	9
	7. Brownish marl, numerous dark-brown grains. *Gramm. Cotteswoldiæ* .	0	7
	8. Yellowish stone. *Gramm. striatulum, Haugia Eseri* . . .	0	6
Variabilis-beds.	9. Rounded lumps and irregular masses of blue-hearted sandstone, the interstices and cavities filled with bed above	1	3
	10. Yellow sands (Cotteswold Sands)		

XI. *Section at Little Sodbury (eleven miles north of Bath).*

		Ft.	In.
	1. Whitish limestone with white grains		
Opalinum-beds.	2. Straw-coloured, shelly, sandy limestone . . . about	2	0
	3. Reddish-brown, very hard, ironshot limestone . . about	1	0
Moorei-beds.	4. Greyish, much ironshot marl; in some places softer, in others harder. *Rhynch. cynocephala, Dumortieria Moorei* . . .	4	6
Dumortieria-beds.	5. Darker, soft mudstone, much ironshot. *Dumortieria radians, Rhynch. cynocephala, Chemnitzia procera*	2	6
	6. Grey ironshot marl	3	0
Dispansum-beds.	7. Grey sandstone, *Lytoc. Germaini* (fragment) . . .	0	4
	8. Yellow and grey micaceous sands	8	0
Striatulum-beds.	9. Hard yellowish, somewhat ironshot stone. *Gramm. striatulum* . .	0	10
	10. Grey marl	1	2
	11. Much ironshot marl and mudstone. *Gramm. Cotteswoldiæ* . .	0	8

[1] "The Cotteswold, Midford, and Yeovil Sands," 'Quart. Journ. Geol. Soc.,' vol. xlv, pp. 440—474, 1889.

		Ft.	In.
12.	Grey shelly sandstone, some few brown oolite specks. *Gramm. striatulum, Haugia occidentalis*	1	6
13.	Yellow sands. *Gramm. striatulum* towards the top . . .	2	0
14.	Grey sandstone. *Gramm. striatulum*	0	4
15.	Greyish sands	2	6
16.	Grey sandstone. *Gramm. striatulum*	0	9
17.	Yellowish sands	4	0
18.	Yellow sandy stone. *Gramm. toarcense-striatulum* (Pl. XXVIII, fig. 14) .	1	8
19.	Yellow sands, only a few inches visible.		
	There are about 15—20 feet more of sands before the clay is reached; but as these are not exposed it cannot be said if they contain any hard bands with Ammonites		

XII. *Section at Lyncombe cutting (about one mile south of Bath).*[1] *Typical section of Midford Sands.*

			Ft.	In.
Parkinsoni-zone.	1.	Yellowish oolite limestone. *Terebr. globata, Rhynch. spinosa,* &c. .	4	0
Midford Sands, upper part uncertain, lower part *Dispansum*-beds.	2.	Yellow micaceous sands containing numerous lines of sandburrs about *Gramm. fallaciosum* was obtained from fallen sandburrs.	100	0
Striatulum-beds.	3.	Yellowish-brown stone with very numerous lighter-coloured oolitic grains, which fall out and leave the stone pitted. *Gramm. striatulum, Gramm. toarcense*	0	5
		This bed is cemented on to:		
Commune-zone.	4.	Yellowish stone with the oolite grains less numerous, and therefore it appears of a closer texture. *Dactyl. Holandrei, Dactyl. crassum, Hild. bifrons, Waldheimia Lycetti, Rhynch. sp.* . . .	0	4
		This bed is firmly cemented to:		
Falciferum-zone.	5.	Close-grained, soapy-feeling, greyish-blue stone, without any trace of grains. *Harp. falciferum*	0	10
	6.	Greyish-blue clay	0	6
	7.	Close-grained, greyish, mottled stone	0	4
	8.	Greyish-blue clay.		

XIII. *Section exhibited in the road at White Lackington, near Ilminster, Somerset.*

			Ft.	In.
Dumortieria-beds.	1.	Yellow micaceous sands (the base of the well-known Yeovil Sands) becoming browner towards the bottom		
Dispansum-beds.	2.	Arenaceous brown and light yellow marl-bed, somewhat decomposed; occasional pockets of bluish-grey argillaceous marl. *Lytoc. jurense, Lytoc. Germaini ?, Lytoc. rubescens ?, Pelecoceras serrodens, Hamm. insigne, Amm. discoides,* fragment like *Gramm. striatulum, Gramm. dispansum* (fragment)	0	2
	3.	Yellowish-grey soft stone, somewhat sticky, with soapy feel. *Amm. discoides, Hamm. insigne*	0	9
Striatulum-beds ?	4.	Bluish-grey tenacious clay with occasional nodules. No fossils found .		

[1] Compare Winwood, 'Proc. Bath Soc.,' vol. iii, No. 2, 1875.

[2] Compare with Section VIII, p. 47.

The correlation of the sections previously given with these, and their arrangement into beds, will be facilitated by the following table:

Name of Beds.[1]	Haresfield, p. 43.	Coaley,[2] p. 45.	Nibley, p. 46.	Burton Bradstock, p. 47.
Opalinum	Nos. 8—15	Nos. 3, 4	Nos. 4, 5	Nos. 3, 4
Moorei	„ 16, 17	„ 5, 6	„ 6, 7	„ 5
Dumortieria[3]	„ 18, 19[4]	Not identified	„ 8—11	
Dispansum	Absent	No. 7	„ 12, 13	
Striatulum		„ 8, 9	„ 14, 15	

The Yeovil Sands contain part of the *Opalinum*-, the *Moorei*-, and the *Dumortieria*-beds of the Cotteswold district, so that their deposition did not commence until after the deposition of the Cotteswold Sands had concluded.

The Midford Sands contain, at any rate in the lower part, *Gramm. fallaciosum*, indicating the presence of the *Dispansum*-beds; while at the base lies a bed with *Gramm. striatulum*, cemented on to a very thin layer of the *Commune*-zone, which in turn is cemented on to the *Falciferum*-zone. The matrix is different in each case, but more noticeably between the two lower.

At Little Sodbury the sands are only about thirty-five to forty feet thick. What the lower part contains is unknown, but the upper part contains Ammonites signifying the horizon of the *Dispansum*- and *Striatulum*-beds. Consequently the deposit of yellow micaceous sands began and finished earlier in the north, and as

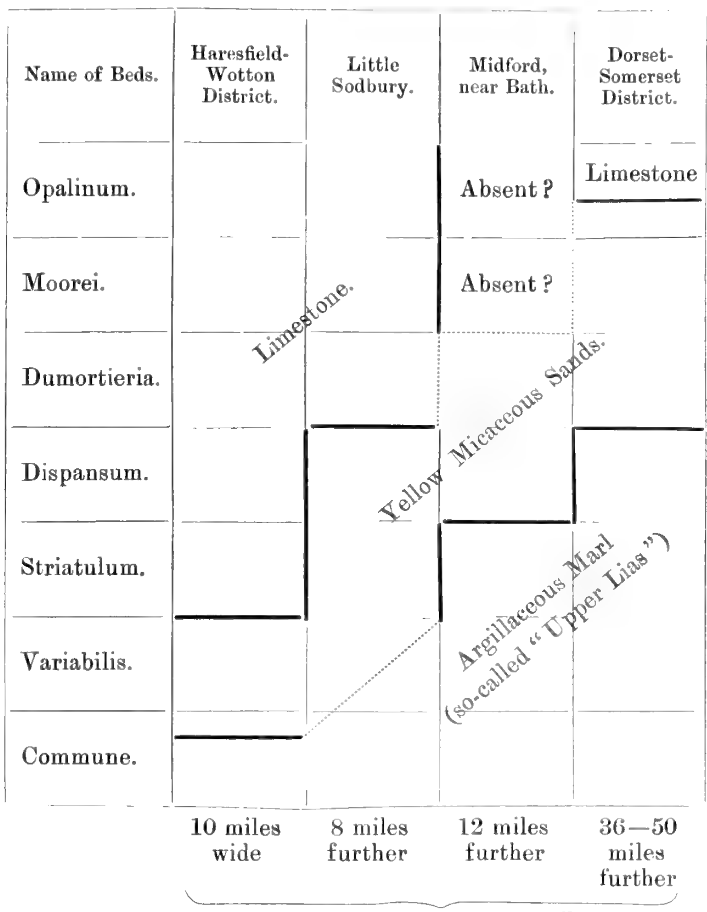
[1] The word "beds" is used as of less value than "zones." The two higher beds I have considered as the *Opalinum*-zone, the three lower as the *Jurense*-zone; but a really sharp line cannot be drawn between them anywhere. It must be understood that I do not pretend that even the species which gives its name to a bed is confined to that horizon, but only that I have found it dominant therein.

[2] In section vi, p. 45, occurs a printer's error: *Striatulum*-subzone should not be opposite C″, but opposite bed 7, which should be marked C′.

[3] Bed 19 at Haresfield (p. 44) belongs to the *Dumortieria*-beds. The true *Striatulum*-beds are apparently wanting there.

[4] *Dumortieria*-beds I had not distinctly recognised when Part II was written because I had not visited the exposures where the strata are typically developed. The Ammonites of all the Cotteswold developments of the *Dumortieria*-beds are extremely poorly preserved. Unfortunately, the strata of the *Opalinum*- and *Jurense*-zones, especially in the Cotteswolds, do not yield Ammonites in good condition, and hence much of our work among the species of the genus *Grammoceras* is rendered very difficult. But the genus *Dumortieria* suffers even more from the poor preservation of its specimens, because the specimens in the *Dumortieria*-beds are in much the worst condition.

we travel southwards we find it ever later in point of time. The following diagram will show this matter clearly:



Total distance about 80 miles.

For further particulars concerning the correlation of the Cotteswold, Midford, and Yeovil Sands, and for additional sections I must refer the reader to my paper on these deposits in the 'Quarterly Journal Geol. Soc.,' vol. xlv, pp. 440—474, 1889.

The annexed table will show how some of these same deposits are found in the Yorkshire and Northampton districts, as well as in the Cotteswolds and south of the Mendips.

My knowlege of the Yorkshire strata is derived from a collection of Ammonites kindly forwarded by Mr. Hudleston, F.R.S. No species of Ammonites indicative of the horizons of the *Opalinum*- and *Moorei*-beds, as now defined, were found; but these strata may possibly be represented, either in the top of the Yellow Sands or the bottom of the overlying Dogger. Ammonites labelled "from the Yellow and Grey Sands" indicate the horizon of the *Dumortieria*-beds; while representative species of the *Dispansum*-, *Striatulum*-, and *Variabilis*-beds are found in the black "*Striatulus*-shales."

Beds.	Yorkshire.	Northampton.	Cotteswolds, Haresfield-Wotton District.	Dorset-Somerset District (south of Mendips).
Opalinum.	...... Absent ?	Northampton Sands.	Sandy ferruginous Limestone.	Inferior Oolite Limestone.
Moorei.				Yeovil
Dumortieria.	Yellow Sands, Grey Sands, below Dogger.		Cephalopoda-	Sands.
Dispansum.	The	Absent.	bed.	"Upper
Striatulum.	*Striatulus-*			Lias
Variabilis.	shales.		Cotteswold	Clay."
Commune.	The Alum-shale.	"Upper Lias Clay"	Sands. "Upper Lias Clay"	

The Northampton Sands contain representative species of the *Opalinum*-beds; but all the evidence obtainable seems to point to the absence of beds from *Moorei* to *Variabilis* inclusive. I have seen no Ammonites of any of those horizons, nor have any of the species been quoted.

From Dundry, which is not included in any of the above districts, Mr. E. Wilson, F.G.S., has sent me specimens of *Gramm. striatulum* and *Gramm. aalense*, indicating the presence of the *Striatulum*- and *Moorei*-beds. Possibly more of the horizons may be present, but the deposit is very thin, and is only occasionally, and very poorly, exposed.

From Cranmore, Somerset, which I have not really included in the above districts, Mr. Hudleston sent me *Gramm. fallaciosum* indicative of the *Dispansum*-beds.

It may be advantageous to say a few words concerning some of the foreign works which deal almost exclusively with the fauna of the *Jurense* and *Opalinum* zones, and consequently with the genus *Grammoceras*. Of course I have no need to mention what may be regarded as the standard works of d'Orbigny, Quenstedt, &c., but will notice the following:

Dumortier, 'Études Paléontologiques sur les Dépots Jurassiques du Bassin du Rhône.' Quatième partie, 'Lias Supérieur,' Paris, 1874. This admirable work contains excellent figures of many species of *Grammoceras*, besides many other

Ammonites confined to the period we have mentioned. The strata with which it deals are divided into the zones of *Am. bifrons*[1] and *Am. opalinus;* and we may take it that the former probably includes the *Jurense*-zone, together with a certain portion of what is referred to in this Monograph as the *Commune*-zone. A large proportion of the species figured by Dumortier are now found in our English strata.

Branco: "Der Untere Dogger Deutsch-Lothringens," 'Abhandlung zur geologischen Spez.-Karte von Elsass-Lothringen,' Band ii, Heft 1, Strasburg, 1879. This work is remarkable for the extreme excellence of its plates. Under the generic name *Harpoceras*, species of the genera *Dumortieria* and *Grammoceras* are included—in fact, in one or two instances specimens really belonging to the two genera are referred to the same species. I have always been especially struck with the extreme accuracy of delineation displayed in the plates of this work, because the little-noticeable points which separate some species of *Dumortieria* from *Grammoceras* are all brought out with the greatest accuracy, so that the task of separating the members of the two genera is rendered comparatively easy. For studies and drawings of the inner whorls of many species this work is also to be noted.

A. Denckmann: "Fauna von Dörnten," 'Abhandlung zur geologischen Specialkarte von Preussen und den thüringischen Staaten,' Band viii, Heft 2, Berlin, 1887. This work contains many new species of *Grammoceras*, concerning which the following pages will give further information. The species are worked out with very considerable care, and many of them are evidently very closely related. Hence to discriminate between the various species intended is a matter of extreme difficulty, which has been rendered all the harder by the fact that the author has, in some cases, been unable to give us sufficient details, especially in regard to front and back views. Where species are so very similar the want of these details presses somewhat hardly on those who try to interpret the work. With a limited number of specimens this interpretation would have been a matter of impossibility.

Grammoceras toarcense (*d'Orbigny*). Plate XXVIII, figs. 4—13; Plate XXXIV, fig. 12; and intermediate form, *Gramm. toarcense-striatulum*, Plate XXVIII, figs. 14, 15.

1830. Ammonites radians, *Zieten* (non *Reinecke*). Verstein. Würt., pl. iv, figs. 3 *a*, *b*, *c*.

1843. — Thouarsensis, *d'Orbigny*. Ceph. Jurass., Pal. Franç., pl. lvii, p. 222.

[1] See p. 114.

1846. Ammonites radians depressus, *Quenstedt.* Ceph., pl. vii, figs. 4 *a*, *b*, only.
1850. — Comensis, *d'Orbigny* (non *von Buch*). Prodrome pal. stratigr., vol. i, p. 245.
1853. — — *Chapuis et Dewalque* (non *von Buch*). Foss. Luxembourg; Mém. cour. et Mém. des sav. étrang., tom. xxv, pl. viii, fig. 4; pl. ix, fig. 1.
1856. — Thouarsensis, *Oppel.* Juraf., p. 248.
1858. — radians depressus, *Quenstedt.* Jura, pl. xl, fig. 14.
1874. — Thouarsensis, *Dumortier.* Études pal. Bassin Rhône, 4e partie, p. 63.
1878. Grammoceras Thouarsense *Bayle.* Explic. carte géol. France, pl. lxxviii, figs. 3—5.
1879. Harpoceras striatulum, *Branco.* Unt. Dogger; Abh. geol. Spez.-Karte Elsass-Lothringen, Bd. ii, Heft 1, pl. i, figs. 1—3.
1881. — radians, *Meneghini* (non *Reinecke*). Foss. du Medolo; Pal. Lombarde, 4e série, App., pl. i, fig. 8 (?).
1884. — striatulum, var. comptum, *Haug.* Nouvelles Amm., Bull. Soc. Géol. France, 3e série, t. xii, pl. xv, figs. 2 *a*, *b* (a form with joined ribs).
1884. — — *Wright.* Monogr. Lias Amm. Pal. Soc., pl. lxxxiv, fig. 4 only.
1885. — — *Haug.* Beitr. Monogr. Harpoceras, Neues Jahrbuch für Mineralogie, &c., iii Beil.-Bd., p. 611 (pars).
1885. Ammonites radians depressus, *Quenstedt.* Amm. Schwäbischen Jura, pl. li, figs. 5 and 12 only; pl. lii, figs. 1 and 2 only (non pl. liv, figs. 15—17).

Discoidal, compressed, evolute. Whorls low, subquadrate, ornamented with ventrally-projected, subarcuate ribs which often rise at the inner edge, but are also at times inconspicuous on the inner third of the whorl, thus leaving a plain band; they are largest at the point of curvature on the edges of the ventral and lateral areas. Ventral area, sometimes, more especially in smaller specimens, flattened, with a depressed band or rudimentary sulcus on each side of the carina; at other times, and in more adult specimens, it is sloping. Carina solid and small, less distinct in the adult. Inclusion slightly variable, but never great. Umbilicus large and open, a little more depressed in the centre. Termination of the adult a plain sigmoidal bend. Suture-line very simple; a siphonal and lateral lobe of about equal length, a small superior lateral lobe, and no auxiliaries.

The inner whorls of this species present us with the following facts :—

What Hyatt calls the *Goniatite*-stage is depicted in Pl. XXVIII, figs. 11—13. To this succeeds a smooth stage reminding us of *Psiloceras*, and the smooth inner whorls of *Arnioceras*. The shell is now becoming more evolute, the ventral area is uncarinate but is becoming sharper. The keel may be said to commence before three lines of diameter are attained; and at four and a half lines there is a well-defined carina bordered by two small depressions. As yet the specimen is smooth, for the ribs are not visible until a diameter of about five and a half lines.

It is not without considerable hesitation that I have retained a name for this form as well as for *Gramm. striatulum*. Both Oppel and Dumortier have done so; but they have based their distinction upon the observation that in the former the ribs run across the side to the inner area, while in the latter they do not. This definition, however, though correct in the main, does not, I find, always hold good;[1] and it is, besides, somewhat uncertain. The form to which I apply the name *toarcense* is that which is lower in the scale than *Gramm. striatulum*, that is, it has a squarer, more flattened ventral area, and generally possesses rudimentary sulci at a certain age; it has a thicker, more quadrate whorl with coarse well-marked ribs, which generally, but not always, run right across the whorl; it has a more open umbilicus generally. I use the word "generally" because the form is so variable and does undoubtedly shade into *Gramm. striatulum;* but I prefer to keep the name *toarcense* to mark this particular stage of development. I cannot call *toarcense* a variety of *Gramm. striatulum*, because it is not. If anything, the relationship of the two forms is correctly described as *Gramm. toarcense* mutating into *striatulum*—the latter being in all probability only a further development of the senile stage of the former. At the same time we must remember that it may possibly not be so; because both may be descended from a common ancestor —*Gramm. striatulum* being the more changed form. In this case our present nomenclature would be correct. Again, we must remember that Sowerby's name has priority over d'Orbigny's, and that we have no right to place it in subjection thereto. On all these grounds I prefer to keep the two names.

In *Gramm. toarcense* the rudimentary sulci on a square ventral area which generally appertain to the middle-aged specimens are the most important features in separating the two forms; because this is a stage which *Gramm. striatulum* does not exhibit. At all ages the latter possesses an acute ventral area.

The well-marked specimen of *Gramm. toarcense* shown in Pl. XXVIII, figs. 4, 5, is easily separable from *Gramm. striatulum;* but the form to which d'Orbigny gave his name is not so pronounced as this very coarsely-ornamented example. A specimen which I have had depicted in Pl. XXVIII, figs. 14, 15, is intermediate; because, while it possesses the acute ventral area of *Gramm. striatulum*, it shows the coarse ribs and pronounced inner margin of *Gramm. toarcense;* while its more numerous irregular ribs, some of which disappear on the inner area, are a feature peculiar to itself.

Another form is still more truly intermediate. It possesses the shape—the

[1] See Pl. XXVIII, in which the contrary is exhibited.

sharp ventral area and no defined inner margin—of *Gramm. striatulum;* but it has the ornamentation—coarse distant ribs—of *Gramm. toarcense.* Another form, regarded as belonging more to *Gramm. striatulum,* shows coarse ribs on its outer whorl, supposed to be a case of reversion.

Considering all these facts, it is obvious that there is no hard and fast line of distinction between *Gramm. toarcense* and *Gramm. striatulum;* and looking at their relationship we have no right to expect one. The separate names are retained for the extreme forms as a matter of convenience; and because the uncertain forms are after all not very numerous.

A form of *Gramm. toarcense* with joined ribs is figured by Haug (loc. cit.) as *Gramm. striatulum* var. *comptum.* I have seen one or two specimens with something of this style of ornamentation, but have not been able to obtain them for figuring. A small specimen, remarkable for its very open umbilicus, broad ventral area, and occasional joined ribs I have had depicted, Pl. XXXIV, fig. 12, but this does not show the character like Haug's figure. These joined ribs, which we trace in the young of *Gramm. dœrntense* and *Gramm. aalense,* must have become a definitely fixed character attached to a particular adult form, and specimens of this kind would require a separate name. However, all that my specimens seem to indicate is the prior stage—the time when the character was by no means constant, and when it appeared casually in any varieties of *Gramm. toarcense.* At present I cannot separate any of my specimens under a definite name on account of this character; but possibly the specimens which Haug has obtained are actual intermediate links between *Gramm. toarcense* and *Gramm. dœrntense.*

For *Hildoceras boreale*[1] this species might sometimes be mistaken, especially when the specimens are small; and since this mistake might involve incorrect geological inferences—*H. boreale* occurs in the *Commune*-zone or possibly deeper—it is necessary that it should be avoided. A greater bend of the ribs upon the lateral area, more persistent ventral furrows, a more pronounced—in adult, concave inner margin—accompany some differences in the suture-line and render *Hildoceras boreale* distinct from *Gramm. toarcense.*

With *Dumortieria Levesquei* (d'Orbigny) it is possible that *Gramm. toarcense* might be confounded; but the same difference which separates the latter from *Hild. boreale* separates *Dum. Levesquei* from *Gramm. toarcense;* and this is straighter ribbing on the lateral area. This feature, accompanying a great difference in the suture line, distinguishes *Dum. Levesquei* from *Gramm. toarcense.*

The name of this form was originally written by d'Orbigny as *Thouarsensis;* and herein he has been followed by all authors except E. Deslongschamps, who wrote *Ammonites toarcensis* and *Lima toarcensis.* Since the name is taken from Thouars, a town in Deux Sèvres, of which the correct Latin name is Toarcium, it

[1] *Harpoceras Levisoni,* Wright (non Simpson), 'Monog. Lias Amm.,' pl. lxi, figs. 5, 6 only.

seems that the name should be written *toarciensis*. A term, "Toarcien," derived from the same source was used by d'Orbigny for the strata between the "Liasien" and "Bajocien." Such strata are equal to the Upper Lias, the Sands, and the lower part of the Inferior Oolite of English Geologists.[1]

One of the commoner species in the *Jurense*-zone, *Gramm. toarcense* occurs—at least in Gloucestershire—more frequently than *Gramm. striatulum*[2] with which it is always associated. I have collected it along the flanks of the Cotteswolds at Buckholt Wood, Coaley Wood, Stinchcombe, North Nibley, Wotton-under-Edge, Sodbury, and many intermediate places in Gloucestershire; in Somerset at the Lyncombe cutting near Bath; and Mr. E. Wilson sent for my inspection a specimen from Dundry in the same county. In Yorkshire the species occurs at the Peak, and, I believe, not unfrequently.

Plate XXVIII, fig. 4, exhibits the side view of a fine, adult, extreme form of *Gramm. toarcense* with very coarse ribs and the sigmoidal termination; fig. 5 represents the ventral portion of the termination, and also the broad square ventral area; fig. 6 shows the simple suture-line taken from this specimen. In fig. 7 is seen the side view of another form of which the ribs are not so coarse and are inconspicuous on the inner third of the whorl; fig. 8, illustrates the front view with a characteristic depressed area each side of the carina. Figs. 9, 10 give two views of another specimen. Figs. 11 and 12 represent the inner whorls of the species enlarged about four times; they clearly indicate the Goniatite-stage, as also does the suture-line, fig. 13. Fig. 14 gives the side view of a coarsely-ribbed form, which, however, in its sharpened ventral area (fig. 15) partakes of the characters of *Gramm. striatulum*. In order to express this I have described it as *Gramm. toarcense-striatulum*. Plate XXXIV, fig. 12, shows a variety with forked ribs.

Grammoceras striatulum (*Sowerby*). Pl. XXVI, figs. 7—10; Pl. XXVIII, figs. 16—21; Pl. A, figs. 43, 44.

1825. Ammonites striatulus, *Sowerby*. Min. Conch., vol. v, pl. ccccxxi, fig. 1, p. 23.
1856. — — *Oppel*. Juraf., p. 248.
1864. — striatulus, *Seebach*. Hann. Jura, p. 140 (pars).
1867. Grammoceras striatulum, *Hyatt*. Ceph.; Bull. Mus. Comp. Zool., p. 99.

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[1] See my paper on the "The Cotteswold, Midford, and Yeovil Sands, and the Division between Lias and Oolite," 'Quart. Journ. Geol. Soc.,' vol. xlv, pp. 440—474.

[2] Hitherto I have used the latter name for both forms indiscriminately.

1874. AMMONITES STRIATULUS, *Dumortier*. Études pal. Bassin Rhône, 4e partie, pl. xvi, fig. 1, p. 64.

1876. HARPOCERAS STRIATULUM, *Blake*. Cephalopoda, Yorkshire Lias, p. 308.

1885. — — *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 611 (pars).

1885. AMMONITES RADIANS DEPRESSUS, *Quenstedt*. Amm. Schwäbischen Jura, pl. li, fig. 13 only.

1887. — (HARPOCERAS) STRIATULUM, *Denckmann*. Fauna ober Lias Doernten; Abh. geol. Specialkarte Preussen und den thüringischen Staaten, pl. viii, figs. 2, 3; pl. x, fig. 12.

Discoidal, compressed, subcarinate. Whorls elliptical, ornamented with fine ventrally-projected subarcuate radii, which are sometimes more or less obsolete upon the inner area. Ventral area not defined, carina small and barely distinct—in the adult almost obsolete. No inner margin. Inclusion about one third. Suture-line (Pl. A, fig. 43) much the same as in *Gramm. toarcense;* lobes very shallow. Termination in youth with a small lateral, apparently spathulate, auricle (Pl. XXVIII, figs. 20—21).

Sowerby thus describes his species: " Discoid, carinated, radiated; sides of the whorl convex, the inner whorls exposed; radii numerous, slender, undulated; surface covered with minute striæ parallel to the radii; aperture elliptical."

I have caused to be redrawn the British Museum specimen (marked with the green ticket used to indicate the figured type-fossils). It is possible that it may have been broken and mended after it was figured in the 'Mineral Conchology.' The broken portions have not been depicted by Sowerby; and the pieces of shell so sharply defined in his figure are not visible on this specimen.

If it be not the original of the species yet I think that the specimen may be considered typical; and from it we see that the characteristics are fine, rather obscure ribs—smaller than Sowerby's drawing might lead us to suppose—and a very slender carina; while the sides of the whorl are convex and slope gradually towards both edges.

The name "*striatulus*" was given to the specimen on account of the fine striæ observable between the ribs on the test. This feature, which is not confined by any means to this species, is to be seen in well-preserved specimens only.

This species may be regarded as inheriting the senile stage of *Gramm. toarcense* very early, and continuing the features of that stage in the same line; and its relationship to *toarcense* has been discussed under that heading. To that species some specimens show a reversion, in the production of coarse ribs late in life.

The horizon—a part of the *Jurense*-zone—of which this species and *Gramm.*

toarcense are together characteristic lies in Yorkshire above the Alum-shale with *Hild. bifrons* and *Dactyl. commune*, and below the Grey Sands with *Dumortieria* sp. *Pelecoceras affine, Pel. Sinon* (Bayle)—(see above, p. 167).[1]

Leaving Yorkshire, we do not find any record of this species or its horizon until we reach the south side of the Stroud Valley.[2] From thence to Wotton-under-Edge it occupies an horizon just above the Cotteswold Sands (sections vi—vii, p. 45, 46; section x, p. 164).

At Little Sodbury it occurs in several rock-bands *in* yellow sands[1] (section xi, p. 164), and I have also found it *in* Sands at Hinton.

At Lyncombe Cutting, on the Somerset-and-Dorset Railway between Bath and Midford, I have found it *below* yellow sands—the Midford Sands (section xii, p. 165). A specimen from Trent, Somerset, and a fragment from White Lackington, near Ilminster, referred to this species, are from the so-called "Upper Lias."

It is interesting to notice that *Gramm. striatulum* and *toarcense* would, in accordance with some geological divisions, have to be quoted as in the Lias in Somerset, and in the Inferior-Oolite Series ("so-called Midford Sands") in Gloucestershire. It is needless to point out that the horizon is really the same in both cases; but the lithology is different, and correlation by lithological characters has caused the error. The same remark applies to several other species, such as *Gramm. dœrntense*, *Gramm. dispansum*, *Amm. discoides*, &c.

On account of the same facts Dr. Wright, having divided these strata into three horizons, called, in ascending order, the Upper-Lias Clay, the Upper-Lias Sands, and the Upper-Lias Cephalopoda-bed, stated that certain species were common to the three horizons. The explanation of this can be found at p. 167.

The typical *Gramm. striatulum* does not occur so frequently as might be supposed from its quotation; but this is because its name has in general, as well as in the earlier parts of this Monograph, been used to include *Gramm. toarcense* (p. 171).

Plate XXVI, figs. 7, 8, give two views of what is believed to be Sowerby's type-specimen of *Ammonites striatulus*, which is contained in the British Museum Collection and came from Robin Hood's Bay, Yorkshire; fig. 9 is added to show the curvature of the ribs accurately, a feature so characteristic of *Grammoceras*, and it is taken from a rubbing of the surface; fig. 10 is the suture-line of this

[1] From examination of specimens sent by Mr. Hudleston. See also his paper on "The Yorkshire Oolites," 'Proc. Geologists' Assoc.,' vol. iii, No. 7, pp. 294, *et seq.*, 1874; and Tate and Blake, 'Yorkshire Lias,' pp. 181, 191, 1876.

[2] P. 45, bed 19. The fragments referred to *Gramm. striatulum* at Haresfield Hill do not belong to that species or to *Gramm. toarcense.*

[3] When I wrote p. 49 I did not know that the sands also occurred above *Gramm. striatulum.*

species. The drawings for both figs. 9 and 10 were made for me by Mr. G. C. Crick, F.G.S., to whom I am much indebted,—fig. 9 from a rubbing of the surface, fig. 10 from a tracing from the specimen. Plate XXVIII, fig. 16, shows the side view of variety with somewhat coarser ribs and a smaller umbilicus; fig. 17 is the outline of the aperture. Figs. 18, 19 show two views of a compressed young form from Stinchcombe; it possesses no portion of its test. Figs. 20, 21 illustrate a small specimen with the mouth-border fairly complete—fig. 20 showing what appears to be a spathulate lateral process incomplete upon its upper edge, fig. 21 exhibiting the bluntly-pointed ventral process. In Plate A, figs. 43, 44 show the suture-line.

GRAMMOCERAS MACTRA[1] (*Dumortier*). Plate XXX, figs. 3—7; Plate XXXI, figs. 1—4.

1874. AMMONITES MACTRA, *Dumortier.* Études pal. Bassin du Rhône, iv, pl. 1, figs. 4, 5.
1878. LUDWIGIA MACTRA, *Bayle.* Explic. carte géol. France, pl. lxxx, figs. 2, 3.
1886. HARPOCERAS MACTRA, *Vacek.* Oolithe Cap san Vigilio; Abh. d. k.-k. geol. Reichsanstalt Wien, Band xii, No. 3, pl. ix, fig. 14.
1883. — AALENSE, *Wright* (non *Zieten*). Monogr. Amm., Pal. Soc., vol. xxxvii, pl. lxxv, fig. 10 only.
But not:—1879. — MACTRA, *Branco.* Unt. Dogger, Abh. geol. Spezialkarte v. Elsass-Lothringen, Bd. ii, pl. i, fig. 10 (*Dumortieria Moorei,* Lyc.).

Discoidal, much compressed. Whorls nearly flat, ornamented with subarcuate radii—generally very fine and numerous, often fascicled, but sometimes irregular and coarser, especially in the inner whorls—always strongly projected ventrally. Ventral area undefined, carrying a small carina, or (Plate XXXI, fig. 4) without any distinct carina—the two edges meeting at a slight angle. Inner margin variable—convex and undefined, or sharply defined and almost concave. Inclusion one-third to one-half. Umbilicus open and flat, scored in the inner whorls with fascicled ribs, or with irregularly-distant coarser ribs producing a somewhat similar appearance.

The general characters of this species—much-compressed whorls ornamented with numerous very fine striæ, render it fairly distinct, but in some features it is liable to vary. The most typical specimen is (*a*) depicted in Plate XXXI, fig. 1, but even this has a smaller umbilicus than Dumortier's figure. Another form, β (Plate

[1] *μάκτρα,* a kneading-trough. For a very flat Ammonite like this the name seems inappropriate.

XXXI, figs. 3, 4), fairly typical in side view, has practically no carina—the edges of the ventral area meet at an angle, which becomes blunt and almost rounded off in the last whorl. Another form, γ (Plate XXX, figs. 3, 4), shows a much more compressed section than Dumortier's figure. It also has a well-marked inner margin, seen neither in that figure nor in the other specimens. Yet another form, δ (Plate XXX, figs. 5, 6), has coarse ribs until what is, for this species, late in life; and these ribs are not fascicled, but are separated by unequal spaces, so that now and then two or three come closely together on the inner margin.

The fact is that the various specimens show a gradual progression of development in different directions. The form δ shows the greatest resemblance in ribbing to the supposed parent-form, while the form γ is more removed, for it assumes at 0·7 inches the fine striæ which the other does not get till 1·7 inches. It also has a more developed inner margin. The form β is actually a senile form, exhibiting—in the fact of its almost uncarinate ventral area—the decay of a character really peculiar to the species. It is this very decay of the carina which helps the convergence to *Dumortieria Moorei*. The form α possesses a smaller umbilicus, and shows the tendency of the species to advance in this direction, though still retaining a sharp carina.

It is most probable that *Gramm. mactra* is the direct descendant from *Gramm. striatulum*, and that the form δ shows the period when greater compression had been obtained, but the coarse ribs had not yet entirely disappeared from the inner whorls.

The other forms show the development of the latter character, accompanied by the acquirement of different characters in each form. Though *Gramm. mactra* be regarded as a still further development of the characters of the senile *Gramm. striatulum*, it may yet be definitely separated from that species by its very numerous, often fascicled, fine striæ, by its compressed shape, and its broader whorls.

As the literature on the subject will show, *Gramm. mactra* is far more likely to be confounded with species of other genera, particularly with those of *Dumortieria*, than with forms of its own genus.

The extraordinary convergence in shape between this species and *Dumortieria Moorei* is one of the most interesting features in Ammonite development. To the researches of Dr. Haug[1] we are greatly indebted for a better knowledge of the curious convergence between *Dumortieria* and *Grammoceras*, and for the correct specific denominations of the various forms.

The list of synonyms given to the various species of *Grammoceras* and *Dumortieria* will abundantly prove the perplexing trouble which they have

[1] "Beiträge Monog. Harpoceras," 'Neues Jahrbuch für Miner., &c.,' iii, Beil.-Bd., 1885, and "Polymorphidæ," *ibid.*, Bd. ii, 1887.

given to palæontologists. *Dumortieria radians*, *Dum. Moorei*, *Dum. subundulata*, *Gramm. subserrodens*, and this species have been considered merely as individuals of one form called *Am. Moorei;* and this form was not even allowed to be a good species, but was, with many other species, considered merely as a variety of a so-called *Am. aalensis*,[1] or sometimes of *Am. opalinus*,[2] or occasionally these two species were merged in one.[3]

Such opinions are partly due to the extraordinary convergences which arise between these species—convergences brought about to a certain extent by the fact of the same law of development governing these forms (p. 133 *et seq.*).

This species has, more than any other, passed under the designation of *Am. Moorei*, Lycett; and it was only by a very careful comparison of certain specimens with Lycett's original in the Museum of the Geological Survey—aided, too, by Mr. E. T. Newton, who kindly developed the suture-line of that species for me—that I was able to see that we really had to deal with two distinct species, and actually, in spite of their great resemblance, with members of two genera—the descendants of two different lines of ancestors whose common source is at any rate not later than the lowest beds of the Lower Lias.

It is both to this species and to *Dumortieria Moorei* mixed together[4] that I am referring whenever I have mentioned *Gramm. Moorei* in the pages of the first three portions of this Monograph (pp. 1—144). The resemblance of the two species is so close that it is necessary not only for the specimens to be in good preservation but for every feature to be clearly shown; and even then it requires not only great care but much experience to rightly separate these two extraordinary species. In general the condition of the specimens found, whether in the so-called Cephalopoda-beds of the Cotteswolds, or in the Yeovil Sands, is far from satisfactory, so that the determination of many specimens cannot be entertained. This remark applies equally to the majority of the *Grammocerata* which have their chief location in these strata.

Grammoceras mactra is not a common fossil. It occurs in that part of the *Opalinum*-zone to which I have applied the term *Moorei*-beds, and consequently is an actual companion of these species of *Dumortieria* which so closely resemble it in all respects, namely, *Dum. Moorei* and *Dum. subundulata.* Whether they are mimetic of this species, or *vice versâ*, is an interesting point. It is also singular to find that in the same bed we first met with *Lioceras opalinum*, a species having a similar ornamentation of fine striæ, which has led to its being considered more

[1] Lycett, "Ammonites of the Sands intermediate to the Upper Lias and Inferior Oolite," 'Proc. Cotteswold Club,' vol. iii, 1865; also Wright, 'Monograph Lias Amm., Pal. Soc.,' p. 458, 1884.

[2] Wright, ibid., p. 148, 1879.

[3] Lycett's manuscript quoted by Wright, ibid., p. 465, 1884.

[4] For the differences see p. 162.

nearly allied to *Gramm. mactra* than is really the case. As if to give further strength to this idea, we have *Gramm. subserrodens* (see below), also a finely-ribbed species, in the same bed, and this species is, in outward shape, exactly intermediate between *Gramm. mactra* and *Lioc. opalinum.*

The head-quarters of *Gramm. mactra* are, in Gloucestershire, on the flanks of the so-called Frocester Hill, namely, in Buckholt Wood and at Coaley Peak; it also occurs at Haresfield Hill. In Dorset it occurs in the Sand-rock of the Yeovil Sands at Bradford Abbas; but there it is very rare, and is with difficulty distinguished from its companion, the commoner *Dumortieria Moorei.*

Plate XXXI, fig. 1, represents the side view of a broken specimen of the form α, with its fascicled striæ producing bulgings or "false ribs" upon the inner area; fig. 2 shows its suture-line. On the same plate, figs. 3, 4 exhibit two views of the senile form β; fig. 4 is noticeable for its almost uncarinate ventral area. Both these specimens came from Frocester Hill (Coaley Peak) *Opalinum*-zone. In Plate XXX, fig. 3, is seen the side view of the form γ, noticeable for its well-marked inner margin (the artist has somewhat exaggerated the irregular ribs); fig. 4 shows the front view of this compressed form. Figs. 5, 6 illustrate two views of the coarse-ribbed variety δ; and fig. 7 shows its suture-line. Of the two specimens figured in this plate the first is from Buckholt Wood and the other from Coaley Peak, two localities not very far apart.

Grammoceras subserrodens (*Branco*). Plate XXXI, figs. 5—14.

1879. Amaltheus subserrodens, *Branco.* Untere Dogger; Abhandl. z. geol. Spez.-Karte v. Elsass-Lothringen. Bd. ii, pl. iii, fig. 2.

Discoidal, compressed, carinate, in general form like a *Lioceras.* Whorls broad and flattened, ornamented with fine, ventrally projected, subsigmoidal radii. Ventral area undefined, the two sides sloping acutely, and forming a fairly prominent carina. Inner margin distinct, upright or slightly concave. Inclusion one-half to two-thirds. Umbilicus small but shallow. Suture-line simple, little ornamented, superior-lateral lobe but little longer than siphonal, inferior lateral about half the size, three or four small denticulations representing incipient auxiliaries.

Branco considered his species to belong to the genus *Amaltheus*, that is to say, to the group of *Am. serrodens*, which has often been placed in that genus. He supposed that the species was closely related to his "*Amaltheus*" *Fridericii;* but he observed (p. 60) concerning the suture-line, "Bei dem kleinen *Am. subserrodens* sind der 1. und 2. Seitenlobus relativ schmäler und tiefer und enden dreispitzig; bei dem grösseren *Am. Fridericii* ist Alles einfacher."

The species itself Branco describes as follows:

"Im ausgewachsenen Zustande besitzt diese, der vorigen verwandte Art 5 Umgänge, welche mässig rasch in die Höhe wachsen. Vom Nabel aus steigen die wenig gewölbten Seiten anfangs mit geringer Convergenz empor, um sich später rasch in der scharfen Externseite zu vereinigen, die keinen abgesetzten Kiel trägt. Die Schaale zeigt feine Anwachsstreifen, von welchen auf dem Steinkerne jedoch keine Spur bemerkbar ist. Auf dem letzten Umgange stellt sich eine (auf der Abbildung ungenügend wiedergegebene) Nathfläche ein, welche ziemlich steil gegen den Nabel hinabfällt."

The above description agrees perfectly with the specimens which I have figured except in two ways. "The ventral area bearing no keel set upon it" is not according to my description; but it really depends on how we consider the matter. The carina is in reality no more than a compression of the two sides of the ventral area, and that it forms a very prominent object is shown by Branco's fig. 2 *a*, in which what I should call the carina—but he regards as the sharpened outside—appears more prominent than in my specimens.

The other matter is that "there is no trace of the fine growth-lines to be detected upon the core." Now, most of my specimens show well-marked growth-lines upon the core (Plate XXXI, figs. 5, 10, 13); but I must also remark that, in some more poorly-preserved examples, the growth-lines are certainly to be detected only with great difficulty, and the specimens really appear quite smooth. Practically speaking the suture-line of this species differs from that of *Grammoceras* only in possessing an inferior lateral lobe rather longer, and the incipient auxiliary lobes more numerous; but these facts are exactly what we might expect on account of the more extended side.

It is this stretching in order to accommodate itself to the increased side that causes the suture-line to appear somewhat more like that of *Pelecoceras* (*Am.-serrodens*-group); yet Branco's own drawings show the difference in this respect. In *Pelecoceras* (i. e. *Am. Fridericii*) the suture-line is little more than a jagged waved line, slightly lower where the lobes are. In this species the superior and inferior lateral lobes are at any rate well-marked and distinctly protruded.

This species occurs in the same bed as *Gramm. mactra;* and I should be entirely disposed to regard it as a further development of the form *α* of that species were it not that some of the young specimens of this one seem to be too coarsely ribbed. However, if not a direct descendant of *Gramm. mactra*, it has evidently sprung from the same stock, and has made more use of its time to attain a smaller umbilicus. In having a smaller umbilicus, broader whorls, and more acute carina it differs from the above-mentioned species; and it possesses as a constant feature what *Gramm. mactra* exhibits only occasionally, namely, a steep inner margin. Another feature peculiar to *Gramm. mactra* is also seen occasionally in this species, namely, fasciation of the striæ producing "bulgings."

This species has brought *Grammoceras* to such a state of development that it converges in shape to *Lioceras;* and this species especially resembles, and has often been mistaken for, *Lioceras opalinum.* I have alluded to this before (p. 39). The suture-line is, of course, the discriminating feature, and it shows that this form is only an involute species of *Grammoceras.* The suture-line of this species lacks most of the ornamentation visible in that of *Lioceras opalinum*, has scarcely one defined auxiliary lobe, and has very small accessory lobes in the siphonal and superior lateral saddles. Its lobes are also broader-stemmed, and the inner part is projected more towards the front, that is, higher from the centre-line. At the same time it should be noticed that the suture-line of this species does present a slight development of the suture-line of *Grammoceras;* and were we not acquainted with the history of *Lioceras*, this fact might be twisted into an argument concerning the intermediate character of this suture-line between that of *Gramm. mactra* and that of *Lioc. opalinum.* The other differences which separate this species from *Lioc. opalinum* are a sharper ventral area with more prominent carina, ribs less curved on the lateral area, and a rather larger umbilicus. In most respects, however, the characters by which *Lioc. opalinum* differs from this one are relatively the same as those in which this one differs from *Gramm. mactra* (*Moorei*, auct.), and consequently we can exactly see the arguments which were used to unite *Lioc. opalinum* and *Gramm. mactra* (*Moorei*) as one species, this one being considered the connecting link. However, the fact to be remembered is that *Lioceras* appeared in the base of the *Falciferum*-zone, while the ancestor of this species is found in the *Jurense*-zone as *Gramm. striatulum*, a species very unlike and only very distantly related to *Lioceras.*

The horizon of this species is in the *Moorei*-beds (*Opalinum*-zone). It therefore occurs at the same time as *Gramm. mactra*, and is common at a time when *Lioc. opalinum* was only first appearing. When *Lioc. opalinum* became dominant—that is, in the stage above—this species had disappeared.

The specific name of this species was applied because of its supposed relationship to *Am. serrodens.* This species occurs more frequently than *Gramm. mactra;* and, though both are found on the same horizon, the two species are seldom associated at the same locality. Generally the specimens are casts, and are very poorly preserved; this is especially the case at Coaley Wood, where the specimens are practically worthless for any purpose of identification.

I have collected this species from the *Opalinum*-zone at Haresfield Hill (Bed 16, p. 44), Coaley Wood (Bed 6, p. 45), North Nibley (Bed 6, p. 46), and Wotton-under-Edge in Gloucestershire. Branco quotes his specimens from 'Oberregion d. Sch. m. Trig. navis. Ziemlich häufig. Signalberg bei Bœvingen." Dr. Haug sent me from Gundershofen a specimen which I identify as this species.

Plate XXXI, figs. 5, 6, represent two views of a specimen, from North Nibley, of moderate size and without test. Larger examples have been found. Fig. 7 shows the side view of another specimen from the same place with its test; figs. 8 and 9 illustrate the aperture and the suture-line respectively. In figs. 10, 11, 12 are seen the two views, and the suture-line, of a specimen from Haresfield Beacon, with a slightly larger umbilicus. Fig. 13 exhibits a specimen with small umbilicus, also from Haresfield Beacon; fig. 14 is the suture-line.

GRAMMOCERAS DOERNTENSE (*Denckmann*). Plate XXIX; Plate XXXIII, figs. 11, 12.

1867. AMMONITES AALENSIS, *Meneghini* (non *Zieten*). Foss. calc. rouge; Pal. Lombarde, 4e série, pl. xi, figs. 1—3.
1867. — sp. INDET, *Meneghini*. Ibid., pl. xi, fig. 4 only.
1884. HARPOCERAS STRIATULUM, *Wright* (non *Sowerby*). Lias Amm.; Pal. Soc., pl. lxxxiv, figs. 5, 6 (non fig. 4).
1887. AMMONITES (HARPOCERAS) DOERNTENSIS, *Denckmann*. Fauna Ob. Lias Doernten; Abh. geol. Specialkarte von Preussen und den Thuringischen Staaten, pl. ii, fig. 4; pl. viii, figs. 1—6; pl. x, fig. 9, p. 50 [164].

Discoidal, compressed, carinate. Whorls elliptical, ornamented with ventrally projected subarcuate ribs, which are often irregular in the inner whorls, and are then sometimes united towards the inner margin. Ventral area not defined; carina small and solid. Inner margin not actually defined; the whorls are almost regularly convex, though the slope towards the preceding whorl is sometimes a little steeper. Inclusion about one-third. Umbilicus open. Sutures simple, on the same pattern as in *Gramm. toarcense*, but with rather longer lobes.

This species, which is practically of later date than *Gramm. toarcense*, is undoubtedly a mutation of the forms with united ribs. It is distinguished from *Gramm. toarcense* by its broader whorls with more convex sides, its smaller umbilicus, and its rather more acute ventral area. Its ribs are also more numerous, less conspicuous, and are, if anything, rather more curved. Its siphonal and superior lateral lobes are also larger in proportion.

For the separation of this species we are indebted to Denckmann's recent work. He devotes the greater part of plate viii to a series of drawings of this species in various stages. His fig. 5 seems to me to indicate a stage intermediate between this species and *Gramm. toarcense* with joined ribs.

Just the opposite to this is the variety of which an adult is figured (Plate XXIX, figs. 8, 10) and—to show that it is not merely the adult stage of the figures above it—a smaller specimen has been depicted (Plate XXXIII, figs. 11, 12). This variety is noticeable for the absence of the irregular and joined ribs so characteristic of *Gramm. doerntense*, and this character, together with the finer ribbing, is well brought out in the smaller specimen. It appears to me that this variety is a further mutation of *Gramm. doerntense* proper—a mutation in which the joined ribs have disappeared, and the ribs themselves have become finer generally; and in consequence of these characters this form converges towards *Gramm. Orbignyi*. It might reasonably be supposed that *Gramm. Orbignyi* was only the further development of this form, and that the proper order of descent might be thus expressed:

tourcense, variety, joined ribs in adult.	Intermediate form, joined ribs not continued to end.	*doerntense*, joined ribs in youth only.	*doerntense*, variety, no joined ribs.	*Orbignyi*, more compression, reversion to some obscure joined ribs.

Now, although the first four stages are, to my mind, correct enough, I am not inclined to think that the last is descended in this manner. The reason is that *Orbignyi* has a slightly larger umbilicus than *doerntense* variety, and it also seems to me much more probable that it is descended directly from *Gramm. striatulum*; because it is what we might call a normal mutation of that species (p. 185). Still the subject requires further investigation.

The horizon of this very scarce species is in the *Dispansum*-bed (*Jurense*-zone), so that it really occurs one stage later than the time when *Gramm. toarcense* was dominant. Its development with regard to that species agrees exactly with its position.

I have found this species at Coaley Wood and Buckholt Wood in Gloucestershire, in this horizon. I have one characteristic little specimen (figs. 6, 7), labelled South Petherton, Somerset. Its horizon cannot be stated any nearer than in the so-called "Upper Lias" of that district, that is, above the Marlstone and *below* the Yeovil Sands; but I have no doubt it would be found to correspond exactly, from a palæontological point of view, with the horizon of the Gloucestershire specimens. It should be noticed that these occur in the second stage *above* the Cotteswold Sands, affording evidence of the distinctly different position of the two deposits of sands in a palæontological sense.

Plate XXIX, fig. 1, represents the side view of a typical specimen from Coaley Wood. The irregularity of its ribs, especially in the inner whorl, is scarcely brought out enough. Fig. 2 gives the front view. Fig. 3 illustrates the suture-line of the same specimen, showing that the lobes are longer and more ornamented than in *Gramm. toarcense.* Figs. 4, 5 show two views of a smaller specimen from the same locality. In figs. 6, 7 are depicted two views of a still smaller form from the so-called "Upper Lias" of South Petherton, probably the horizon of Bed 2, Section XIII, p. 165. In figs. 8, 9, 10 are shown three views of a grand specimen from Coaley Wood; in fig. 8 the fine growth-lines of the body-chamber are noticeable and also the portion of lateral mouth-border is visible; fig. 9 shows the front view; and fig. 10 the back view, with the ventral striæ well marked over the carina. In Plate XXXIII, figs. 11, 12, a smaller specimen of this same form is depicted, in order to show that the adult specimen last mentioned is not the adult of specimens of the typical *doerntense* (Plate XXIX, figs. 1—7), but is the adult of this. The specimen came from the *Dispansum*-beds, Coaley Wood, and is in my Collection. It is very nicely and sharply preserved, though parts of the outer layer of test are absent; the carina is entire.

GRAMMOCERAS ORBIGNYI, *S. Buckman.* Plate XXVII, figs. 3—6.

1842. AMMONITES RADIANS, *d'Orbigny.* Ceph. Jurass.; Pal. franç., pl. lix.
1852. — — *Chapuis et Dewalque.* Foss. Terr. secondaires Luxembourg; Mém. cour. et Mém. des sav. étrang., tom. xxv, pl. x, fig. 3; pl. xi, fig. 1 (?).
1885. — cf. COMPTUS, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, fig. 47 (?).
1885. — AALENSIS, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, fig. 6 (?).

Discoidal, compressed, carinate. Whorls convex from inner edge to the carina, ornamented with subarcuate, passing to subsigmoidal, radii which are nearly the same size all across the whorl, but sometimes slightly fascicled on the inner area. Ventral area undefined, acute, and carrying a small solid carina. No inner margin. Inclusion about one-third. Umbilicus shallow and open, somewhat more depressed in the centre.

The extreme scarcity of this species prevents a full discussion of its peculiarities To my mind it seems to agree with d'Orbigny's figure of *Am. radians* in every way but one; and that one is a slight fasciation of the ribbing upon the inner area. I cannot, however, say if this be constant; because, in what we can see of the umbilicus of fig. 3, Pl. XXVII, there appears to be no such fasciation; but as the umbilicus is gone in the centre, I cannot make further researches. Also no such fasciation is to be seen in the otherwise exactly similar specimen depicted by d'Orbigny; and that especially inclines me to the belief that this faint fasciation was but a chance character. I therefore name the species *Gramm. Orbignyi.*

The differences between *Gramm. Orbignyi* and the variety of *Gramm. doerntense* are not very great. They may be summed up as greater compression, a slightly wider umbilicus, a sharper ventral area and more acute carina, and a junction of the ribs on the inner area on the part of the former. I have, however, observed that there is some doubt concerning the constancy of the latter character. If constant it might be thought to cause the species to resemble the type-form of *Gramm. doerntense,* but the coarser ribs and much squarer proportions of that form cause it to be separated without difficulty.

I fancy that this species is a descendant of *Gramm. striatulum,* from which—barring the fasciation—it differs only by its broader whorls, finer ribbing, and more elevated carina; and therefore the development may be considered normal. An alternative theory may, however, be held concerning its descent, and to this I have alluded (p. 183).

I consider it very curious that among the certainly large number of specimens which I have collected from the Cotteswold Ammonitiferous deposits no specimen of this species has rewarded my efforts. The specimen now figured (Pl. XXVII, figs. 5, 6) was sent to my father by the late Dr. Lycett as an example of his *Am. dispansus,* and it bears a label in the doctor's handwriting, "*A. dispansus,* Lyc. *radians,* 'W.' Sands upper bed, Frocester Hill."

It was evidently on account of the joined ribs that Lycett regarded this specimen as a typical *Am. dispansus.* As Lycett never figured his species there might be some doubt as to which he really intended, but his statement[1] that "*A. dispansus* . . . . probably equals in its numbers all other Ammonites at Frocester Hill," is most characteristic of that species, and indicates that the selection—as a typical *Am. dispansus*—of a specimen, which I have seen reason to separate as a distinct species, was merely accidental.

The possession of these fasciated ribs upon the inner margin might induce the belief that this species was the parent of *Gramm. dispansum;* but the fasciated ribs certainly appear to die away too soon in *Gramm. Orbignyi* for that to be the case. Another argument against this theory is furnished in the existence of *Gramm. metallarium;* and so we must, I think, regard the similarity of *Gramm. Orbignyi* and *Gramm. dispansum* only as an instance of convergence.

While writing of these two species I must not omit to mention how they differ,

[1] 'Proc. Cotteswold Field Club,' vol. iii, p. 5, 1865.

namely, by *Gramm. Orbignyi* having an umbilicus quite one-fourth larger—whorls narrower and more convex—a more gibbous ventral area—a smaller, and so far as I can find, not hollow, carina—rather coarser ribbing, with the fasciation only very slightly marked—and, lastly, no appearance of inner margin.

This species has, together with *Gramm. fallaciosum* and many others, received the name of *Am. radians*. Now the identification of the species described by Reinecke as *Nautilus radians* ('Maris Protogæi,' figs. 39, 40, 1818) has been an extremely difficult task. It was placed both by Hyatt and by Haug in the genus *Grammoceras;* but, when I tried to find anything among my specimens of that genus to agree with Reinecke's figure, I was entirely unsuccessful. Several species were something like it, but differed in their quicker coiling—fewer whorls in a smaller umbilicus. *Gramm. striatulum* was the only species which approached it in the matter of slow coiling, and it seemed probable that "*Nautilus radians*" was nothing more than a fine-ribbed *Gramm. striatulum*, in which case the latter name would have been a synonym.

However, to make sure of the point, I wrote to Dr. Haug, asking him to send me a specimen of what he had identified as *Grammoceras radians*. With this request he very kindly complied, and generously presented me with the little specimen shown in the woodcut, fig. 3. I at once saw that I disagreed with my friend concerning the genus of the specimen; that to my mind it was not a *Grammoceras* but a *Dumortieria;* that it agreed with many specimens which I had procured from the *Jurense*-zone of Gloucestershire; and further, that some of these specimens agreed exactly with Reinecke's figure excepting in the size of the carina (Haug's specimen has a little smaller centre). Reinecke's figure (fig. 2, p. 187) shows the characteristic trait of *Dumortieria*, namely, ribs straight on the lateral area; but the ribs of *Grammoceras* are, as the plates show, all slightly bent on this area. We may, therefore, I think, come to the following conclusions:—Either Reinecke delineated the ribs of his specimen incorrectly, and drew the centre too large, and with too many whorls, by which mistakes he made a *Grammoceras* resemble a *Dumortieria;* or else he drew these points correctly, but made the carina just a trifle too prominent in his fig. 40. Now, to slightly enlarge the carina is a mistake very easily made; and, considering that it is a case of one slight mistake against three greater errors, I incline to the belief that, in all probability, the specimen Reinecke had before him to draw was a *Dumortieria;* and that he was quite correct in drawing the ribs straight across the lateral area.

In order that my readers may judge of these matters for themselves I have had a woodcut of Reinecke's original figure placed by the side of a woodcut of the specimen Dr. Haug sent me; and it will be seen that in ribbing the two figures agree exactly; but that they both differ from *Gramm. striatulum* (Pl. XXVI, figs. 7, 9) by wanting the lateral bend of the ribs.

Dr. Haug informs me that Reinecke's collection has disappeared, so that it is impossible to appeal for final judgment to an examination of the original specimen. We must, therefore, take the figure as it stands, and judge it on its merits. The specimen which Dr. Haug sent me, and which is here figured, is from the *Opalinum*-zone, Gundershofen. When I come to the genus *Dumortieria* I shall have more to say about this interesting species, and shall then point out why the straightness of the rib upon the lateral area is such an important feature.

FIG. 2.

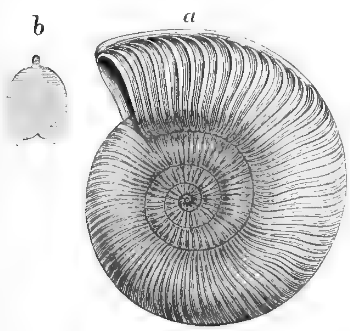
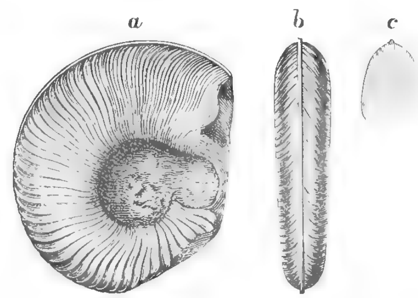


FIG. 3.



FIGS. 2 *a, b*.—Copy of Reinecke's original figure of "*Nautilus radians*," 'Maris Protogæi Nautilos et Argonautos,' &c., figs. 39, 40.

FIGS. 3 *a, b, c*.—A specimen sent to me by Dr. Haug as "*Grammoceras radians*," to be figured in comparison with Reinecke's original. The small curvature of the ribs on the lateral area and the absence of the long ventral projection should be compared with the figures of the genus *Grammoceras*. (Natural size.) *Opalinum*-zone, Gundershofen.

Since I have thus interpreted Reinecke's *Am. radians* in a manner different from every other author, except Quenstedt in part, I have of course to give a fresh name to the species which was figured by d'Orbigny as *Am. radians*.

Dr. Haug suggested to me that it would be preferable to consider d'Orbigny's *Am. radians* as the type of the species, and to strike Reinecke's figure out of the question altogether; but I am extremely reluctant so to violate the law of priority when the figure can really be identified, to my complete satisfaction, with specimens of *Dumortieria* in my own cabinet, not to mention those in Dr. Haug's as proved by what he sent me. I think, in this case, we have no excuse to justify such a proceeding. Neither is there any reason why d'Orbigny's figure should be taken as the type. In fact, to show the great diversity of opinion to which the interpretation of *Am. radians* has given rise, I have appended on the next page a synopsis of the references to that species from my point of view. Probably this belongs more correctly to the article on *Am. radians;* but I must give my reasons here for the change of name; and, also, I shall not reach that species for some time.

I cannot say anything nearer concerning the horizon of this very scarce species than that it occurs in the *Jurense*-zone. It is true that the Yorkshire specimen came from the *Striatulum*-beds; but it seems to me possible that the *Striatulum*-beds of that district may also contain what, in the more developed Gloucestershire deposits, I should call *Dispansum*-beds.

Pl. XXVII, fig. 3, represents a side view of a specimen which Mr. Hudleston obtained at Peak, Yorkshire, and has kindly lent to me for the purposes of this work; fig. 4 shows the back view. Fig. 5 illustrates the side view of a specimen with fasciated ribs collected by the late Dr. Lycett at Frocester Hill and by him sent to my father; fig. 6 gives the front view.

Synopsis of the various species of Ammonites to which the trivial name "*radians*" has been applied by different authors.

1818. NAUTILUS RADIANS, *Reinecke.* Maris protogæi Nautilos et Argonautos, figs. 39, 40. The type-figures. I have had a copy of these figures reproduced in a woodcut (fig. 2) so that full comparison may be made.

1830. AMMONITES RADIANS, *Zieten.* Verstein. Württemburg, pl. iv, fig. 3. This is *Grammoceras toarcense* (d'Orbigny).

1837. — — *Bronn.* Lethæa geognostica, pl. xxii, fig. 5, is probably a *Grammoceras.*

1844. — — *d'Orbigny.* Céph. Jurass.; Pal. Franç., pl. lix. This is what I now call *Gramm. Orbignyi* (p. 184).

1846. — — DEPRESSUS, *Quenstedt.* Cephalopoden, pl. vii, fig. 4, is *Gramm. toarcense* (d'Orbigny).

1846. — — DEPRESSUS, *Quenstedt.* Ibid., pl. vii, figs. 5, 6. These agree very closely with Reinecke's figures, and show the true slow coiling; also they have the ribs straight on the lateral area, and a suture-line indicative of *Dumortieria.* They only differ from Reinecke's figure in having less carina, and in one having a thicker, the other a thinner and longer aperture.

1846. — — DEPRESSUS, *Quenstedt.* Ibid., pl. vii, fig. 8. I am uncertain about this fragment. Its ribbing resembles that of *Gramm. toarcense,* but its suture-line inclines more to that of *Haugia.*

1846. — — COMPRESSUS, *Quenstedt.* Ibid., pl. vii, fig. 9. This is *Haugia Eseri* (Oppel).

1846. — — COSTULA, *Quenstedt.* Ibid., pl. vii, fig. 11. This is *Dumortieria Munieri,* Haug.

1852. AMMONITES RADIANS, *Chapuis et Dewalque.* Foss. Luxembourg; Mém. cour. et Mém. des sav. étrang., pl. x, fig. 3; pl. xi, fig. 1. This is probably a variety of *Gramm. Orbignyi,* but the ribs do not appear to have been quite correctly delineated. The side view shows them much less projected ventrally than would be expected from the front view.

1853. — — AMALTHEI, *Oppel.* Mittlere Lias Schwabens, pl. iii, fig. 1. This is perhaps *Gramm. normanianum,* d'Orbigny (see Oppel, 'Juraformation,' p. 168).

1853. — — NUMISMALIS, *Oppel.* Ibid., pl. iii, figs. 2 *a*, *b*, p. 51. This is *Cycloceras Stahli* (Oppel, 'Juraformation,' p. 168).

1858. — — *Quenstedt.* Jura., pl. xl, fig. 9. This is a *Dumortieria,* and agrees with Reinecke's original figure of *Am. radians.*

1858. — — COMPRESSUS, *Quenstedt.* Ibid., pl. xl, fig. 13, is *Haugia Eseri* (Oppel), but fig. 14 is *Gramm. toarcense,* d'Orbigny.

1865. — — *Lycett.* Amm. of Sands.; Proc. Cotteswold Field Club, vol. iii. *Gramm. fallaciosum, Saemanni,* &c., are referred to.

1867. — — *Meneghini.* Lias supérieur; Pal. Lombarde, 4e série, pl. ix, figs. 2—6. These are evidently species of the "*Fallaciosum*-group" (p. 200).

1867. — — *Meneghini.* Ibid., pl. xi, fig. 6. This is probably a hollow-carinate *Grammoceras* with the carina broken off. Fig. 7 is perhaps *Gramm. striatulum.*

1874. — — *Dumortier.* Études pal. Bassin du Rhône, iv, pp. 60, 61. The author notices the fact that the ribs of Reinecke's figure "ne sont pas flexeuses dès l'ombilic commes les Ammonites connues de tous les géologues sous le nom de *radians* . . . ."

1879. HARPOCERAS AFF. RADIANS, *Branco.* Unt. Dogger; Abh. z. geol. Spez.-Karte v. Elsass-Lothringen. This is probably *Dumortieria radiosa* (Seebach).

1882. — RADIANS, *Wright.* Lias Ammonites; Pal. Soc., pl. lxiv. These are probably forms of *Gramm. fallaciosum.* The real carina is absent. I have examined the original of figs. 4—6 in the British Museum.

1883. — — *Wright.* Ibid., pl. lxxiv, figs. 1, 2. This is a fine specimen of my *Gramm. fallaciosum* var. *Struckmanni* (p. 206).

1884. — — *Wright.* Ibid., pl. lxxxi, figs. 4—6. This is a variety of *Gramm. fallaciosum.*

1885. Ammonites radians gigas, *Quenstedt.* Amm. Schwäbischen Jura, pl. li, fig. 2. This is probably *Haugia Eseri.* Fig. 3 is *Gramm. fallaciosum.* Pl. liv, fig. 20, is possibly a *Grammoceras.*

1885. — — *Quenstedt.* Ibid., pl. li, fig. 4, is *Gramm. fallaciosum.* Pl. lii, fig. 5, is possibly *Gramm. toarcense.* Pl. liv, figs. 43, 44, belong to *Dumortieria*, and agree fairly with Reinecke's figure of *Amm. radians.* Pl. liv, fig. 56, is perhaps *Gramm. Saemanni.*

1885. — — depressus, *Quenstedt.* Ibid., pl. li, figs. 5 and 12; pl. lii, figs. 1, 2. These are *Gramm. toarcense.* Pl. li, fig. 13, is *Gramm. striatulum.* Pl. lii, fig. 6, is *Gramm. fallaciosum.*

1885. — — compressus, *Quenstedt.* Ibid., pl. li, figs. 6, 7, 8, are *Haugia Eseri.*

1885. — — quadratus, *Quenstedt.* Ibid., pl. li, figs. 9, 10 (11?) are probably *Gramm. quadratum*, Haug.

1885. — — cf. quadratus, *Quenstedt.* Ibid., pl. lii, fig. 3. This is *Gramm. Saemanni*, Dumortier.

1885. — — cf. compressus, *Quenstedt.* Ibid., pl. lii, fig. 4, is *Haugia Eseri.*

1885. — cf. radians, *Quenstedt.* Ibid., pl. liii, fig. 13, is *Gramm. fallaciosum.* Pl. liv, fig. 19, is a *Dumortieria*, and agrees fairly with Reinecke's figure of "*radians.*" Pl. liv, fig. 21, is perhaps *Gramm. fluitans.* Pl. liv, figs. 36, 37, are uncertain. Fig. 38 is *Gramm. normanianum.*

1885. — — depressus, *Quenstedt.* Ibid., pl. liv, figs. 15, 16, 17, appear to belong to *Grammoceras.*

Grammoceras fluitans (*Dumortier*). Plate XXX, figs. 1, 2.

1874. Ammonites fluitans, *Dumortier.* Études pal. Bassin du Rhône, iv, pl. li, figs. 7, 8.

1878. Ludwigia Aalensis, *Bayle* (non *Zieten*). Explic. carte géol. France, pl. lxxix, fig. 4, only.

1879. Harpoceras cf. fluitans, *Branco.* Untere Dogger; Abh. z. geol. Spez.-Karte v. Elsass-Lothringen, Bd. ii, pl. ii, fig. 5.

1885. — fluitans, *Haug.* Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 666.

1885. Ammonites cf. radians, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, fig. 21 (?).

Discoidal, compressed, carinate. Whorls in shape subquadrangular, ornamented with coarse, rounded, ventrally-projected, arcuate ribs which sometimes coalesce near the inner margin to form a slight protuberance. Ventral area rather broad, slightly gibbous, carrying a small but distinct solid carina. Inner margin well defined, quite smooth, almost upright. Inclusion not quite one half. Umbilicus scored with coarse, irregular ribs.

This species is the descendant of *Gramm. toarcense*—of one of the forms which have ribs joined occasionally near the inner margin (p. 172). Its development from such a form has followed the normal course (p. 134). It is distinguished from *Gramm. toarcense* by its flatter, broader whorls, smaller umbilicus, more acute ventral area, and more prominent carina; from its "cousin," *Gramm. doerntense*, by its more compressed and more involute form, its coarser ribs, and more prominent carina. Its relation to *Gramm. aalense* is that of parent, and it is therefore very similar to that species, but differs, as would be expected, in being thicker, more umblicate, and coarser-ribbed.

Dumortier's figure of this species represents a specimen larger than I possess. Branco's figure seems to be a variety of this species with less conspicuous, but more distant ribs.

This very scarce species occurs in the *Opalinum*-zone (*Moorei*-beds) at Haresfield and Frocester Hills.

Pl. XXX, figs. 1, 2, give two views of a very good little specimen of this species.

GRAMMOCERAS, sp. Plate XXXII, figs. 11, 12.

1886. HARPOCERAS FLUITANS, *Vacek*. Oolithe Cap san Vigilio; Abh. d. k.-k. geol. Reichsanstalt, Wien, Bd. xii, No. 3, pl. ix, fig. 6.

Vacek's figure represents a form which differs from *Grammoceras fluitans* in being considerably more compressed; and in this respect it is to a certain extent intermediate between that species and *Gramm. aalense*. It, however, differs from the latter by the absence of united ribs in the inner whorls. The specimen which I have had depicted seems to agree very well with Vacek's figure; but as it possesses no centre I cannot say much about it.

This specimen came from the *Opalinum*-zone (*Moorei*-beds) of Haresfield Hill. Its more regular, more distant ribs separate it from the specimens referred to *Gramm. aalense*.

Pl. XXXII, figs. 11, 12, represent two views of this specimen.

GRAMMOCERAS AALENSE, *Zeiten.* Plate XXXI, figs. 15, 16; Plate XXXII, figs. 1—10.

1832. AMMONITES AALENSIS, *Zieten.* Verstein. Württ., pl. xxviii, fig. 3
1843. — CANDIDUS, *d'Orbigny.* Céph. Jurass., pl. lxiii.
1843. — AALENSIS, *d'Orbigny.* Idem, Texte, p. 238.
1846. — AALENSIS, *Quenstedt.* Cephalopoden, pl. vii, fig. 7.
1856. — — *Oppel.* Juraformation, p. 248.
1867. GRAMMOCERAS AALENSE, *Hyatt.* Ceph. Mus. Comp. Zoöl., p. 100.
1874. AMMONITES AALENSIS, *Dumortier.* Études paléont. Bassin du Rhône, iv, pl. 1, figs. 1—3.
1879. LUDWIGIA AALENSIS, *Bayle.* Expl. carte géol. France. Pl. lxxix, figs. 1—3.
1881. HARPOCERAS DISPANSUM, *S. Buckman* (non *Lycett*). Inf. Ool. Amm.; Quart. Journ. Geol. Soc., p. 605 (pars).
1885. — AALENSE, *Haug.* Beiträge Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., iii, Beil.-Bd., p. 667.
1885. AMMONITES cf. AALENSIS, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, figs. 51, 52, only.

But *not* :—
1883. HARPOCERAS AALENSE, *Wright.* Lias Amm.; Pal. Soc., pl. lxxv, figs. 8 (*Lioc. opalinum*), 9 (*Gramm. costulatum*), 10 (*Gramm. mactra*).
1884. — — — Ibid., pl. lxxx, figs. 1—3; pl. lxxxii, figs. 1, 2 (*Dumort. radiosa*), 3, 4 (*Dum. Levesquei*).

Discoidal, compressed, carinate. Whorls broad, flattened, ornamented with ventrally-projected subarcuate radii, which are sometimes, on the inner whorls, united in twos towards the inner margin. Ventral area not defined, acute, carrying a small, barely distinct, solid carina. Inner margin well defined, smooth, nearly upright. Inclusion about one-half. Umbilicus open, scored with irregular, sometimes united ribs. Termination, in youth with a short lateral lappet and a small ventral process; in adult probably subsigmoidal, without a projected lateral lappet.[1] The suture-line simple, with only one auxiliary lobe (Pl. XXXII, fig. 6).

Gramm. aalense is a somewhat variable species; but the chief direction of its efforts seems to have been towards a smooth whorl, and greater compression. The species is undoubtedly descended from *Gramm. fluitans;* and the well-ribbed form (*a*) differs from that species only in being more compressed, and having somewhat more slender ribs.

Pl. XXXII, figs. 1, 2 represents the adult of this form, which may be considered typical; and fig. 3, which agrees best in size and ornaments with Zieten's figure, is probably the young of the same.

[1] The shape of the termination is shown by the specimen figured Pl. XXXII, fig. 1, but the edges of the mouth are ragged.

The next development (var. α) is seen in figs. 7, 8. This has become almost smooth at an early age, and is more compressed; it may be considered as the senile form of the species. A variety (β) which is more compressed than α, but exhibits the united and irregular ribbing more forcibly, is depicted in figs. 4, 5. Like α, it has a tendency to smoothness towards the latter part of the whorl. Another variety (δ) (figs. 9, 10) has what appear to be single ribs in the umbilicus, and this feature causes a likeness to *Gramm. lotharingicum* (p. 199).

A consideration of these, the principal forms of the species, will suggest the transition from *Gramm. fluitans* to *Gramm. leurum* by the following arrangement: *fluitans—aalense—aalense* α*—leurum.* Each form exhibits at an earlier age the senile characters of its predecessor accompanied by greater involution and compression.

Dr. Wright in his Monograph on Lias Ammonites placed several species under the name *Harpoceras aalense*, but as I have not admitted them in the synonymy, the following analysis may be useful to the reader of the present Monograph:

HARPOCERAS AALENSE, *Wright* (non *Zieten*).

Pl. lxxv, fig. 8.	Probably *Lioceras opalinum.*	
,, fig. 9.	*Gramm. costulatum* (Zieten).	
,, fig. 10.	—	*mactra* (Dumortier).
Pl. lxxx, figs. 1, 2.	*Dumortieria Moorei* (Lycett).	
Pl. lxxxii, figs. 1, 2.	—	*radiosa* (Seebach).
,, figs. 3, 4.	—	*Levesquei* (d'Orb.).

The presence of joined ribs will separate *Gramm. aalense* from all the above species; and the difference in suture-line will distinguish it from most of them. The first character may cause it to be confounded with *Lioceras comptum* (p. 53), and with *Ludwigia Murchisonæ* (p. 16). From the former it may be known by its larger umbilicus and simpler suture-line—with fewer auxiliary lobes; from the latter by its ribbing being straighter on the lateral area, more projected ventrally, and altogether more irregular.

From species of *Grammoceras* with joined ribs, *Gramm. aalense* is separated as follows:—From *Gramm. doerntense* by greater compression and involution; from *Gramm. dispansum* by less compression, larger umbilicus, coarse irregular ribbing, and a solid carina; from *Gramm. subcomptum* by coarser ribbing not so fascicled.

In this country the horizon which is characterised by *Grammoceras aalense* is very narrowly defined; for I have not found the species outside the limits of the *Moorei*-beds; and I consider it is indicative of that series. Dr. Haug,[1] however,

[1] Op. cit., p. 667.

says, "Die Zieten'sche Abbildung vom *Amm. Aalensis* stellt den schwäbischen Typus der Art dar, wie er in der Zone des *Lyt. jurense* vorkommt. Die Exemplare, die man in den Sammlungen unter dem Namen *Amm. Aalensis* findet, kommen fast alle aus der Zone des *Harp. opalinum* von Gundershofen oder von la Verpillière und gehören dem Typus an, den d'Orbigny, Dumortier, und Bayle abbilden und der vom Zieten'sche etwas abweicht. Dennoch möchte ich die Figuren der ebengenannten Autoren als massgebend für die Bestimmung der Art betrachten, um so mehr als die schwäbischen Exemplare keineswegs die charakteristischen Merkmale, also vor allem die starken V-förmig gestellten Rippen, scharf ausgeprägt zeigen."

Gramm. aalense occurs at Haresfield Hill, Buckholt Wood, Frocester Hill, Gloucestershire. I have a specimen from Somerset labelled "Sands, Crewkerne Station," but I do not know the exact locality. In Dorset the species occurs at Burton Bradstock in a rock-band which lies towards the top of the cliff of yellow Sands.

Pl. XXXII shows the various forms of this species. Figs. 1, 2, represent the two views of a very fine adult specimen with well-preserved test; the upper part of this specimen I was fortunate enough to obtain some six months after the other part had been placed in my cabinet. Fig. 3 illustrates a small specimen, without test, with the lateral lappet of the mouth-border. Fig. 4 is the side view of another specimen; fig. 5 is a sectional view of its ventral area; while fig. 6 exhibits its suture-line. In figs. 7 and 8 is shown a variety which has the latter portion of the outer whorl smooth, and this apparently indicates how *Gramm. leurum* has been evolved. All these specimens are from Frocester Hill. Figs. 9, 10, illustrate a specimen from the Yeovil Sands of Burton-Bradstock Cliff; it is in the collection of Mr. W. H. Hudleston.

In Pl. XXXI, figs. 15, 16, are depicted what is an ill-shaped, perhaps diseased, form of this species; it is without test, and its ribs being rather faintly marked cause an apparent convergence towards *Gramm. lotharingicum* or *subcomptum*. Fig. 16 shows that the two sides are not equal. The specimen came from Haresfield Hill (*Moorei*-beds).

GRAMMOCERAS LEURUM, *S. Buckman.* Plate XXXIII, figs. 5—10.

1885. AMMONITES cf. LYTHENSIS, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, figs. 54, 55.

Discoidal, compressed, carinate. Whorls broad, very slightly convex, ornamented in youth with subsigmoidal radii, in adult almost perfectly smooth. Radii in the inner area somewhat distant, branching into twos or threes on the outer area, and also on this area are occasional intermediate ribs; at intervals a rib larger than its fellows crosses the side; the radii becoming finer, die away first on the outer area, and finally disappear altogether. Ventral area scarcely defined, the two sides falling towards a small but distinct solid carina. Inner margin upright and flat. Inclusion about one-half. Umbilicus small, marked with somewhat coarse ribs. Aperture acutely sagittate. Suture-line simple, superior lateral lobe really no longer than siphonal lobe.

Like *Gramm. subserrodens* this species has, in general, all the appearance of a *Lioceras;* but the simple suture-line shows that it does not belong to that genus, and that it is only an involute development of *Grammoceras.* I believe that the parent of this species is either *Gramm. aalense* or *Gramm. costulatum* (p. 197); and I incline to the former, because the ribs in some specimens appear to be more numerous than I should expect in the descendant of *costulatum.* Still, it is a point which cannot be absolutely decided without more material. The transition from *aalense* (Pl. XXXII, fig. 7), or from *costulatum,* to this species is but a step, which may be expressed as a further development of involution,[1] accompanied by an earlier acquirement of the senile—the smooth—stage.

The above remarks will show how this species differs from *Gramm. aalense* or from *Gramm. costulatum,* to the former of which it stands in the same relation as the species to which it converges, namely, *Gramm. subserrodens,* does to *Gramm. mactra.*

This convergence to *Gramm. subserrodens* is a curious fact; but I believe that it is the true explanation of the case, and not that this species is a coarse-ribbed variety of that one. Practically speaking, it differs from *Gramm. subserrodens* only in the coarseness of its ribbing, and the absence—but this is rather remarkable and striking—of those fine, hair-like striæ; because almost as soon as the ribs die away the specimen appears perfectly smooth. It is on account of this smooth character that I have made use of the name *leurum* (λευρος = smooth).

There is a noticeable, but possibly not important, difference in the sutures of the two specimens figured. Fig. 10, which belongs to the specimen shown in

[1] To see the difference between *Gramm. costulatum* and this species in the size of umbilicus requires older specimens of the former, of which the umbilicus is one-fourth larger.

fig. 8, appears shallower and more stretched than fig. 7; the inferior lateral lobe is broader, and the inner part of the suture-line not so elevated. These differences are what might be expected to accompany greater involution.

This species is scarce. It occurs in the *Opalinum*-zone (*Moorei*-beds) at Haresfield Hill, Frocester Hill (Coaley Peak), Coaley Wood, and North Nibley, Gloucestershire.

Plate XXXIII, fig. 5, represents a specimen from Coaley Peak with its inner test preserved; fig. 6 is the front view; and fig. 7 is the suture-line. Fig. 8 represents the side view of a specimen from Coaley Wood—a specimen not quite so smooth, and with a rather different suture-line (fig. 10). Fig. 9 is the front view.

GRAMMOCERAS DISTANS, *S. Buckman.* Pl. XXXIII, figs. 1, 2.

1879. HARPOCERAS SUBUNDULATUM, *var.* EXTERNE-PUNCTATUM, *Branco.* Unt. Dogger; Abh. geol. Spez.-Karte Elsass-Lothringen, Bd. ii, Heft 1, pl. iv, figs. 1 *a—g*, only.

Discoidal, compressed, carinate. Whorls ornamented with somewhat distant, subarcuate, generally single ribs. Ventral area undefined, ornamented with a small solid carina. Inclusion about one-fourth. Umbilicus very open and shallow.

At first I was inclined to identify this form with Reinecke's "*Nautilus*" *costula;* but now I believe that this would be a mistake, and that the species is unnamed. I give it the name of "*distans*" on account of the large spaces which separate the costæ.

As the best interpretation of Reinecke's dubious form, "*Nautilus*" *costula*, I take Quenstedt's delineation ("Ceph.," Pl. vii, fig. 11). This represents a species belonging to the genus *Dumortieria*, from which the present species differs in having subarcuate radii projected considerably on the ventral area, and, presumably, therefore, in having a different suture-line. Its ribs are also closer together, and it is somewhat more compressed.

I know of nothing to which I can trace the origin of this rare little species, except it be to *Gramm. toarcense*, of which we may imagine it a dwarf descendant, differing mainly in being so much more compressed. From *Gramm. striatulum* it is distinguished by its coarser ribs and more evolute whorls; while from *Gramm. aalense* it may be known by its more distant, generally single ribs, and its more evolute whorls.

The *Opalinum*-zone (*Moorei*-beds) of Haresfield Hill has yielded the specimen depicted in Pl. XXXIII, figs. 1, 2. Another specimen I obtained from Buckholt Wood on the same horizon.

Grammoceras costulatum (*Zieten*). Plate XXXIII, figs. 3, 4.

1830. Ammonites costulatus, *Zieten*. Verstein. Württ., pl. vii, fig. 7.
1858. — Aalensis, *Quenstedt* (non *Zieten*). Der Jura, pl. xl, fig. 10, only.
1879. Harpoceras costula, *Branco*. Unt. Dogger; Abh. geol. Spez.-Karte Elsass-Lothringen, Bd. ii, pl. i, fig. 9.
1883. — Aalense, *Wright*. Monogr. Lias Amm.; Pal. Soc., vol. xxxvii, pl. lxxv, fig. 9, only.
1884. — costula, *Wright*. Ibid., vol. xxxvii, pl. lxxxii, fig. 5, only (?).
1885. Ammonites costula, *Quenstedt*. Amm. Schwäbischen Jura, pl. liv, figs. 7—14.

Discoidal, compressed, carinate. Whorls broad, much flattened, ornamented with distant, single, subarcuate radii, which soon die away, leaving the whorl quite smooth. Ventral area undefined, acutely sloping to form a small, barely distinct carina. Inclusion one-half. Inner margin slightly defined.

The characteristic of this species is the decadence of the ribs after about one-and-a-half inch diameter—that is, just the size of the specimen figured.[1] The ribs die away on the outer area first, and then finally disappear altogether. This species is the direct descendant of *Gramm. distans;* and it differs therefrom in having smooth, broader whorls, sharper ventral area, and a smaller umbilicus. Its inner whorls may be said to represent the *distans*-stage, but are somewhat more involute.

This species is also very like *Gramm. aalense*, which we need not wonder at, considering how it is related by descent from the probable common ancestor, *Gramm toarcense;* but it is distinguished by the small number of regularly-distanced, regular-sized ribs, set very widely apart from one another—by the early age at which the test becomes quite smooth, or has only a slight appearance of ribbing on the inner area—by the greater sharpness of the ventral area.

The horizon of this form is the *Opalinum*-zone (*Moorei*-beds). It occurs at Frocester Hill and Haresfield Hill, Gloucestershire, and although not so rare as the last described species, is certainly very scarce. In Pl. XXXIII, figs. 3, 4, two views of this species are given.

[1] My examples above this diameter are not good enough for delineation; but a specimen may be seen depicted in Dr. Wright's 'Monograph,' Pal. Soc., pl. lxxv, fig. 9.

GRAMMOCERAS SUBCOMPTUM (*Branco*). Plate XXX, figs. 11—14.

1879. HARPOCERAS SUBCOMPTUM, *Branco.* Untere Dogger; Abhandl. geol. Spez.-Karte v. Elsass-Lothringen, Bd. ii, pl. v, fig. 3 (*not* fig. 4, which is a *Dumortieria*).
1885. — — *Haug.* Beiträge Monog. Harp.; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd., p. 670.
1885. AMMONITES AALENSIS, *Quenstedt.* Amm. Schwäbischen Jura, pl. liv, figs. 1—4 (5 ?)

Discoidal, compressed, carinate. Whorls broad, ornamented with numerous ventrally-projected, subarcuate radii, which are irregularly fasciated on the inner area. Ventral area very narrow, much sloping, and bearing a trenchant, but ill-defined, solid carina. Inner margin distinct, steep, and inclining to concave. Inclusion about one-half; umbilicus flat and open.

In appearance intermediate between *Gramm. aalense* and *Gramm dispansum;* it differs from the former by its more numerous and more fascicled ribs, and slightly smaller umbilicus; while from the second, for which perhaps it is more likely to be mistaken, it differs in the fasciated portion of the ribs being longer, and not so clubbed at the inner margin—in having a larger umbilicus—in possessing a solid and not a hollow carina.

In spite of its resemblance this species is not a very near relative of *Gramm. dispansum.* It certainly is a form cognate to *Gramm. aalense*, but not, I think, an actual descendant.

All the specimens in my collection are smaller[1] than the specimen figured by Branco, which again is smaller than the adults of either *Gramm. aalense* or *Gramm. dispansum.* With us the species does not attain a diameter of two inches.

Branco gave figures of two specimens under the name *Harpoceras subcomptum.* The fig. 4 is different in side view, and has a different suture-line to fig. 3, and judging from these points I believe that it is a *Dumortieria*—probably a synonym of *Dum. radians.* Fig. 3 is, therefore, the type of the present species.

This species occurs in the *Moorei*-beds (*Opalinum*-zone) associated with *Gramm. aalense.* Its position is thus very much above that of *Gramm. dispansum*, a fact which it is well to bear in mind.

I have obtained the majority of my specimens from Haresfield Hill (bed 16); but the species also occurs at Coaley Peak. Apparently it is very local in its distribution. It is generally only poorly preserved.

Pl. XXX, figs. 11, 12, give two views of a specimen of this species. Figs. 13, 14 show two views of another, rather thicker, specimen, with more fascicled ribs,

[1] Their ribs also are rather more fascicled. Possibly they may best be considered a dwarf variety.

and exhibiting the ventral projection to the mouth-border. The lateral part of the mouth-border has not been preserved.

GRAMMOCERAS LOTHARINGICUM (*Branco*). Plate XXX, figs. 8, 9, 10.

1879. HARPOCERAS LOTHARINGICUM, *Branco*. Untere Dogger; Abhandl. z. Geol. Spez.-Karte v. Elsass-Lothringen, Bd. ii, pl. ii, fig. 6.
1885. — — *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Band iii, p. 668.

Discoidal, compressed, carinate. Whorls flat, ornamented with small, but well-marked subsigmoidal radii which, on the air-chambers, join together, two and two, at the inner edge, and which are strongly projected on the ventral area. This area is undefined, and slopes sharply to form a distinct, solid carina. Inner margin distinct and subconcave. Inclusion about one-half.

I have so little material belonging to this species that I do not feel confident concerning the identification. Branco says (p. 80), "Die Seiten der Schaale sind flach und fallen nach dem Nabel zu in Gestalt einer niedrigen, aber ziemlich steilen Nahtfläche ab, bilden jedoch keine Nabelkante." My specimen differs from this description because it shows a distinct inner margin; but I believe that this is practically the only matter in which it does not coincide with Branco's figure and description.

From *Gramm. aalense,* of which it is probably a mutation, this species differs in its more regular, smaller ribbing, which is rather more strongly bent on the lateral area. The species also increases in diameter more quickly.

This species occurs in the *Opalinum*-zone at North Nibley, Gloucestershire. It is very scarce.

Pl. XXX, figs. 8, 9, show two views of a specimen in my collection. Fig. 10 exhibits a young form with larger umbilicus, possibly a variety of this species, with which it was found.

The Hollow-Carinate *Grammocerata*.

The species which we have now to discuss are easily separable from the other members of the genus *Grammoceras* by the fact that they possess a hollow carina, which is generally very prominent. Two of the species, *Gramm. dispansum* and *Gramm. metallarium*, are so easily recognised by their tubercles from the other members of this group that we may pass them at once; another species, *Gramm. nannodes*, is very distinct on account of its combination of dwarf size and adult characters: but the remainder—the *Fallaciosum*-group—require some introduction. They are *Gramm. quadratum, subquadratum, Sæmanni, Muelleri, fallaciosum, Cotteswoldiæ*, which have generally been referred to by the name *Am. radians* (see page 188).

The relationship of these species one to another is undoubtedly very close; and it is oftentimes a hard matter to decide how such a group may be most conveniently divided. The ribbing remains practically the same throughout, and the only differences among the forms are in shape of whorl and amount of involution. In this group Denckmann has made two more species, *Am. Struckmanni* and *Am. Bingmanni;* but I have preferred to consider these forms as varieties of *Gramm. fallaciosum*, because, although it is easy enough to see the differences between the extreme forms, yet it appears to me almost hopeless to separate a large series of specimens with any satisfaction. *Gramm. Cotteswoldiæ*, again, is little better than a variety of *Gramm. fallaciosum*,—it is simply the more involute development thereof; but it stands out rather more conspicuously on account of its small umbilicus and compressed whorls.

Between *Gramm. quadratum, subquadratum,* and *Sæmanni* there does not seem to be any very sharp lines of distinction; yet the forms are sufficiently separate for our purpose, and may be divided with very slight attention.

Among these species the normal process of development appears to be traceable, namely, from evolute quadrate whorls (*Gramm. quadratum*) to involute compressed whorls (*Gramm. Cotteswoldiæ*); and, looking at this fact, it seems very singular that they should all occur on the same horizon—the *Jurense*-zone (p. 208). However, from *Gramm. quadratum* to *subquadratum, Sæmanni, Bingmanni, fallaciosum, Cotteswoldiæ*, appears a perfect "ascending series," involving not only the gradual changes of whorl shape, but also a corresponding increase in the fineness of the ribbing.

Gramm. Muelleri seems to be a mutation of *Gramm. subquadratum.* It has attained to greater involution without much loss of thickness. *Gramm. Struckmanni* I take to be an aberrant form of *Gramm. Bingmanni*—a form which had gone back to a wider umbilicus and yet had decreased in thickness.

I have alluded above to the similarity of ribbing in the "*Fallaciosum*-group." Well-preserved examples have an appearance, not as if they were ribbed, but as if sulcated, and that the sulci had been cut out with a gouge held slightly aslant towards the preceding rib, and as if the lower corner of the gouge had cut a ribbon from out of the side of that rib. This appearance may be explained as follows:—The top of the ribs is more or less flattened, especially so in *Gramm. Struckmanni*; between the ribs, and about equal to them in breadth, is a concave furrow, interrupted about the middle, or towards the previous rib, by a small, raised, thread-like line. I cannot detect this kind of ribbing on *Gramm. metallarium;* while *Gramm. dispansum* is never well enough preserved.

It may be worth noting that the only way to obtain good specimens of Ammonites of the "*Fallaciosum*-group" in the Cotteswolds—and they occur hardly anywhere else—is to employ a man to make an opening on purpose. Then the matrix must be entirely removed from the specimens out in the field while they are still wet; otherwise it adheres tenaciously, and the result is generally very unsatisfactory.

Grammoceras quadratum (*Haug*). Plate XXXIV, figs. 6, 7.

1846. Ammonites radians quadratus, *Quenstedt*. Cephalopoden, p. 113.
1874. — Grunowi, *Dumortier* (non *Hauer*). Études pal. Bassin Rhône, iv, pl. xiv, figs. 6, 7 ; pl. xv, figs. 1, 2.
1855. Hildoceras quadratum, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineral., &c., Beil.-Band iii, p. 638.

Discoidal, presumably hollow-carinate. Whorls quadrate, ornamented with coarse, subarcuate ribs. Ventral area broad, carrying a prominent carina, on each side of which is a shallow sulcus. Inclusion slight.

This is really a very distinct form; but, since I possess very insufficient material, I have only been able to figure a young specimen. A capital figure of this species is given by Dumortier (see synonyms) under the incorrect name *Am. Grunowi*, Hauer.[1] Haug, referring to Dumortier's figure, gave to this form the name *Hildoceras quadratum*, presuming that it was the form to which Quenstedt alluded under the name *Am. radians quadratus*, 'Ceph,' p. 113. To include it in the genus *Hildoceras* was, however, not correct (p. 160). Its ribbing is typical of *Grammoceras*, and it is probably the parent of *Gramm. Sæmanni*, *fallaciosum*, &c.

[1] A totally different species; belongs to *Am. liassicus*-group (*Ophioceras*).

This species occurs at Coaley Wood in the *Dispansum*-beds (*Jurense*-zone), but I have only small examples. Plate XXXIV, figs. 6, 7, gives two views of a specimen which is none too well preserved.

GRAMMOCERAS SUBQUADRATUM, *S. Buckman.* Plate XXXVI, figs. 3, 4, 5.

1887. AMMONITES (HILDOCERAS) QUADRATUS, *Denckmann* (non *Haug*). Fauna von Dörnten; Abh. der geol. Specialkarte, &c., Bd. viii, Heft 2, pl. vi, fig. 3; pl. x, fig. 6.

Discoidal, hollow-carinate. Whorls slightly compressed laterally, ornamented with rather strongly-reflexed, subarcuate ribs. Ventral area broad, carrying a strong hollow carina. Inner margin steep, smooth, and broad. Inclusion about one-third. Umbilicus rather deep, whorls slowly coiled.

I have only seen this one example; but, although it may be regarded as somewhat intermediate between *Gramm. quadratum* and *Gramm. Sæmanni*, yet it possesses some peculiar and distinct characters, which have induced me to separate it provisionally as a distinct form.

From Dumortier's figure of *Gramm. quadratum* it may be easily separated by its almost inconspicuous ventral furrows—more conspicuous carina—broader whorls—deeper umbilicus, with well-defined inner margin—and, finally, by the ribs being more strongly reflexed, forming larger curves on the outer area. From a form of *Gramm. Sæmanni*, which I have had depicted on the same plate (figs. 6, 8), *Gramm. subquadratum* differs by its coarser, more reflexed ribs—by its stronger inner margin, caused by the greatest thickness of whorl being on the edge of the margin (figs. 5 and 8), and by its deeper umbilicus with a greater number of whorls, that is, more slowly coiled.

Gramm. subquadratum appears to agree with the specimen depicted by Denckmann, except that it is a trifle smaller-centred. Denckmann's figure also shows more conspicuous sulci at the top of the aperture; but it almost appears as if this were an error in drawing, because the sulci are not shown like this in the lower part of the whorl.

Probably Denckmann's figure represents a form intermediate between *Gramm. quadratum* (Dumortier's figure) and my *subquadratum*. Such a form is, of course, to be expected, and the separation of *Gramm. subquadratum* from *Gramm. quadratum* on the one hand and *Gramm. Sæmanni* on the other, is more or less arbitrary, and for the sake of convenience.

This unique example, which is very nicely preserved, came from the *Dispansum*-beds of Cam Down.

Pl. XXXVI, fig. 3, illustrates the side view; fig. 4 the back view; and fig. 5 an outline of the whorl and the inner margin to compare with fig. 8. Herein it may be observed that, on account of the whorls being thickest at the inner edge and then falling away, the inner margin is much deeper than in fig. 8.

GRAMMOCERAS SÆMANNI (*Dumortier*). Plate XXXIV, figs. 1, 2; Plate XXXVI, figs. 6—8.

1874. AMMONITES SÆMANNI, *Dumortier* (non *Oppel*). Études pal. Bassin Rhône, iv, pl. xiii, figs. 4—6.
1885. HILDOCERAS SÆMANNI, *Haug*. Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 638 (pl. xi, fig. 18, suture-line).
1887. AMMONITES (HILDOCERAS) SÆMANNI, *Denckmann*. Fauna Ob. Lias; Abh. geol. Specialkarte von Preussen, Bd. viii, Heft 2, pl. iii, fig. 2; pl. x, figs. 18, 19.
1885. — RADIANS, cf. QUADRATUS, *Quenstedt*. Amm. Schwäbischen Jura, pl. lii, fig. 3.

Discoidal, compressed, hollow-carinate. Whorls compressed, ornamented with ventrally-projected, subarcuate ribs, which begin at the bottom of the inner margin. Ventral area rather broad, carrying a distinct hollow-carina; but, in the absence of the test, a small false carina, bordered by two plain, slightly depressed, sometimes sulcate areas, is present. Inner margin sloping, fairly steep, and distinctly marked by the ribbing. Inclusion two-fifths. Umbilicus depressed in the middle, and somewhat quickly-coiled.

A certain amount of history attaches to the name *Sæmanni*. Oppel first applied it ('Juraf.,' p. 242) to a species from the Alum-shale of Yorkshire. In the absence of a figure it has been concluded[1] that the species he described was what had been previously known as *Am. Levisoni*, Simpson, also unfigured at the time. Dumortier has, however, interpreted Oppel's description otherwise, and has figured the form which is the subject of this article under the name "*Sæmanni*." This name may be retained for this form without any question; but, since there is reasonable doubt if Dumortier has rightly interpreted Oppel's views, it avoids confusion to assign the authorship of the specific name to Dumortier, treating it as a new creation, as at the heading.

[1] Meneghini, 'Monogr.'; 'Pal. Lombarde,' 4e Série, p. 198; also Haug, op. cit., p. 639.

Dumortier's figure only exhibits a fragment, and is not all that could be wished for the purposes of identification. Denckmann has, however, supplied the deficiency by giving a good side view.

From *Gramm. quadratum* this species may be distinguished by the smaller ventral furrows, the finer ribbing, and the quicker coiling; from *Gramm. subquadratum* by the quicker coiling, the straighter ribs, more compressed whorls, and far less conspicuous inner margin; from *Gramm. fallaciosum*, var. *Bingmanni*, by greater thickness, squarer ventral area, and more depressed umbilicus.

There are two varieties of this species figured in my plates, namely, α (Plate XXXVI, figs. 6—8), which may be considered as more nearly related to *Gramm. subquadratum.* It is more coarsely-ribbed and rather squarer altogether than is β (Pl. XXXIV, figs. 1, 2), which I should regard as the more typical form. This one, however, in its turn leads us on to *Gramm. Bingmanni* (figs. 3, 4.)

Gramm. Sæmanni is decidedly rare. The *Dispansum*-beds of Cam Down and Coaley Wood, Gloucestershire, have yielded the examples in my cabinet. Pl. XXXVI, figs. 6, 7, give two views of the form α of this species; and fig. 8 shows the outline of the whorls and inner margin for comparison with fig. 5. Pl. XXXIV, figs. 1, 2, illustrates the finer-ribbed form, β.

GRAMMOCERAS FALLACIOSUM, *Bayle.* Plate XXXIII, figs. 17, 18; Plate XXXIV, figs. 3—5, and 10, 11; Plate XXXV, figs. 4—7; Plate A, figs. 39, 40.

1867. AMMONITES RADIANS, *Meneghini* (non *Reinecke*). Monogr. fossiles calc. rouge Ammonitique; Pal. Lombarde, 4e série, pl. ix, figs. 2—6 only, p. 33, in part.

1874. — ESERI, *Dumortier* (non *Oppel*). Études paléont. Bassin du Rhône, 4e partie, pl. xii, fig 3 (*Cotteswoldiæ*).

1878. GRAMMOCERAS FALLACIOSUM, *Bayle.* Explic. Carte géol. France, pl. lxxviii, figs. 1, 2.

1878. — ESERI, *Bayle* (non *Oppel*). Ibid., pl. lxxviii, fig. 6 (*Cotteswoldiæ*).

1880. HARPOCERAS RADIANS, *Meneghini.* Revision systématique, Monogr. calc. rouge; Pal. Lombarde, 4e Série, p. 203, in part.

1882. — — *Wright* (non *Reinecke*). Monogr. Lias. Amm.; Pal. Soc., vol. xxxvi, pl. lxiv, figs. 1—3 (4?), 5—7.

1883. Harpoceras radians, *Wright* (non *Reinecke*). *Ibid.*, vol. xxxvii, pl. lxxiv, figs. 1, 2.
1884. — — — *Ibid.*, vol. xxxviii, pl. lxxxi, figs. 4—6.
1885. — fallaciosum, *Haug.* Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Band iii, p. 616.
1885. Ammonites radians, *Quenstedt.* Amm. Schwäbischen Jura, pl. li, fig. 4; pl. liv, fig. 56.
1885. — — depressus, *Quenstedt. Ibid.*, pl. lii, fig. 6.
1885. — — gigas, *Quenstedt. Ibid.*, pl. li, fig. 3.
1885. — cf. radians, *Quenstedt. Ibid.*, pl. liii, fig. 13.
1887. — (? Harpoceras) Struckmanni, *Denckmann.* Fauna von Dörnten; Abhandl. der geol. Specialkarte von Preussen und den Thüringischen Staaten, Bd. viii, Heft 2, pl. iii, fig. 1.
1887. Ammonites (? Harpoceras) Bingmanni, *Denckmann. Ibid.*, pl. v, fig. 4; pl. vi, fig. 5; pl. x, fig. 17, p. 71.

Discoidal, compressed, hollow-carinate. Whorls ornamented with ventrally-projected subarcuate or subsigmoidal radii, which are considerably flattened; and each one being, as it were, badly joined to its predecessor causes an intermediate hair-like rib in the intervening sulcus (p. 201). Ventral area sloping, sometimes acute. Inclusion variable. Umbilicus shallow. Termination subsigmoid, with a ventral projection.[1] Suture-line[2] simple, a prominent and broad superior lateral lobe, a well-defined inferior lateral lobe.

Since specimens of this species have been previously figured in the volumes of this Society, although under the incorrect name *Harpoceras radians* (see synonyms, p. 187), I have thought it unnecessary to occupy space with more than a few supplementary figures. It should, however, be noted that in Dr. Wright's Monograph on the Lias Ammonites, the specimens figured on pl. lxiv are without the test, and the ventral area is depicted as if it possessed a distinct, sharp, prominent, solid carina, the text intimating nothing to the contrary. The species when perfect has a hollow carina, but if the test be absent the hollow carina is removed, and the core exhibits only a very small, blunt, rounded, false carina, which sometimes appears more conspicuous because part of the partition-band, and some of the infilling of the hollow carina, may be attached to it in places. This latter condition is the case in *Gramm. Muelleri*, Pl. XXXV, fig. 2 (p. 209); and it is the restoration of this infilling into the semblance of a keel which has led to the false appearance in the above-mentioned plate. I have commented upon a similar fault in Oppel's drawing of *Haugia Eseri* (p. 156). The shape of the ventral area without test (in section) may be seen in my Plate XXXIV, fig. 4. The difference which the presence of the hollow carina makes

[1] Wright, pl. lxxiv, figs. 1, 2. [2] Pl. xxxiv, fig. 5; pl. A, figs. 39, 40.

to the ventral area may be noticed in many figures in this Monograph, and, with regard to this group of Ammonites, in Pls. XXXIV—XXXVI; and I have frequently referred to this matter in the text (pp. 81, 82, 87, 203).

Under the name *Grammoceras fallaciosum* I have thought it most convenient not only to include the forms named by Denckmann, *Am. Bingmanni* and *Am. Struckmanni*, but also the form which Dumortier and Bayle figured under the incorrect specific name of *Eseri.* The differences betweeen them and *Gramm. fallaciosum* are very slight and inconstant, consisting of a variation in thickness, size of umbilicus, and flexure of ribs. These forms may, in my opinion, be best treated as varieties as under:

Gramm. fallaciosum, sensu stricto (Pl. XXXIII, figs. 17, 18). Fine, fairly straight ribs.

Var. *Bingmanni* (Pl. XXXIV, figs. 3, 4). Thicker and squarer, with coarser ribs.

Var. *Struckmanni.* Larger umbilicus, whorls not so high and more slowly coiled; thinner than *Bingmanni.*

Var. *Cotteswoldiæ* (Pl. XXXV, figs. 4—7; Pl. XXXIV, figs. 10, 11). Higher whorls and a smaller umbilicus than the others; also more compressed.

Of the delineations given in Dr. Wright's Monograph, figs. 1—3, pl. lxiv, appear to me to represent *Gramm. fallaciosum* though it is rather coarsely-ribbed; while figs. 5, 6 illustrate an adult var. *Bingmanni.* In pl. lxxiv, figs. 1, 2, is depicted a splendid specimen of the var. *Struckmanni*, with test and carina preserved and also the termination. Pl. lxxxi, figs. 4—6, represents what would seem to be another variety of this species. It is a form which none of my specimens match exactly; and, though much like *Gramm. fallaciosum*, it has a smaller carina and a smaller umbilicus.

The following notes concerning *Gramm. fallaciosum* and its varieties[1] may be of service :

Fallaciosum. Bayle's figure of the type represents a form with numerous very straight ribs. The side view is excellent; but the other view, not being quite full-front, prevents a correct appreciation of the thickness of the specimen. No text has been published concerning these plates.

Bingmanni. Denckmann gives us three views of immature specimens of this form. The specimen represented in his pl. v, fig. 4, has a larger umbilicus and finer ribs than the specimen in his pl. vi, fig. 5. Of the latter no front or back view is given. Concerning these figures he says (p. 71), "Dem *Amm. Sæmanni* nahe verwandt, unterscheidet sich *Amm. Bingmanni* von diesem leicht durch stärkere

[1] I have obtained two more varieties; one like *Bingmanni* but thinner, yet more involute than *Struckmanni;* the other similar, but the whorls slope more to the carina, giving the aperture a subtriangular appearance.

Windungszunahme, grössere Hochmundigkeit, convexe Seitenflächen, und durch allmähliches Abfallen der Seiten nach der Externseite zu."

Struckmanni. Denckmann gives only a side view of this form; and it is not at first easy to see wherein it differs from his form of *Am. Sæmanni* below (pl. iii, fig. 2). However, he states (page 72) that *Am. Struckmanni* "in Querschnitt der Windungen *Amm. Bingmanni* . . am nächsten kommt, aber bedeutend schlanker und nicht so hochmündig ist, auch sehr langsam zunimmt." The correct identification of this form must therefore depend altogether upon whether *Am. Bingmanni* may have been correctly determined. Had it not been for this statement concerning *Struckmanni*, I should have probably identified as *Bingmanni* the form I call *Cotteswoldiæ;* but *Cotteswoldiæ* is decidedly thinner than *Struckmanni.*

As a further character of *Struckmanni* Denckmann says, "die Rippen werden in Alter enorm breit." I do not find this to be quite correct. In adult forms the ribs pass into very fine striæ; but just before doing so they are certainly rather large. Yet, on the other hand, in the form I have identified as *Bingmanni* the ribs are in places very broad, to show which the specimen depicted in Pl. XXXIV, fig. 3, has been selected; and this character is not so pronounced in the specimens I have identified as *Am. Struckmanni.*

Denckmann states that *Am. Struckmanni* is nearest to *Am. fallaciosum.* I should have thought *Am. Bingmanni* to be so. Denckmann does not say how either differ from Bayle's species.

Var. *Cotteswoldiæ.* The broad whorls causing a quick increase in diameter in proportion to the turns—the small umbilicus—the compressed shape—these are the characteristics of this form, which is a further development of *Gramm. fallaciosum.*

Both Dumortier and Bayle have figured this form under the incorrect specific name of *Eseri.* It does, certainly, on account of its involute, compressed shape, bear some resemblance to this species of *Haugia*, but may be distinguished (1) by its larger umbilicus which lacks a strong inner margin, (2) by its more distinct ribs being much more strongly projected forwards on the ventral area. The latter is *the* important feature, although the former is the more conspicuous.

With *Gramm. Cotteswoldiæ* we seem to complete what may, in the absence of any better term, be defined as an "ascending series." *Gramm. quadratum, Gramm. Sæmanni* α, *Gramm. Sæmanni* β, *Gramm. Bingmanni, Gramm. fallaciosum, Gramm. Cotteswoldiæ.* With each form the turns become fewer, the whorls broader and more compressed, the involution greater, the umbilicus smaller, and the markings finer, in other words the development is normal (page 134).

The form *Gramm. Bingmanni* is near to *Gramm. Sæmanni* β; but is more compressed, and has a quicker-coiled umbilicus. *Gramm. Struckmanni* has an appearance very similar to *Gramm. dœrntense,* variety (Pl. XXIX, figs. 8—10), but may be distinguished by its more prominent carina, which is also hollow, except on the body-chamber.

Haug supposes[1] that *Gramm. fallaciosum* is descended from the Middle Lias species, *Gramm. kurrianum* (Oppel). Seeing that this species is more compressed, and has a much thinner ventral area, this supposition is directly contrary to the mode of development which seems to be the rule among other species. I prefer to consider that *Gramm. fallaciosium* is derived from *Gramm. quadratum*, and that I do not know any species sufficiently evolute to be the parent of *Gramm. quadratum*.

The facts that in the adults of these forms the ventral area is becoming thinner, and the ribs pass into fine striæ, point to the direction in which development may be expected. It is, however, rather singular that both *Gramm. fallaciosum* and its variety *Cotteswoldiæ* occur in the *Striatulum*-beds, as well as in the *Dispansum*-beds above (I have mentioned them in my sections under the name "*Gramm. radians*, Wright," pp. 45, 46). Now, the other forms such as *Gramm. Sæmanni*, &c. I have only found in the *Dispansum*-beds; but, then, this may be due to the fact that these forms are all so very much scarcer.

Gramm. fallaciosum seems to be very local in its distribution. At particular places it is certainly rather an abundant shell; but good adult specimens are only to be obtained with difficulty. The best locality is certainly Coaley Wood, in the *Dispansum*-beds (page 45). I have also collected the species and its varieties at Buckholt Wood, Cam Down, Stinchcombe, Wotton-under-Edge, Gloucestershire; and Mr. Hudleston has found it at Cranmore, Somerset. I have also small specimens from Milhau, Aveyron (France).

Pl. XXXII, figs. 17—18, represent what may be considered as the typical form of this species. Pl. XXXIV, figs. 3, 4, show the var. *Bingmanni* with broader ribs at intervals; and fig. 5 is the suture-line. Pl. XXXV, figs. 4, 5, give two views of the var. *Cotteswoldiæ;* it lacks the test and the large hollow carina from nearly all round the whorl. Fig. 6 shows the suture-line from both sides of the whorl; and it may be noticed that the siphonal lobe is situated to one side of the keel-line, causing the sutures to be unsymmetrical. Fig. 7 is the front view of the lobes and saddles taken from another specimen. Pl. XXXIV, figs. 10, 11, give two views of a young specimen; it is remarkable for the fineness of its ribbing and for being very involute. In Plate A, figs. 39, 40, two examples of the suture-line of this species are depicted; fig. 40 is taken from a specimen which is the older and more involute.

[1] Op. cit., p. 616.

GRAMMOCERAS MUELLERI (*Denckmann*). Plate XXXIV, figs. 8, 9; Plate XXXV, figs. 1—3.

1887. AMMONITES (HARPOCERAS) MUELLERI, *Denckmann*. Fauna von Dörnten; Abh. der geol. Specialkarte v. Preussen, &c., Bd. viii, Heft 2, pl. iii, fig. 3; pl. iv, fig. 2; pl. x, fig. 8.

Discoidal, compressed, hollow-carinate. Whorls with broad, nearly parallel sides, ornamented with subarcuate radii. Ventral area undefined, scored by the ventrally-projected radii, and carrying a large hollow carina. Inner margin well marked, smooth, sloping, convex. Inclusion about one-third. Umbilicus fairly open, somewhat depressed, increasing in size slowly.

In general appearance this form approaches *Gramm. subquadratum*, but may be at once distinguished from it by broader whorls, straighter ribbing, greater compression, and a more closed umbilicus. We may consider this form to be derived from *Gramm. subquadratum*, and that we have an "ascending series"—*Gramm. quadratum*, *Gramm. subquadratum*, *Gramm. Muelleri*.

From *Gramm. fallaciosum* the slower coiling and the distinct inner margin easily separate it.

In many respects this form converges to *Haugia occidentalis*, but may be distinguished by greater thickness, a smaller umbilicus, and more conspicuous ribs. Young specimens, in which the ribs are well preserved, are easily separable on account of the stronger ventral projection thereof; but in older specimens this feature is not so conspicuous—in fact, the whorl becomes altogether nearly smooth; and, in the case of poorly preserved specimens, there is a great simulation of *Haugia*.

Denckmann's figures of this species represent only small forms. My figures 1 and 2 in Pl. XXXV, show what is probably an adult example. Denckmann speaks of indications of furrows upon the ventral area (Andeutung von Furchen); but I cannot detect this in my specimens. Doubtless very small examples possess this character, since indications of small furrows can be detected at the end of the whorl in *Gramm. subquadratum*. The small specimen which I have had depicted has irregular ribs slightly bunched on the inner area; while the edge of the inner area of the older specimens is uneven, probably from the same cause.

Gramm. Muelleri is a very scarce form. It occurs with *Gramm. fallaciosum*, &c., in the *Dispansum*-beds, and I have collected it at Stinchcombe, North Nibley, and Sodbury, Gloucestershire. None of the examples possess any test. Pl. XXXV, figs. 1, 2, give two views of a large specimen; fig. 2 shows the partition-band and a portion of the infilling of the hollow-carina remaining attached to the ventral area. Fig. 3 is the suture-line. In Pl. XXXIV, figs. 8, 9, are exhibited two views of a smaller specimen.

GRAMMOCERAS METALLARIUM (*Dumortier*). Plate XXXVI, figs. 1, 2.

1874. AMMONITES METALLARIUS, *Dumortier*. Études paléont. Bassin du Rhône, 4e partie, pl. xvi, figs. 2—4.

Discoidal, compressed, hollow-carinate. Whorls compressed with rather broad sides, ornamented with strongly-marked, ventrally-projected, subsigmoidal ribs, irregularly fasciated on the inner area and inner margin, producing irregular, elongate tuberosities. Ventral area acute, carrying a large hollow-carina not laterally sulcate. Inner margin fairly steep, but very rugose on account of the fascicled ribs. Inclusion about two-fifths.

I cannot form any conjecture concerning the parentage of this form, but it is very obviously the parent of *Gramm. dispansum*. The fasciation of the ribbing upon the inner area distinguishes it from all the previously-described species of hollow-carinate *Grammocerata*, and gives it the appearance of *Haugia;* but from the forms of this genus its ventrally-projected ribs at once separate it, and show that its correct place is in the genus *Grammoceras*.

Of the previously-described species of hollow-carinate *Grammocerata* only *Gramm. Muelleri* shows any indication of fasciated ribbing, and this only so slightly that no stress can be laid thereon.

So far as I know the example figured is the only specimen which has been found in this country. It has its test preserved. It does not exhibit the suture-line, which must for the present remain unknown, as Dumortier did not figure it.

The *Dispansum*-beds of Buckholt Wood have yielded me this rare specimen. It bears evidence of having continued for at least three parts of another whorl.

Pl. XXXVI, figs. 1, 2, exhibit two views of this specimen. The hollow-carina is present upon the greater part of the ventral area. The remains of a further continuation of the whorl are to be seen on the lateral area as depicted.

Grammoceras dispansum (*Lycett*). Plate A, figs. 41, 42 (suture-line).

1860. Ammonites variabilis, var. dispansus, *Lycett.* Proceedings of the Cotteswold Club, vol. ii, p. 146.
1864. — dispansus, *Seebach.* Hannoverische Jura, pl. viii, fig. 5 *a—d.*
1865. — — *Lycett.* Proceedings of the Cotteswold Club, vol. iii, p. 5.
1882. Harpoceras variabile, *Wright* (non *d'Orbigny*). Monogr. Lias Amm.; Pal. Soc., pl. lxvii, figs. 3, 4, only.
1885. — dispansum, *Haug.* Beiträge Monogr. Harpoceras; Neues Jahrbuch für Mineral., &c., Beil.-Band iii, p. 669.
1887. Ammonites (Harpoceras) dispansus, *Denckmann.* Fauna von Dörnten; Abhandl. z. geol. Specialkarte v. Preussen und den Thüringischen Staaten, Band viii, Heft 2, p. 78.

Discoidal, compressed, hollow-carinate. Whorls broad, flattened, ornamented with ventrally-projected, subsigmoidal radii, which are united into small club-shaped bundles near the inner margin. Ventral area not defined, the two sides of the whorls meeting at a very acute angle, and supporting a large hollow-carina. Inner margin feebly defined, consisting of a slight slope. Inclusion about one-half. Sutures (Pl. A, figs. 41, 42) show superior lateral lobe a little longer than siphonal, and not much branched; inferior lateral about half the size; auxiliaries generally about three in number.

Up to $2\frac{1}{2}$ lines diameter the species is smooth, uncarinate, and its whorls have gibbous sides; at $3\frac{1}{2}$ lines diameter the ribs are present, a small but distinct carina has appeared, and the whorls are less gibbous. At 6 lines diameter the species has much the appearance of an adult *Gramm. toarcense*, and the ribs are joined in pairs on the inner area (page 172).

In a paper read July, 1857, and published in the second volume of the 'Proceedings of the Cotteswold Field Club,' bearing date 1860, Dr. Lycett regards *Am. dispansus* as a variety of *Am. variabilis*, and defines it in these words: "The variety *dispansus* is more compressed, the volutions more enveloped; both the fasciated tubercles and the ribs are smaller, less prominent, and more numerous, the ribs being much more curved near to the keel."

The first figure of the species is that given by Seebach, but it cannot be considered characteristic. It apparently represents a specimen without test which does not show the sharp hollow-carina. The figure given by Dr. Wright is the only one which represents the species at all properly. There are two forms of the species, differing in the size of the umbilicus; and he has depicted the scarcer—the more narrow umbilicate—form.

I have made, however, the following notes concerning the specimen so figured, which is now in the British Museum, No. C 1860:—"The umbilicus is drawn slightly too large; the carina of fig. 4 at the bottom and at point of re-entry is not sufficiently separated from the sides of the whorl, which do not slope so gradually into the carina, but are bounded by a slight flattening. The shape of the aperture is rather too broad above the middle and not sufficiently triangular." I would also add that the fascicled radii are rather too long and not sufficiently clubbed at their commencement to represent the characters of the species as shown in my specimens.

Haug was mistaken when he stated that this species differed from *Haugia variabilis* "durch den Mangel eines Hohlkiels" (op. cit., p. 670); but he correctly enough assigned it to its true position when he placed it in the group of *Am. aalensis*. Dr. Lycett[1] at first considered this species a variety of *Am. variabilis;* but subsequently he separated it definitely, and gave full particulars of the distinction between *Am. dispansus* and *Am. variabilis* (*jugosus ?*), which fully justify the position he took up. The differences between *Gramm. dispansum* and *Haugia variabilis* (or *jugosa ?*) may be stated most clearly in a tabular form thus:

Gramm. dispansum.	*Haugia variabilis* (*jugosa*).
Ribs curved on the lateral area.	Ribs straight on the lateral area.
Ribs strongly projected forwards on the ventral area.	Ribs very little projected on the ventral area.
Ribs fascicled on the inner area, and forming club-shaped costæ, of which the thick end is on the inner margin, while the thin end extends across the inner third of the whorl.	Ribs springing directly in twos and threes from rounded tubercles which are on the edge of the inner margin.
Sutures plain, with shallow lobes.	Sutures somewhat ornate; somewhat deep lobes; large superior lateral saddle.

Lycett's statement that "*Am. dispansus* probably equals in its numbers all other Ammonites at Frocester Hill" is most characteristic of this species, and indicates that, in reality, the selection, for a typical *Am. dispansus*, of a specimen which I had to separate as *Gramm. Orbignyi* was merely an accident.

Gramm. dispansum, however, might be thought to be a mutation of *Gramm. Orbignyi* were it not for the existence of *Gramm. metallarium*. It seems, in face of this fact, more probable that this species is a descendant of *Gramm. metallarium*, and that it has developed in the normal manner—namely, that it has acquired more compression, a smaller umbilicus, and finer ribs.

Seeing that this species was delineated in Dr. Wright's monograph, I have not

[1] "Amm. of Sands, &c.," 'Proc. Cotteswold Club,' vol. iii, p. 5, 1865.

thought it necessary to occupy space with figures. The points to be remembered are those which I have noticed concerning this author's figure, and that the specimens are, usually, slightly more umbilicate.

Gramm. dispansum must be considered a common fossil; at the same time it is very local; while the condition of the specimens is generally very inferior on account of the manner in which the matrix adheres to the test.

This species characterises a definite horizon just above that which *Gramm. toarcense* and *Gramm. striatulum* dominate; and consequently it may be considered to occupy about the middle of the *Jurense*-zone. It occurs in Gloucestershire at Buckholt Wood, Frocester Hill, Stinchcombe, North Nibley, Wotton-under-Edge, &c.; but it is very rare at Coaley Wood. From White Lackington, near Ilminster, I have a fragment obtained from beds below the Yeovil Sands (section xiii, page 165).

The horizon of this species is so well marked, and the species itself is one so little likely to be mistaken, that I have chosen its name[1] for the strata which succeed the *Striatulum*-beds (page 164). The species is not found at all in the Cotteswold Sands, and is therefore not associated with *Haugia variabilis* or *jugosa*, a fact which Lycett noticed in his papers on these Ammonites. In reality I have never found it above or below the thin stratum to which I apply the name of this species.

For figures of this species, see Dr. Wright's Monograph as quoted in the synonymy. My Pl. A, figs. 41, 42, gives the suture-lines of two specimens.

Grammoceras nannodes, *S. Buckman.* Plate XXXIII, figs. 13—16.

Discoidal, much compressed, hollow-carinate. Whorls very narrow, convex from inner to outer edge, ornamented with very fine, ventrally-projected, subarcuate striæ. Ventral area undefined, carrying a very prominent hollow-carina, conspicuously sulcate on each side, so that in section it appears not unlike a rail from the railway, except that the outer—the flanged—part is more circular. Inner margin undefined. Inclusion one-fourth. Umbilicus very shallow. Sutures unknown.

This most distinct little form is easily known by its dwarf size in comparison with other members of the genus; hence the name "*nannodes*."[2] It is further distinguished by its very fine striæ, its compressed shape accompanied, singularly enough, by evolute whorls, and by its trenchant, laterally-sulcate hollow-carina.

[1] "The Cotteswold, Midford, and Yeovil Sands," 'Quart. Journ. Geol. Soc.,' vol. xlv, p. 443 *et seq.*

[2] *ναννώδης*, dwarfish.

I know nothing of the sutures of this species, but, judging from the shape of the striæ, it belongs to the genus *Grammoceras.* The striæ are not at all falcate, as would be the case if it belonged to *Harpoceras.*

I can form no conjecture concerning the descent of this species; its evolute whorls are a most unexpected feature considering its position and the state of its other characters. It must be regarded as a degraded form of the genus, and that it had, as to the umbilicus, reverted to the more ancestral shape.

Not only is this species distinct in appearance from its congeners, but it is separated from them in time; for it occurs in the *Murchisonæ*-zone, and is, so far as I know, the solitary representative of the genus on that horizon.

Only two specimens of this most interesting form are known to me; and I have not had the fortune to find either myself. One was in my father's collection; it came from Bradford Abbas, Dorset; and judging by its matrix I have no hesitation in saying that it came from the "Paving-bed." The other specimen was obtained for me from Stoford, Somerset, by Mr. F. Stubbington. Pl. XXXIII, figs. 13, 14, exhibit two views of the specimen from Stoford, showing the trenchant carina. Figs. 15, 16, give two views of the specimen from Bradford Abbas.

HILDOCERATIDÆ (*continued*).

Genus—POLYPLECTUS,[1] *S. Buckman.*

Definition. — Discoidal, compressed, highly-involute. Whorls, in section, acutely-triangular, without ventral edge, but with a very sharp outside; with broad sides, ornamented with sigmoidal radii strongly-projected on the outer area. No separate carina. Sutures extremely complicated—siphonal lobe large, and with an accessory tuft—siphonal saddle with a large accessory lobe—superior lateral lobe shorter than the siphonal—seven or more auxiliary lobes.

Remarks.—Only one species, namely, *Polyplectus discoides* (Zieten), is included in this genus. It is a descendant of *Harpoceras;* but the changes which it has undergone, resulting in the fixing of its characters, have made it so different in many ways from the other members of the genus *Harpoceras*, that it cannot be included in that genus without spoiling the compactness or upsetting the definition thereof.

I reserve any further remarks, and proceed to a description of the species, when this matter will be further discussed.

[1] πολύπλεκτος = closely-twined, in reference to the complicated sutures.

POLYPLECTUS DISCOIDES (*Zieten*). Plate XXXVII, figs. 1—5.

1830. AMMONITES DISCOIDES, *Zieten.* Verstein. Württ., pl. xvi, figs. 1 *a*, *b*, *c*.
1844. — — *d'Orbigny.* Terr. jurass.; Pal. Franç., pl. cxv.
1846. — CAPELLINUS JURENSIS, *Quenstedt.* Ceph., p. 106.
1856. — DISCOIDES, *Oppel.* Juraf., p. 245.
1858. — — *Quenstedt.* Der Jura, pl. xl, fig. 7, p. 283.
1867. — — *Meneghini.* Foss. calc. rouge; Pal. Lombarde, 4e Série, p. 20.
1867. LEIOCERAS DISCOIDES, *Hyatt.* Ceph.; Bulletin Mus. Comp. Zool., p. 102.
1874. AMMONITES DISCOIDES, *Dumortier.* Bassin du Rhône, iv, p. 54.
1881. HARPOCERAS DISCOIDES, *Meneghini.* Révision systématique; Pal. Lombarde, 4e Série, p. 199.
1884. — — *Wright.* Monogr. Lias Ammonites; Pal. Soc., vol. xxxviii, pl. lxxxii, figs. 12, 12 *a*, 13.
1885. — — *Haug.* Beitr. Monogr. Harpoceras; Neues Jahrbuch für Mineralogie, &c., Beil.-Bd. iii, p. 620.

The description of this species is given under the generic definition.

Side and front views of this species have been given by Dr. Wright, who stated that, as none of his specimens showed the lines of the structure of the suture, the suture-line (fig. 12 *a*) drawn by his artist was a copy of that given by d'Orbigny (*op. cit.*, pl. cxv, fig. 4).[1]

The suture-line of this species increased in complexity as the shell grew, so that it becomes extremely difficult to follow it on adult examples. The clearest part of the suture-line is towards the outer edge; and this is just where d'Orbigny's mistake is, namely, that the accessory lobe in the siphonal saddle is nothing like large enough. This is a serious mistake. There are some other errors in the suture-line, as I will presently point out; but they are of minor importance. The same mistake appears in d'Orbigny's front view—there is no accessory lobe depicted in the siphonal saddle. It is in order to rectify this mistake that I have had the present figures drawn (Pl. XXXVII, figs. 1—5). The suture-line I have traced from a specimen obtained at White Lackington, which shows the sutures in many places with great clearness; and the details of these sutures are confirmed by two little specimens from Milhau, Aveyron (France), which are also entirely without test. One of these specimens furnishes the front view (fig. 3).

[1] 'Monograph on the Lias Ammonites,' p. 467.

Except for the points mentioned above the figures of this species by the various authors cited at the heading are certainly unmistakable. The description by Meneghini is very concise and interesting; and he also refers to a description by Giebel ('Fauna der Vorwelt,' iii. p. 523, 1852) which I have not had the opportunity to study. Besides this he gives as a synonym *Ammonites depressus*, Zieten, 'Verst. Württ.,' p. 7, pl. v, fig. 5; but as Zieten's work is not at present at hand I cannot venture an opinion on this point.

Polyplectus discoides is an unmistakable species on account of its very sharp ventral area, its very small umbilicus, and its complicated sutures. It seemed to be an entirely isolated form; and for a long time its descent, and consequently its correct place in a system of classification, remained a complete mystery to me. At one time, deceived entirely by its general shape, and by its lobe-line, especially the peculiar accessory tuft on the siphonal lobe (Pl. XXXVII, figs. 1, 4, 5), and misled by d'Orbigny's figure of the suture, I expressed an opinion that it was "one of the earliest forms of *Oppelia*-like species;"[1] and I also referred it to the genus *Oxynoticeras*, although with a query, thinking it possibly a highly-developed form of some members of that genus. Now, however, its descent is clearly proved by the small specimens from Milhau, which show exactly how the suture-line developed as the specimen grew; and consequently I have much pleasure in confirming Haug's view that this species is closely connected with *Harpoceras subplanatum*. The fact of the matter is that this species is a highly-developed form of *Harpoceras*, is directly descended from *Harpoceras subplanatum*, and is consequently the highest developed form of an ascending series—a form in which the ventral area has attained the greatest degree of sharpness, the umbilicus has become nearly closed up, and the sutures have been made most complicated in order to support the broad sides of the whorl.[2]

I am of opinion that it is advantageous to give this species a distinct generic name; because it differs in so many important respects from *Harpoceras*, and it develops its peculiar characters at a very early age. The sharpened ventral area without, so far as I can see, any trace of the hollow-carina of *Harpoceras*—

[1] This Monograph, p. 40, foot-note.

[2] It is worth while to notice another rather tempting and suggestive theory, namely, that *Pol. discoides* is the further involute development of *Ammonites kurrianus* (Oppel). Meneghini has figured a species* which is in position and the amount of involution exactly intermediate between *kurrianus* and *discoides*; but, unfortunately, he gives no suture-line. I believe, however, that the suture-line observable on young *Polyplectus discoides* really disposes of the matter, and that *Harpoceras* is the true parent, although in general appearance, and especially in the shape of the ventral area, the species above mentioned are very similar.

* *Ammonites, sp. ind.*, Meneghini, 'Foss. calc. rouge, Pal. Lombarde,' 4e Série, pl. ix, fig. 1; *Harpoceras*, cf. *Kurrianum*, ibid., p. 199.

the absence of a definite ventral area—the almost occluded whorls—the ribs without the sharp falcate shape—the complexity of the suture-line generally, and the manner in which the chambers are crowded one into another—the large accessory tuft in the siphonal saddle—the large number of auxiliary lobes—all these are points which separate this species entirely from *Harpoceras, sensu stricto;* and although they may be regarded, when taken together, as the consummation to which the series of *Harpoceras falciferum* was making more or less progress, yet it is just because this consummation has been obtained so completely in *Pol. discoides* that the species is so distinct from its forerunners in so many respects, and that it seems to be entitled to have its peculiarities duly noted by a distinct generic or subgeneric appellation.

The development of the suture-line of this species fully bears out my remarks at p. 135, that the suture-line increased in complexity after the involute shape had become a fixed character. The ascending series having attained, as *Harpoceras subplanatum*, nearly as broad a side as it was possible to acquire, had yet not altered the suture-line to any great degree; but the broad whorls having become a definitely fixed character, we find that *Polyplectus discoides* begins, even when quite small, to increase the complexity of its suture-line, presumably to give adequate support to its broad, flat whorls. The development of the accessory tuft is also entirely in accordance with the loss of the carina and ventral area, and the acquirement of a very sharp ventral edge; because this change has converted the branches of the siphonal lobes into lobes supporting the outer edge of the lateral area. These branches have, in *Pol. discoides*, to support a flattened portion of the lateral area, instead of, as in *Harp. subplanatum*, an arched ventral area. A complicated suture-line with an accessory tuft to the siphonal saddle is therefore no argument for the relationship of this form to *Oppelia.* It is true that the accessory tuft is also found in most species of that genus; but its production is a necessary result of a similar change in the relative shape of the ventral and lateral areas. A similar augmentation of the branches of the siphonal lobe—but without a definite accessory tuft—is to be seen in the sutures of *Amaltheus margaritatus;*[1] and I have stated that this is due to the same cause.[2]

Not only is the suture-line of *Pol. discoides* more complicated in general on account of the extra growth and greater division of all the small follicles of the lobes, but an extraordinary array of auxiliary lobes is put forth—a great advance on what obtains in *Harp. subplanatum.* D'Orbigny gives four not very clearly defined auxiliary lobes for *Harp. subplanatum* (*Am. complanatus*, pl. cxiv, fig. 4); while he gives six distinct auxiliary lobes for *Pol. discoides* (pl. cxv, fig. 4). This is, of

[1] "The Descent of *Sonninia* and *Hammatoceras*," 'Quart. Journ. Geol. Soc.,' vol. xlv, pl. xxii, fig. 5.

[2] Ibid., p. 656.

course, on the outside of the whorl; and, similarly, on a small specimen from Milhau I can count seven to the top of the inner margin.

The suture-line of this species is, as I have said, extremely hard to follow; and this is due not only to the extraordinary complexity of the septa of a series of chambers very closely crowded together, but also because the suture-line may not be absolutely separated from its predecessor. In fact, in many places—and I have observed the same in the complex sutures of other species—the lobes are sometimes distinctly joined to the saddles of the preceding suture at one or two points; and the consequence is that in tracing a suture-line under such circumstances one is apt to branch off, at the point of junction, on to the wrong suture-line.

I could wish that I had more material of this species, so as to give its history from the earliest period. Failing that, the following notes upon the suture-line may be of service. When the side of the whorl is $3\frac{1}{2}$ lines broad the siphonal lobe is fairly simple. It is not, however, so simple as in adult *Harpoceras*, but shows a certain addition in the way of follicles; and also it is more divergent and not so dependent. (Fig. 4 in Pl. XXXVII shows the terminal branch of the siphonal lobe when the whorl is $3\frac{1}{2}$ lines broad; but of course the drawing is much enlarged.) At this time the accessory lobe in the siphonal saddle is large and well developed, and its lowest point hangs level with point *d*, fig. 4; the superior lateral lobe is large, and is just longer than the siphonal; the inferior lateral lobe is little larger than the accessory lobe; and there are four fairly conspicuous auxiliary lobes, and a fifth rudimentary.

At this age the only points in which the suture-line differs from that of *Harpoceras* are the slightly more developed siphonal lobe, and the more conspicuous auxiliary lobes; while the large accessory lobe is so characteristic of *Harpoceras*.

Although the whole suture-line gradually increases in complexity as the shell grows, yet there is a very noticeable, in fact much quicker, development in the branches of the siphonal lobe. When the whorl is $5\frac{3}{4}$ lines broad—that is to say, just at the ninth suture onwards—the terminal branch of the siphonal lobe shows the form represented (enlarged) in fig. 5. It will be noticed that the points marked *a*—*e* have all very much developed from the same points in fig. 4; and that, on account of a rather greater growth in *c*—*e*, the terminal branch stands out still more conspicuously from the keel-line than it did before (fig. 4). Not only have the various points *a*—*e* increased in size, but they also show several additional minor points which indicate the manner in which further development of the lobe in the matter of complexity could be brought about.

The remainder of this suture is more complex than the one formerly described;

and there are seven complete auxiliary lobes. It is noticeable that the forked termination to the superior lateral lobe now becomes conspicuous (fig. 1 *f*). In the suture at $3\frac{1}{2}$ lines side-breadth the follicles of this termination were more divergent; and the outer one, especially, pointed towards the circumference of the whorl.

The further development of the suture-line is shown in fig. 1. This is taken from a specimen obtained at White Lackington; and the breadth of the side where the suture is taken from is $9\frac{1}{2}$ lines. The suture-line, which is given of natural size, shows how the terminal branches of the siphonal lobe have become developed into the accessory tuft. Thus the point *a* has become very much produced, and has apparently usurped the place which the point *b* formerly occupied (fig. 4); while the points *b*, *c*, *d*, *e*—the last especially—have all developed, becoming further separated and more pronounced. The growth of this accessory tuft to the siphonal lobe—that is to say, the great proportionate enlargement of the siphonal lobe—altogether diminishes the importance of the accessory lobe in the siphonal saddle in comparison. The superior lateral lobe is also smaller in comparison, and is now not quite so long as the siphonal lobe. The inferior lateral lobe is still only a little bigger than the accessory lobe, showing that it is not any decrease of the lateral lobes, but inordinate increase of the siphonal lobe, which has caused the difference in the appearance of the suture-line. The auxiliary lobes in this drawing are confessedly incompletely delineated.

I must now make a few remarks on the way in which the lobe-line differs from d'Orbigny's delineation. The principal point is the size of the accessory lobe in the siphonal saddle. In d'Orbigny's drawing this occupies an entirely subordinate place. While, in my drawing, the accessory lobe hangs down below the upper branches of the accessory tuft of the siphonal lobe, and interposes itself between them and the lower points of the superior lateral lobe, in d'Orbigny's drawing it does not reach the accessory tufts, and there is no room for it to interpose between them and the superior lateral lobe. Again, in my drawing this accessory lobe is nearly as large as the inferior lateral; in d'Orbigny's drawing it is not half the size. It is true that d'Orbigny's figure is taken from a broader side than mine, namely, 15 lines; but I find that the same characters of the accessory lobe are shown in my specimen at that size. The large accessory lobe is important because it points to the connection of this species with *Harpoceras*.

Another point about the suture-line is the peculiar bifurcate appearance of the terminal points of the superior lateral lobe. This character is not shown at all in d'Orbigny's drawing; and yet it is most conspicuous in my specimen all round the whorl, and gives to these points the appearance of a pair of forceps; it is also to be seen in the later sutures of the specimens from Milhau (France), as I have stated.

The inferior lateral lobe in d'Orbigny's drawing is proportionately larger than in mine.

Dr. Wright states that this species is the leading fossil of the *Opalinum*-zone (*op. cit.*, p. 468). It is true that at a locality like Coaley Wood the species occurs but a very little distance, about eight inches, below *Lioc. opalinum*. Yet, geologically, the interval which separates the two species is very considerable, though the deposit is small. One distinct Ammonite-horizon intervenes; and though only about eight inches thick at Coaley Wood, yet it is over 100 feet thick in the Dorset-Somerset area.

The correct position of this species is a matter of importance, because it is a form so unmistakable. Its actual horizon is in strata which I have called "*Dispansum*-beds," and which I have placed[1] as one of the middle divisions of the *Jurense*-zone.[2] It shares this horizon with many species, of which three are very characteristic, namely, *Gramm. dispansum*, *Gramm. fallaciosum*, and *Hamm. insigne*.

I have collected this rare species in Gloucestershire at Coaley Wood and North Nibley; in Somerset at White Lackington. I have also specimens from Milhau (Aveyron), France, and from La Porcarella (Central Apennines), Italy. Meneghini speaks of this species being common in Umbria and in the Toarcian of the Apennines, but scarce in Lombardy. It is certainly one of those species which have been regarded as having their head-quarters on the borders of the Mediterranean, and which seem to become gradually rarer further north.

The figures of *Polyplectus discoides* which I have given are merely to illustrate the lobes and saddles and my description thereof. Pl. XXXVII, fig. 1, is the suture-line, of natural size, from a specimen obtained at White Lackington, Somerset. Fig. 2 is the side view of a small specimen from Milhau, Aveyron (France). Fig. 3 is the front view of the same to show the lobes and saddles, and to demonstrate that the omission, in d'Orbigny's drawing, of the accessory lobe, *a a*, of the siphonal saddle was a mistake. Fig. 4 gives a portion of the terminal branch of the siphonal lobe from the same specimen where the whorl is $3\frac{1}{2}$ lines broad. Fig. 5 illustrates the same part from the same specimen where the whorl is $5\frac{3}{4}$ lines broad, showing how the lobe proceeds to develop the accessory tuft.

[1] See p. 166, foot-note 1.

[2] Haug (*op. cit.*, p. 621) states that the species occurs with *Lytoceras jurense*.

Remarks on the Genera *Haugia* and *Grammoceras*.

In the foregoing pages I have expressed my views upon the relationship of the various members of these genera in the articles concerning the different species. The theory that *Haugia* is descended from *Lillia* causes the former to be regarded as the "cousin" of *Ludwigia;* and it is interesting to observe the differences which may be developed in two genera sprung from the same source.

In *Grammoceras* we have a large and influential genus to deal with—a genus which dominated the *Jurense-* and the *Opalinum*-zone. It may be reckoned to contain altogether thirty-one so-called species, ranging from the *Jamesoni-* to the *Murchisonæ*-zone inclusive. Out of this number, twenty forms, more or less entitled to the name of species, have been dealt with in this Monograph; and these are distributed into the *Murchisonæ*-zone—1, the *Opalinum*-zone—9, and the *Jurense*-zone—10. It may be useful to give a table showing the probable relationship of these species; because such a table will demonstrate at a glance what can only be gathered otherwise from the perusal of many pages. I have stated that I cannot satisfactorily identify the ancestor of the species now dealt with, and that, although several species of the genus appeared before the *Jurense*-zone, yet I do not attribute the parentage to them (p. 163).

Table IV.—*The Grammocerata.*

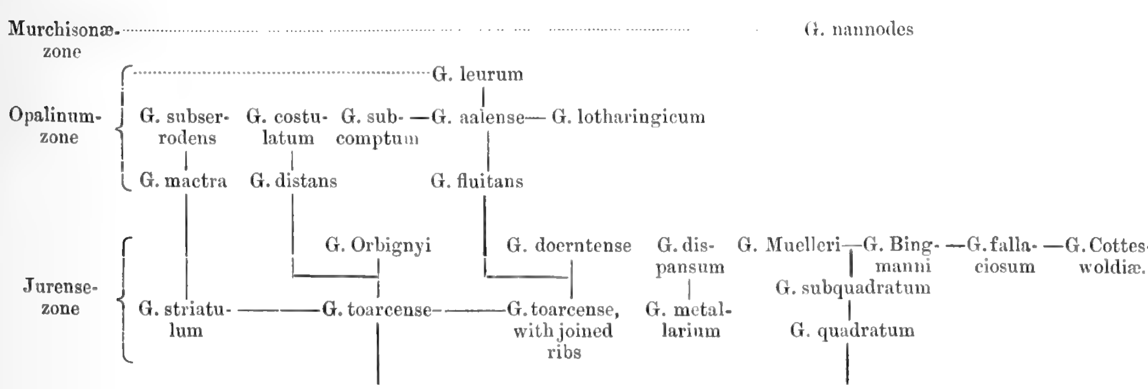


Table IV shows that, with trifling exceptions, I have traced the *Grammocerata* to two sources—the solid-carinate to *Gramm. toarcense*, the hollow-carinate to *Gramm. quadratum;* but whether the source of these two species is really very widely separated is a point which I cannot determine at present. In a great measure this is due to the apparent paucity and isolated character of the species of *Grammoceras* in the zones below that of *Jurense.* In the *Jurense-* and *Opalinum*-zones we have a very fairly compact series; and it must truly be said that it is often possible, with a very extended series of specimens, to trace the gradual development of one so-called species into another, so that many of the lines of division between the forms named are more or less arbitrary. Such, for instance, is the case between *Gramm. toarcense* and *Gramm. striatulum*,—between *Gramm. mactra* and *Gramm. subserrodens*,—between *Gramm. fluitans*, *aalense*, and *leurum*,—and from *Gramm. quadratum* to *Muelleri* on the one hand and to *Cotteswoldiæ* on the other. At the same time, although the boundaries between the species may be bridged over more or less, it is certainly expedient to retain names for the different stages of development in any genetic series, provided that these steps possess peculiar features sufficiently distinct and recognisable. So far as more intermediate specimens are concerned, it may be worth while to consider a suggestion made to me by Mr. H. B. Woodward, F.G.S., namely, to use a double name for intermediate forms; thus, *Gramm. mactra-subserrodens* would mean the form intermediate between these two species.

One fact of particular interest, which the *Grammocerata* bring prominently to our notice, is that Ammonite-species exhibit a tendency to vary in several directions; and, further, that one of these variations is successful and develops into a well-marked form, which is deemed worthy of another name. It is true that the variations to be observed in a species are slight characters which can very often only be detected on extremely good specimens, but this is obviously a necessity of the case. If the characters were more strongly marked the form might receive a distinct name.

Suppose we take *Gramm. mactra* as an example. Its tendency is towards finer ribbing, but in one case this is accompanied by a decay of the carina (Pl. XXXI, figs. 3, 4); in another case by a sharpening of the carina, a fasciation of ribbing, and a slight inner margin (Pl. XXXI, figs. 1, 2); in a third case by a sharpening of the carina, a pronounced inner margin, and more compressed sides. Now it is the third case which seems to be continued into *Gramm. subserrodens.*

The case of *Gramm. aalense* is much the same. There are five slightly different forms of this species figured. One of these (Pl. XXXII, figs. 7, 8) is the form which is continued into *Gramm. leurum.*

Concluding Remarks on the Family *Hildoceratidæ*.

By considering the base of the *Opalinum*-zone as the base of the Inferior Oolite, the species and genera which comprise the family *Hildoceratidæ* are divided most unnaturally into two sections—Oolitic and Liassic. In consequence of the manner in which the *Jurense*- and the *Opalinum*-zone are bound together by the genera *Haugia* and *Grammoceras*, I have found it necessary to trespass beyond my original limits in order to give a more complete account of the members of those genera. I shall have to repeat this offence on other occasions.

So far as the *Hildoceratidæ* are concerned I have completed my task—at any rate for the present. That there are many matters in which the knowledge gained during the progress of this work indicates that improvements might be made I very readily confess. There are many points connected with the genealogy of the species of the *Hildoceratidæ* which are very obscure; and it is only too probable that the advent of fresh specimens and new species may necessitate certain alterations in the general grouping of the family, by furnishing clearer evidence of the genesis of the different species. No doubt in the future I shall have to add a supplement upon the *Hildoceratidæ*, and then I shall hope to treat of the whole family, and not merely, as in this work, of a portion separated by a more or less artificial geological division.[1]

The family *Hildoceratidæ* was dominant from the *Falciferum*- to the *Concavum*-zone inclusive. The species which lived prior to the time of the *Falciferum*-zone were few in number, and, in a geographical sense, belong more especially to the area in contact with the Mediterranean. It would seem as if this family, as well as others, made that district their head-quarters, and that from thence successive waves of less-modified species were constantly being sent forth. As these species spread they ousted their more changed predecessors; while, after having in their turn become modified, they were themselves ousted by the species of the next wave of Ammonite-immigration—members, possibly, of the same family.

In this manner the genus *Harpoceras*, which dominated the *Falciferum*- and the *Commune*-zone, was ousted by *Grammoceras*, which dominated the *Jurense*- and the *Opalinum*-zone; and the latter in its turn was ousted by *Ludwigia* and *Lioceras*, which dominated the *Murchisonæ*- and the *Concavum*-zone.

The ideal to which the *Hildoceratidæ* tended was the compressed, involute shape. Thus, for instance, if we take only the species described in this Monograph which obtained this shape, we have *Ludwigia cornu*—the genera *Lioceras, Pseudolioceras*, and *Hyperlioceras*,—*Haugia Eseri*—*Grammoceras subserrodens, leurum*, and *Cotteswoldiæ*—and *Polyplectus discoides*. It may be suggested that this shape was, in reality, a necessity. When the evolute form became dominant it caused over-crowding, brought about a scarcity of food, and induced greater economy, which resulted in the compressed, involute shape. The involute forms therefore possessed a distinct advantage over the evolute forms of their own genus, and consequently they survived while the latter died out. When, however, from any cause they were brought into conflict with a fresh immigration of evolute—and therefore presumably vigorous—forms of another genus, which had not felt the

[1] See my paper "On the Cotteswold, Midford, and Yeovil Sands," &c., Quart. Journ. Geol. Soc.,' vol. xlv, pp. 461—463, &c.

pinch of hard times, it was not these involute forms which continued to perpetuate the Ammonite-race. They had to yield place to the evolute species of the other genus. In turn the new immigrants passed through the same changes, on account of similar causes, and with very similar results.

Finally, I have one more point to mention—a point which concerns Ammonites generally, but the *Hildoceratidæ* more particularly, at present. At p. 159, foot-note, I have alluded to the manner in which all traces of an intermediate stage of development may be omitted from the inner whorls. Assuming a tendency to dispense with a stage dissimilar to its predecessor or successor so as to avoid a useless change, yet it seems probable that this tendency might not be very powerful until the dissimilar stage had, owing to the encroachments of its successor, become very unimportant. It seems to me that, allowing all the characters of the parent to have been inherited at an age ever so slightly earlier in each successive generation (p. 134, foot-note), it is necessary also to suppose that the later-acquired character always made the most progress in this matter; and, therefore, each preceding character made a progress gradually slower in proportion to the remoteness of the time when it had been acquired.

Allowing the fact of "earlier inheritance" in the descendant, then each generation must add something of its own. If the descendants continued the development in the same course as their parents, then the additions made would be practically imperceptible; but if gradual modifications were being introduced, no matter how slowly, then in a certain number of generations there would be an appreciable change—we should have a new "stage." The result I wish to arrive at is that the characters, whether perceptible or otherwise, which originate with the parents make greater progress in the matter of "earlier inheritance" than those derived from the grandparents; and these again make greater progress than those derived from the great-grandparents, and so on. Applying this idea to what are called the "different stages," which are really the perceptible additions, then the last stage makes greater progress than the penultimate stage, and so on; or, stated as a general law, *the "earlier inheritance" of a given character is always diminishing*. Of necessity the omission of the characters of any stage, that is, its obliteration by its encroaching successor, must depend upon the number of generations through which the stage endured without change—the greater the number the longer the time required; but, as I have said, we may also suppose an acceleration of the process towards the last if what had come to be a useless change could thereby be avoided.

The theory above enunciated would account for the persistence of the characters of innermost whorls, because, being derived from ancestors so very remote, their progress in the matter of "earlier inheritance" would be practically-speaking, though not actually, *nil*.

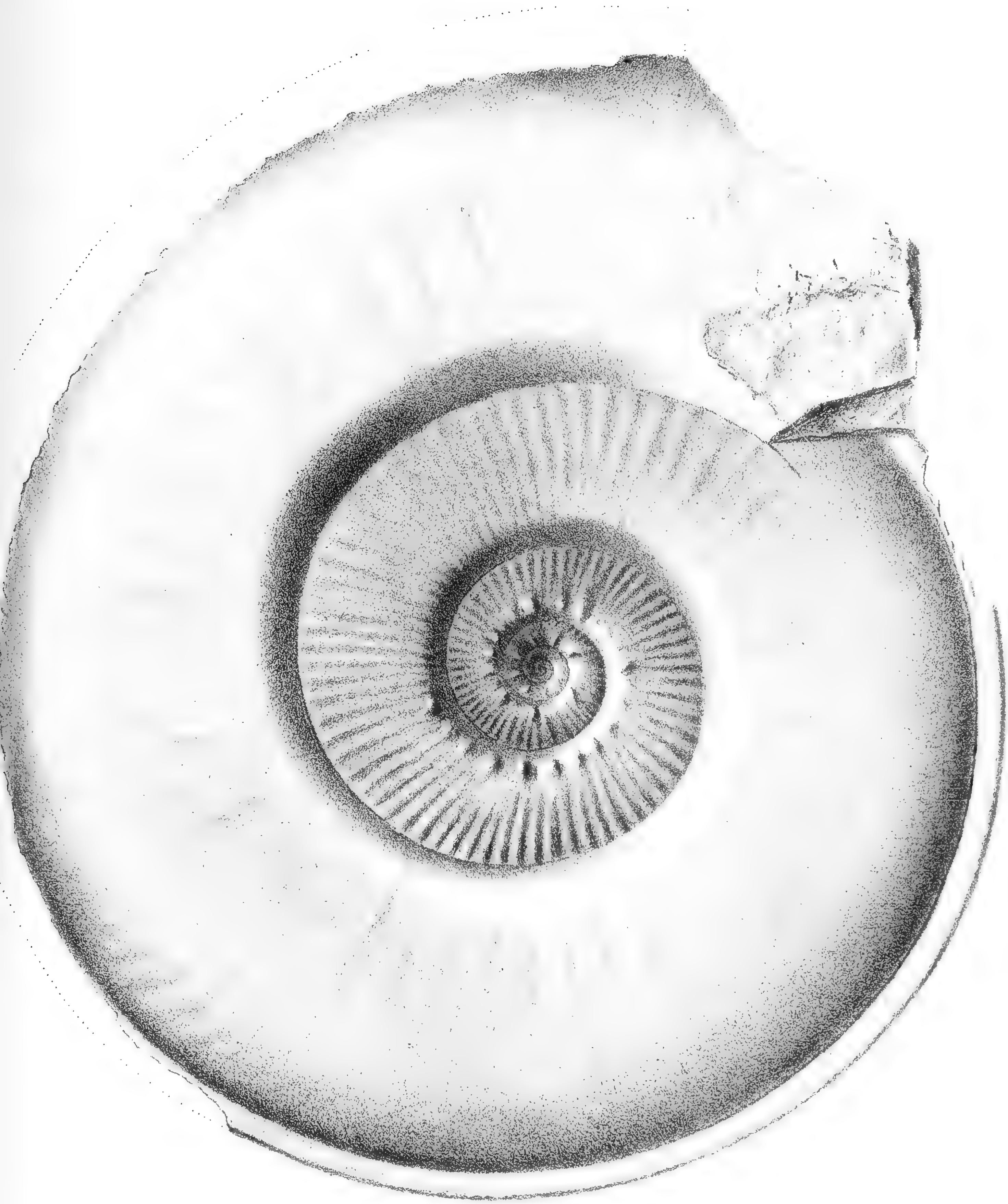
PLATE XXIV.

Variabilis-subzone.

HAUGIA JUGOSA (*Sowerby*).[1]

Splendid adult specimen, with the test and a large part of the strong carina well preserved. It shows the loss of ribs characteristic of adult age. Quite five-eighths of the last whorl is body-chamber. Cotteswold Sands, Coaley Wood. My Collection. (Page 149.)

[1] It is requested that the following alterations be made in the explanations of Plates XXIII and A. Plate XXIII, figs. 11—15, for "*variabilis*, d'Orbigny," read "*jugosa* (Sowerby);" erase the sentence beginning "But as neither . . .;" figs. 16, 17, for "*Ogerieni* (Dumortier)" read "*Dumortieri*, S. Buckman." Plate A, fig. 35, for "*variabilis*" read "*jugosa*;" fig. 36, for "*Ogerieni* (Dum.)" read "*Dumortieri*, S. Buckman."



A Gawan del. et lith.

PLATE XXV.

Variabilis-subzone.

Fig. 1.—Haugia jugosa (*Sowerby*).

Fig. 1.—Front view of the specimen depicted in Plate XXIV. (Page. 149.)

Fig. 2.—Haugia variabilis (*d'Orbigny*).

Fig. 2.—Side view of a small specimen with the characteristic reflexed ribs and the open umbilicus; test partly preserved. Compare with *Haugia jugosa*, Plate XXIII, figs. 11 and 14. Cotteswold Sands, North Nibley, Gloucestershire. My Collection. (Page 146.)

Jurense-zone (Striatulum-beds).

Figs. 3—7.—Haugia Eseri (*Oppel*).

Fig. 3.—Side view of a typical specimen, but without test. Coaley Wood, Gloucestershire, Bed No. 8. My Collection. (Page 155.)

Fig. 4.—Front view of the same specimen.

Fig. 5.—Side view of a larger but not nearly adult specimen. The test on the specimen is not preserved. North Nibley, Bed No. 15. My Collection.

Fig. 6.—Front view of the same specimen, showing the difference where the hollow carina is present, and where it is absent.

Fig. 7.—Side view of a more umbilicate and more compressed form, in which a certain amount of obscure fasciation of the ribs is to be noticed. Stinchcombe Hill, Gloucestershire. My Collection.

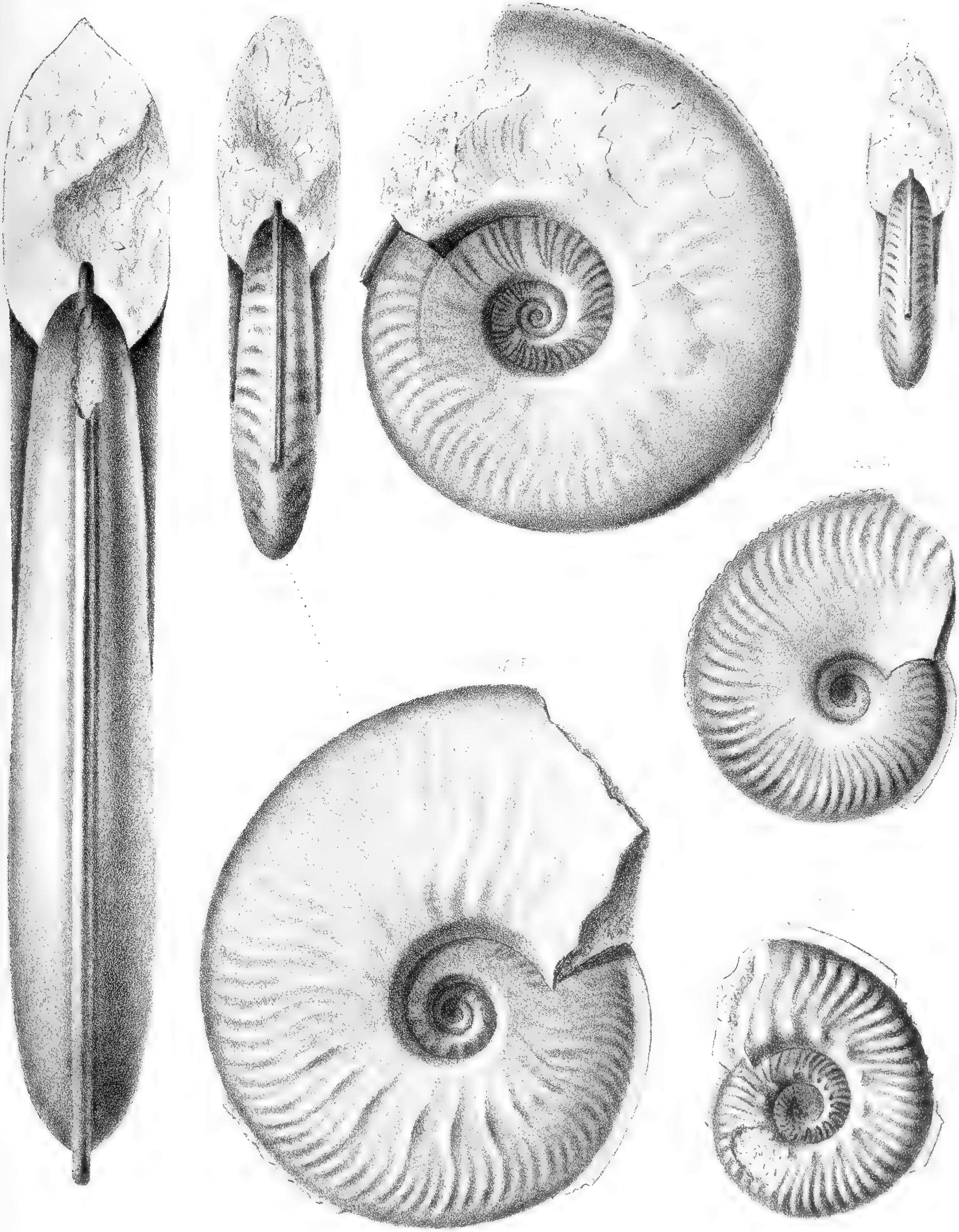


PLATE XXVI.

Jurense-zone (Striatulum-beds).

Figs. 1, 2.—Haugia Eseri (*Oppel*).

Fig. 1.—Side view of a form with coarse ribs in the umbilicus, which rather suddenly give place to entire smoothness. The test is very well preserved. North Nibley, Gloucestershire. My Collection. (Page 155.)

Fig. 2.—View of the aperture of the same specimen.

Figs. 3—5.—Haugia illustris (*Denckmann*).

Fig. 3.—Side view of a poorly preserved, in fact slightly crushed, example, but showing the general contour. Penn Wood, near Stroud, Gloucestershire. My Collection. (Page 153.)

Fig. 4.—Side view of a fragment of another example in a better state of preservation to show the ornamentation. Coaley Wood, probably Bed No. 8. My Collection.

Fig. 5.—A sectional view of the same example to show its proportions.

Variabilis-subzone.

Fig. 6.—Haugia jugosa (*Sowerby*).

Fig. 6.—Outline of the mouth-border, taken from a rather poor specimen obtained in the Cotteswold Sands, Coaley Wood. My Collection. (Page 149.)

Jurense-zone (Striatulum-beds).

Figs. 7—10.—Grammoceras striatulum (*Sowerby*).

Fig. 7.—Side view of Sowerby's original example contained in the Collection of the British Museum (Natural History). This specimen was "found embedded in a marly Limestone nodule . . . . on the coast in Robin Hood's Bay by Mr. Crawford, of Scarborough." 'Min. Conch.,' vol. v, pl. ccccxxi, p. 23. (Page 173.)

Fig. 8.—Front view of the same example.

Fig. 9.—Copy of a rubbing from the surface of the whorl to show the correct bend of the ribbing, a characteristic feature in *Grammoceras* (see page 162.)

Fig. 10.—Tracing of the suture-line. The designs for this and for fig. 9 were kindly prepared for me by Mr. G. C. Crick, F.G.S.

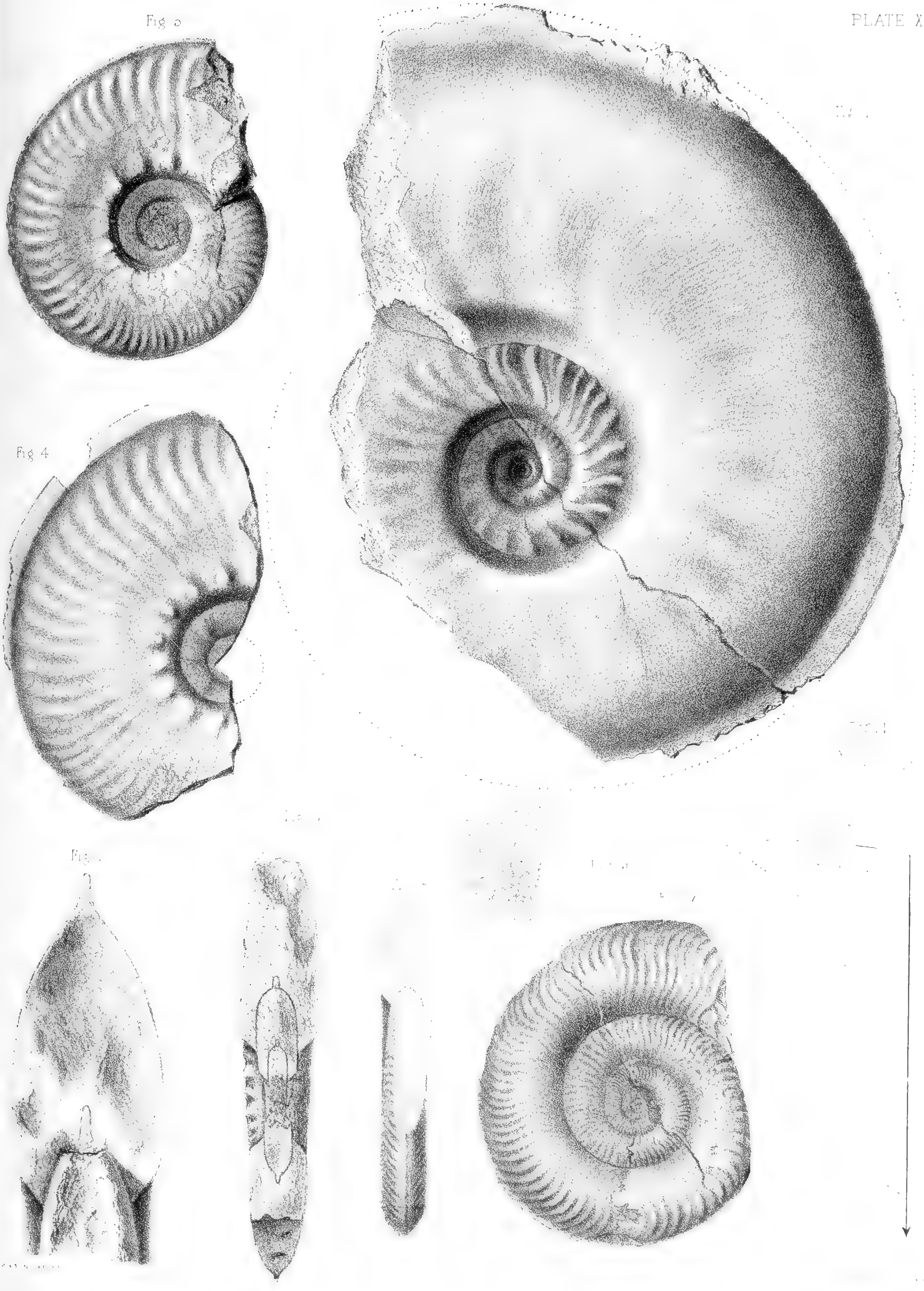


Fig 3
Fig 4

PLATE XXVII.

Jurense-zone (Striatulum-beds).

Figs. 1, 2.—Haugia occidentalis (*Haug*).

Fig. 1.—Side view of a fine adult specimen with its test fairly preserved. From the yellow sands, Little Sodbury, Gloucestershire (see Section XI, p. 165). My Collection. (Page 154.)

Fig. 2.—View of aperture in outline.

Jurense-zone.

Figs. 3—6.—Grammoceras Orbignyi, *S. Buckman.*

Fig. 3.—Side view of a specimen from Peak, Yorkshire. Collection of Mr. W. H. Hudleston, F.R.S., &c. (Page 184.)

Fig. 4.—Back view of the same specimen, showing the forward-projected radii.

Fig. 5.—Side view of a variety with ribs slightly fascicled on the inner margin. Frocester Hill. My Collection. Presented to my father by the late Dr. Lycett, L.R.C.P.E., &c. (The drawing gives the idea of small round tubercles, which is not quite correct, for the fasciation produces rather inconspicuous club-shaped costæ.)

Fig. 6.—Front view of the same specimen.

PLATE

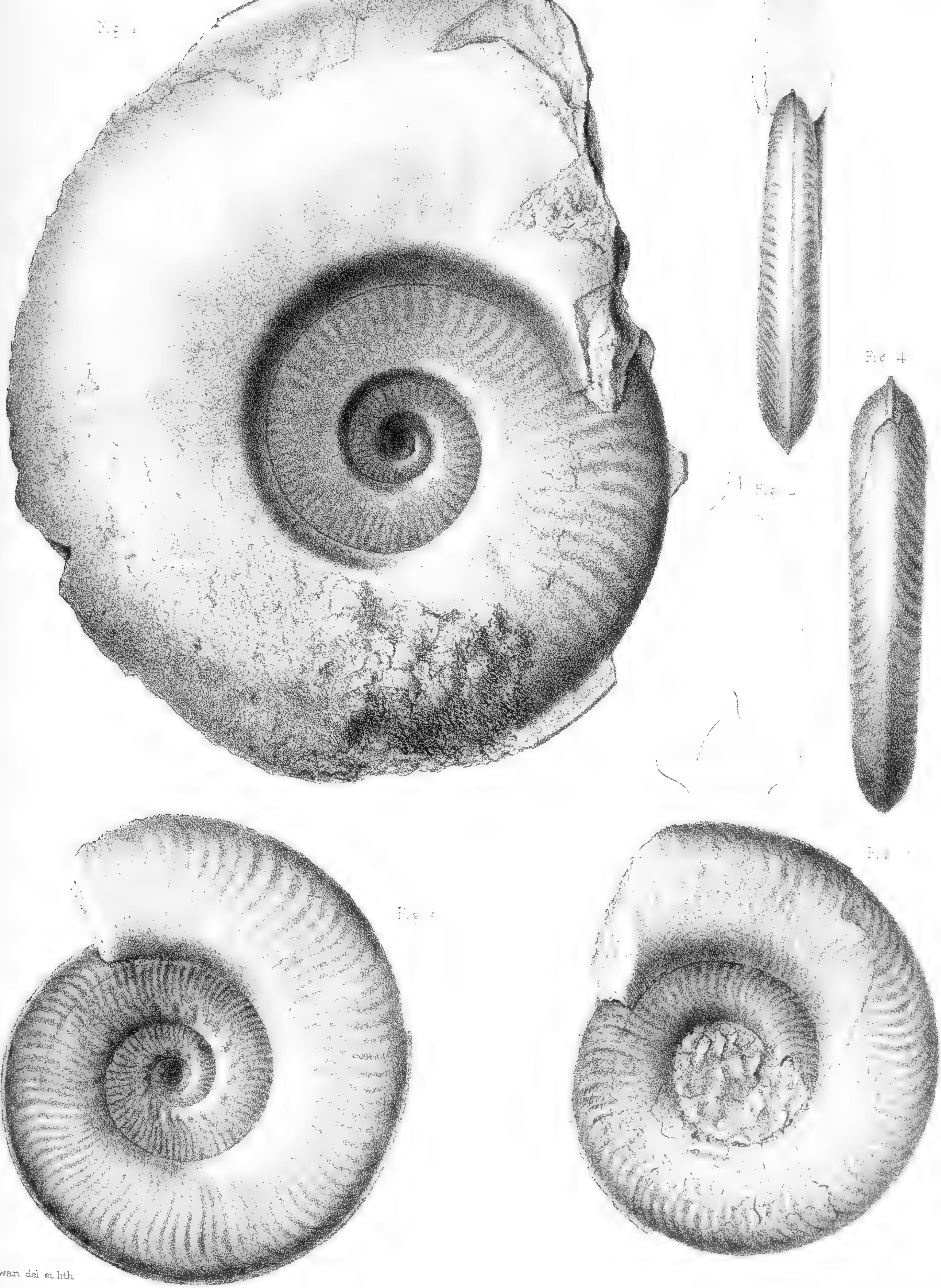


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PLATE XXVIII.

Variabilis-subzone.

Figs. 1—3.—HAUGIA JUGOSA (*Sowerby*).

Fig. 1.—Side view of the smooth inner whorls, obtained by breaking up a large specimen. Natural size. My Collection. (Page 149.)

Fig. 2.—Front view of the same specimen, showing uncarinate ventral area.

Fig. 3.—Suture-line of the same specimen slightly enlarged.

Jurense-zone (Striatulum-beds).

Figs. 4—13.—GRAMMOCERAS TOARCENSE (*d'Orbigny*).

Fig. 4.—Side view of a very coarsely-ribbed adult form with the mouth-border preserved. The test is absent from the specimen except on the ventral portion of the mouth. Coaley Wood Gloucestershire. My Collection. (Page 169.)

Fig. 5.—View of the same specimen from the top to show the ventral lappet of the mouth and also the width and squareness of the ventral area.

Fig. 6.—The simple suture-line of the same specimen.

Fig. 7.—Side view of an immature specimen, showing a smooth inner part of whorl. The specimen is without test. North Nibley, Gloucestershire. My Collection.

Fig. 8.—Front view of the same specimen to show the flatness on each side of the carina, the only indication which the species possesses of the ancestral sulcate ventral area.

Fig. 9.—The front view of a smaller specimen, showing similar characters. Coaley Wood, Gloucestershire. My Collection.

Fig. 10.—Side view of the same specimen. The test is partly preserved. These two figures are to compare with figs. 18, 19.

Fig. 11.—Side view of the smooth inner whorls broken out of a larger specimen. Magnified.

Fig. 12.—Front view of the same with uncarinate ventral area. The line at the side shows the size of the original specimen.

Fig. 13.—Simple suture-line of the same. These figures (11—13) illustrate what Hyatt calls the Goniatite stage.

Figs. 14, 15.—GRAMMOCERAS TOARCENSE-STRIATULUM, *S. Buckman.*

Fig. 14.—Side view of a form possessing the coarse ribs of *Gramm. toarcense* but with a more sharpened carina. Little Sodbury, Gloucestershire. My Collection. (Page 171.)

Fig. 15.—Section of the whorl in outline.

Figs. 16—21.—GRAMMOCERAS STRIATULUM (*Sowerby*).

Fig. 16.—Side view of a specimen with small ribs, which reach, though faintly, to the inner edge in places. Stinchcombe Hill. My Collection. (Page 173.)

Fig. 17.—Section of the whorl in outline. The suture-line of this specimen is depicted in Plate A, fig. 43.

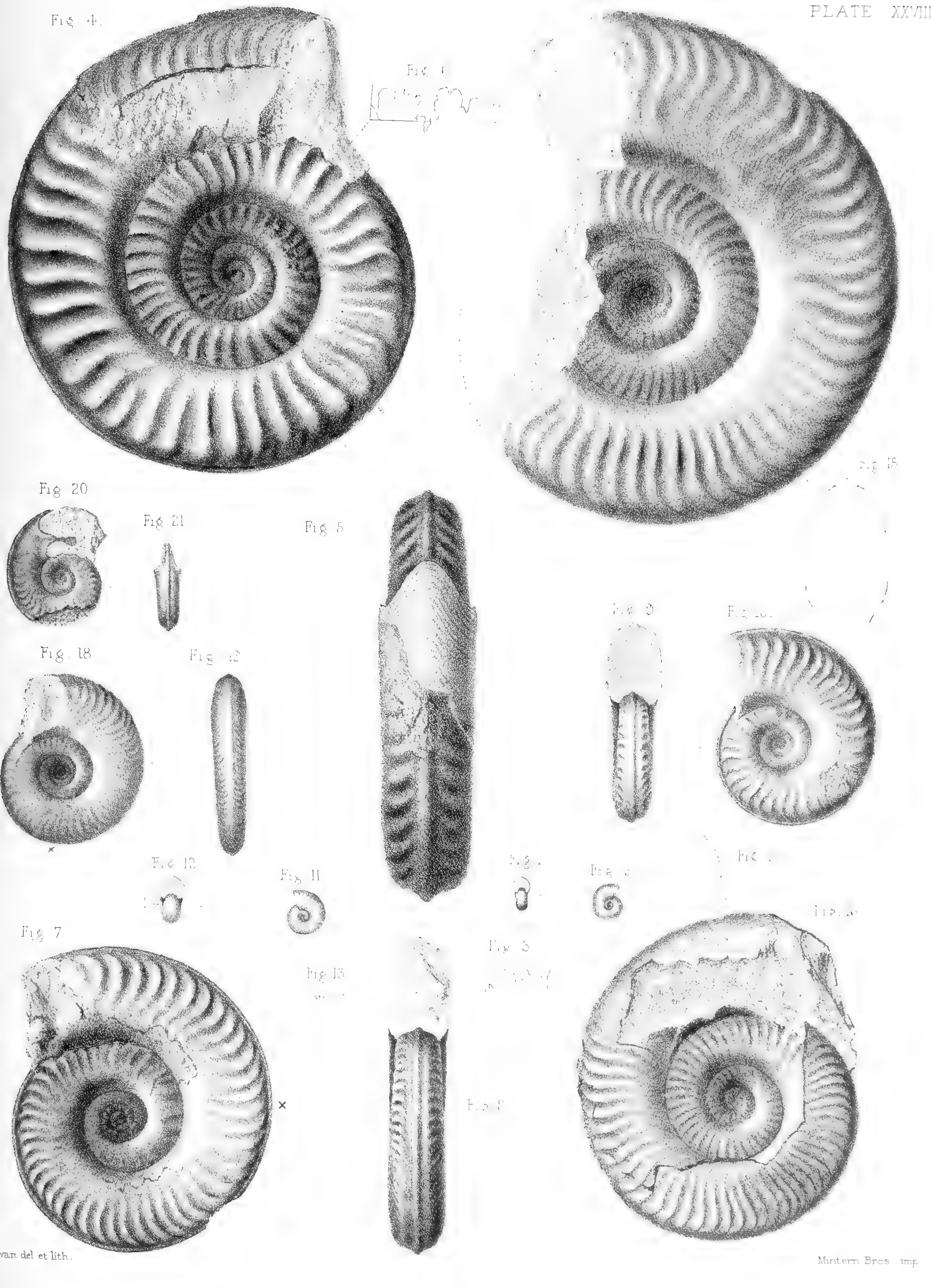
Fig. 18.—Side view of a smaller specimen without test, showing inconspicuous ribs. Stinchcombe. My Collection.

Fig. 19.—Back view of the same specimen.

Fig. 20.—Side view of a young specimen, showing the mouth-border. The lateral auricle is probably not quite complete along its upper edge. The last suture is opposite the line joining the two specimens. From a Sandstone nodule at the very top of the Cotteswold Sands. Buckholt Wood. My Collection.

Fig. 21.—View from above to show the ventral process of the mouth.

PLATE XXVIII



A Gawan del et lith.

Mintern Bros imp.

PLATE XXIX.

Jurense-zone (Dispansum-beds).

Figs. 1—10.—Grammoceras doerntense (*Denckmann*).

Fig. 1.—Side view of a characteristic specimen, showing the irregular ribbing. The test is only partly preserved. Coaley Wood. My Collection. (Page 182.)

Fig. 2.—Front view of the same specimen.

Fig. 3.—Suture-line of the same specimen.

Fig. 4.—Side view of a smaller specimen, showing ribs rather strongly bent on the lateral area. Most of the test is nicely preserved. Coaley Wood. My Collection.

Fig. 5.—Front view of the same specimen.

Fig. 6.—Side view of a smaller specimen. From marly limestone below the Yeovil Sands, South Petherton, Somerset. My Collection.

Fig. 7.—Back view of the same specimen.

Fig. 8.—Side view of a fine specimen, a variety representing a more advanced stage of the development of this species wherein the irregular ribs have disappeared, and the other ribs have become finer generally, and on the body-chamber are merely striæ; the ventral area is also more acute, and the carina not so distinct. This specimen has its test almost complete, and shows a portion of the lateral part of the mouth. For a smaller specimen of this form see Plate XXXIII, figs. 11, 12. Coaley Wood. My Collection.

Fig. 9.—Front view of the same specimen.

Fig. 10.—Back view of the same specimen, showing the manner in which the radii cross the ventral area and carina, indicating the shape of the ventral appendage of the mouth.

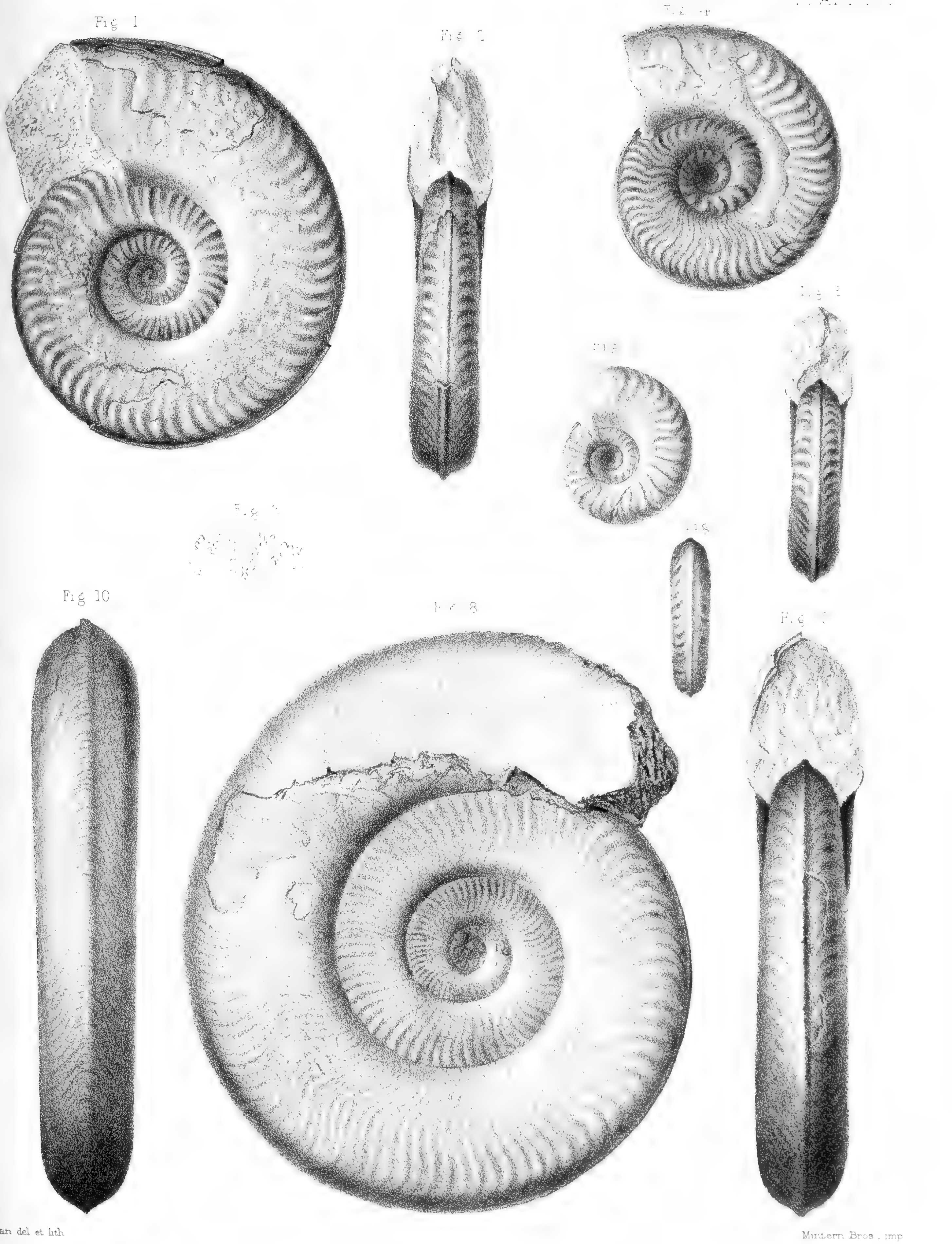


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PLATE XXX.

Opalinum-zone (Moorei-beds).

Figs. 1, 2.—Grammoceras fluitans (*Dumortier*).

Fig. 1.—Side view of a specimen with well-preserved test, showing irregular ribs, sometimes closely approximate or sometimes united at the inner margin. Frocester Hill (Coaley Peak). My Collection. (Page 190.)

Fig. 2.—Front view of the same specimen showing the squareness of the aperture.

Figs. 3—7.—Grammoceras mactra (*Dumortier*).

Fig. 3.—Side view of a specimen with well-preserved test, showing the ribs strongly projected on the ventral area (var. γ). The coarse ribs of the inner whorls have not been clearly depicted, while the irregular ribs are too prominent. Buckholt Wood. My Collection. (Page 176.)

Fig. 4.—Front view of the same specimen.

Fig. 5.—Side view of a variety in which the distant ribs last until a later period of life (var. δ). The ribs on the top of the whorl are not projected enough towards the front. Frocester Hill (Coaley Peak). My Collection.

Fig. 6.—Front view of the same specimen.

Fig. 7.—Suture-line of the same specimen.

Figs. 8—10.—Grammoceras lotharingicum (*Branco*).

Fig. 8.—Side view of a specimen not preserved as well as could be wished, especially the inner whorls; the test is present. North Nibley, Gloucestershire (Bed 6, Section vii, p. 46). My Collection. (Page 199.)

Fig. 9.—Front view of the same specimen.

Fig. 10—Side view of a smaller specimen, perhaps a variety of the above form. North Nibley. My Collection.

Figs. 11—14.—Grammoceras subcomptum (*Branco*).

Fig. 11.—Side view of a specimen without test. Haresfield Hill. My Collection.

Fig. 12.—Front view of the same. (Page 198.)

Fig. 13.—Side view of a specimen with the ventral lappet of the mouth. Haresfield Hill. My Collection.

Fig. 14.—Back view of the same specimen to show the ventral lappet.

Figs. 15—17 and 19.—Dumortieria Moorei (*Lycett*).

Fig. 15.—Side view of a specimen to compare with fig. 3. From the Yeovil Sands, Bradford Abbas, Dorset. My Collection.

Fig. 16.—Front view of the same specimen.

Fig. 17.—Suture-line of the same specimen to compare with fig. 7. The smaller inferior lateral lobe and the drooping inner part of the suture-line are the distinctions. (Page 162.)

Fig. 19.—Portion of a specimen to show the mouth-border. Buckholt Wood. My Collection.

Fig. 18.—Dumortieria radiosa (*Seebach*).

Fig. 18.—Side view of a specimen with well-preserved test showing straightness of the ribs on the lateral area, and their little projection ventrally. Frocester Hill (Coaley Peak). My Collection.

PLATE XXX

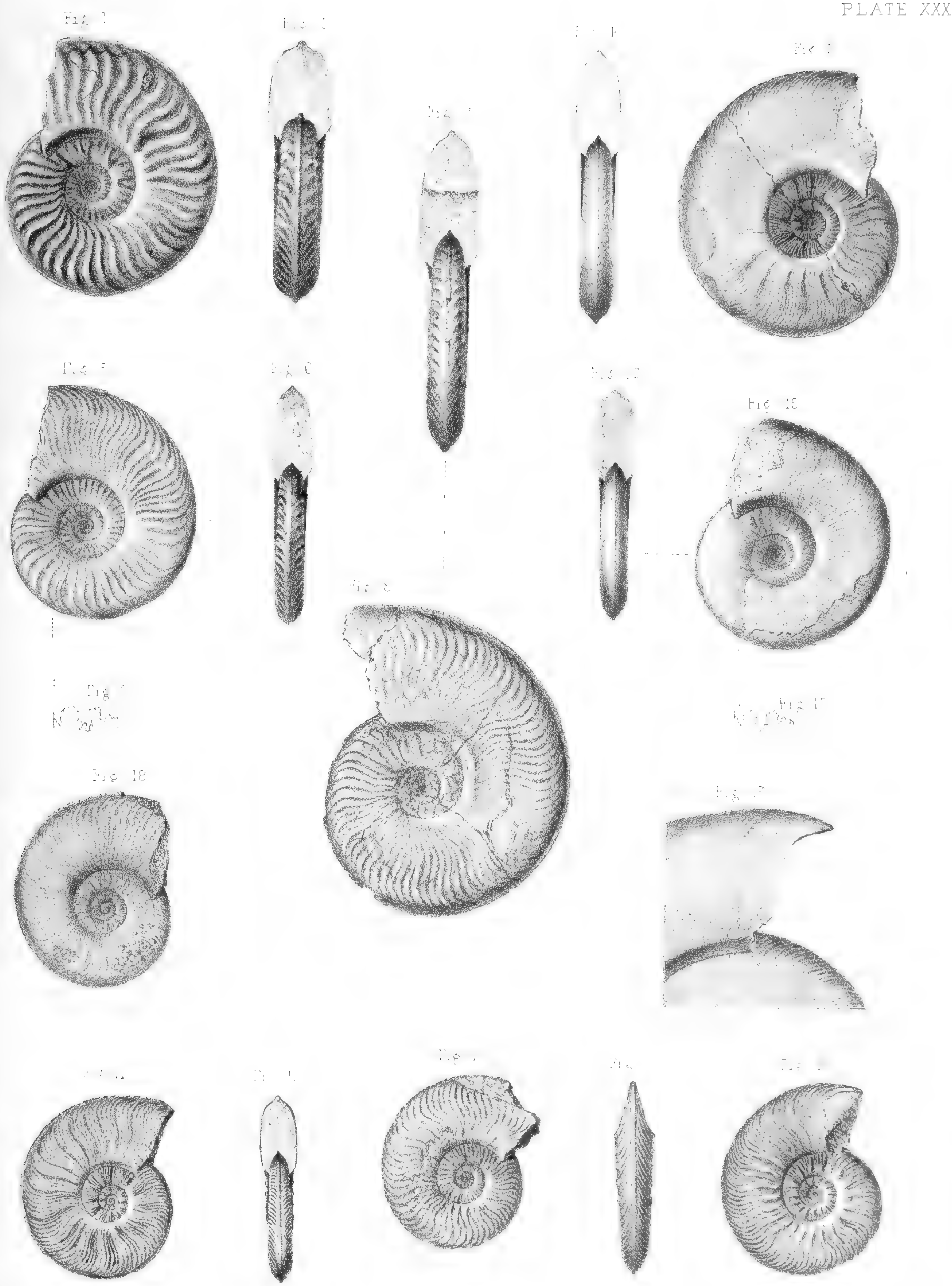

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PLATE XXXI.

Opalinum-zone (Moorei-beds).

Figs. 1—4.—Grammoceras mactra (*Dumortier*).

Fig. 1.—Side view of a fairly typical example (var. α). Frocester Hill (Coaley Peak). My Collection. (Page 176.)

Fig. 2.—Suture-line of the same specimen.

Fig. 3.—Side view of a very well-preserved example (var. β), showing well-pronounced senile characters. Frocester Hill (Coaley Peak). My Collection. (Page 177.)

Fig. 4.—Front view of the same, showing the absence of any distinct carina, the ventral area being only slightly and bluntly angular.

Figs. 5—14.—Grammoceras subserrodens (*Branco*).

Fig. 5.—Side view of a specimen without test. North Nibley. My Collection. (Page 179.)

Fig. 6.—Back view, showing the sharp carina.

Fig. 7.—Side view of an example with part of the inner test preserved. It shows slightly fascicled ribs. North Nibley, Gloucestershire. My Collection.

Fig. 8.—Aperture of the same in outline.

Fig. 9.—Suture-line of the same.

Fig. 10.—Side view of a form with coarser ribs and a rather larger umbilicus. Haresfield Hill. My Collection.

Fig. 11.—Front view of the same specimen.

Fig. 12.—Suture-line of the same specimen.

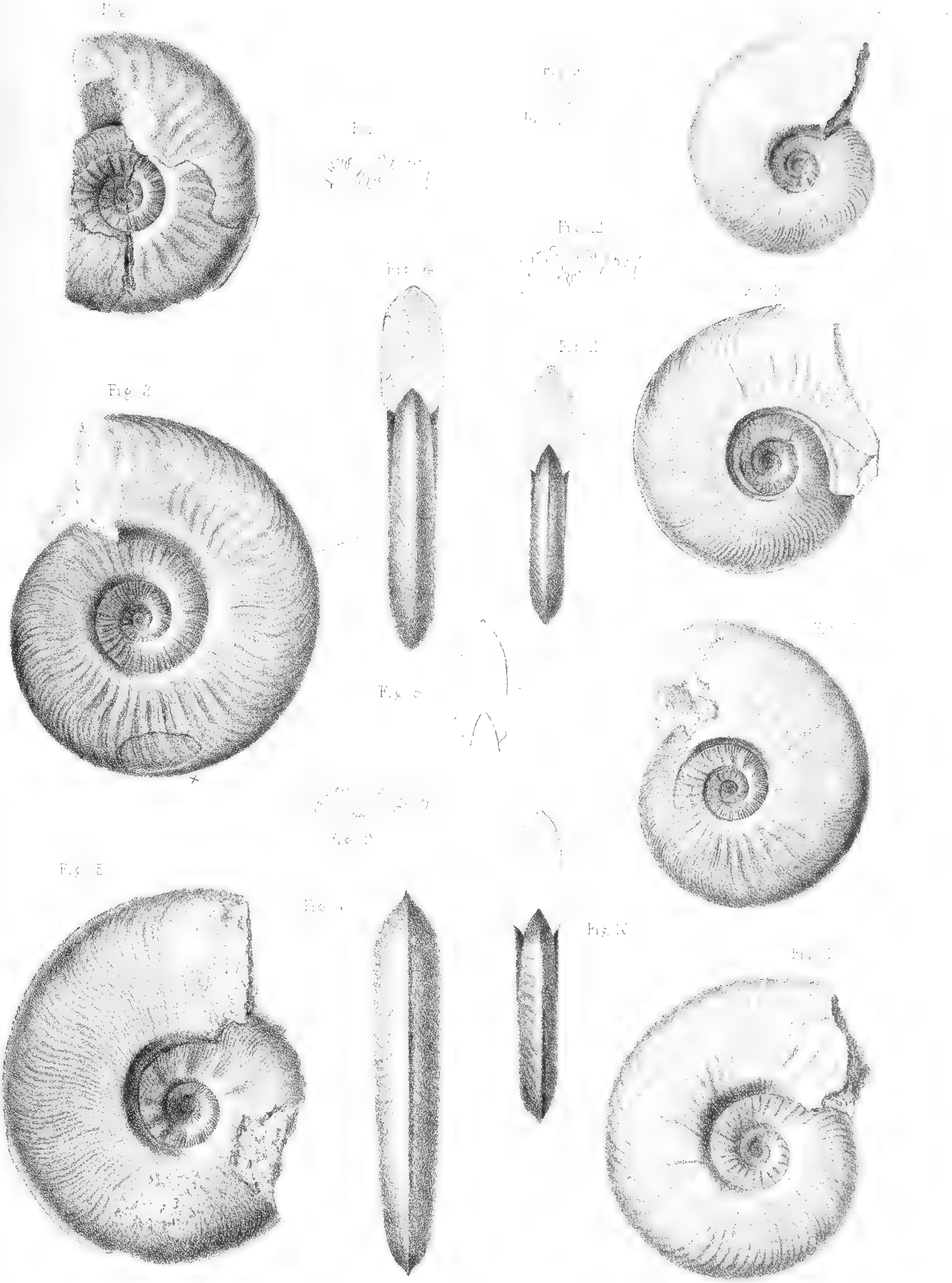
Fig. 13.—Side view of a specimen with small umbilicus and very fine ribs. Haresfield Hill, Gloucestershire. My Collection.

Fig. 14.—Suture-line of the same specimen. These two figs. (13, 14) are given expressly to compare with *Lioceras opalinum*, Plate XIII, fig. 9, and Plate A, fig. 10. See Page 39.

Figs. 15, 16.—Grammoceras aalense (*Zieten*).

Fig. 15.—Side view of a form without test. The faintness of the ribbing is noticeable, and the single ribs in the inner whorls give it an appearance like *Gramm. lotharingicum* (Branco). Haresfield Hill. My Collection. (Page 192.)

Fig. 16.—Front view of the same, showing that the specimen is unequal-sided.



A. Gawan del et lith.

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PLATE XXXII.

Opalinum-zone (Moorei-beds).

Figs. 1—12.—Grammoceras aalense (*Zieten*).

Fig. 1.—Side view of a very fine adult example with its test well preserved and showing the shape of the mouth-border, though the edge is not quite perfect and the ventral process is not complete. Frocester Hill (Coaley Peak). My Collection. (Page 192.)

Fig. 2.—Front view of the same specimen.

Fig. 3.—Side view of a young example, showing the complete mouth-border with its elongated lateral process. Frocester Hill (Coaley Peak). My Collection.

Fig. 4.—Side view of another form with a portion of test preserved. Frocester Hill (Coaley Peak). My Collection.

Fig. 5.—The sharp ventral area of the whorl in outline.

Fig. 6.—The suture-line of the same specimen.

Fig. 7.—Side view of a form showing the early accession of the smooth or senile stage. Test complete. Frocester Hill (Coaley Peak). My Collection.

Fig. 8.—Front view of the same form.

Fig. 9.—Side view of another form with single ribs in the inner whorls, causing it to appear like *Gramm. lotharingicum.* From towards the upper part of the Yeovil Sands at Burton-Bradstock Cliff. Collection of Mr. W. H. Hudleston, F.R.S.

Fig. 10.—The aperture in outline.

Figs. 11, 12.—Grammoceras sp.

Fig. 11.—Side view of a variety with single and equal ribs apparently much like the figure given by Vacek of *Harpoceras fluitans* ("Oolithe Cap San Vigilio," 'Abh. k.-k. geol. Reichsanstalt,' Bd. xii, No. 3, Plate IX, fig. 6). The test and the centre are wanting. Haresfield Hill. My Collection. (Page 191.)

Fig. 12.—Front view of the same specimen.

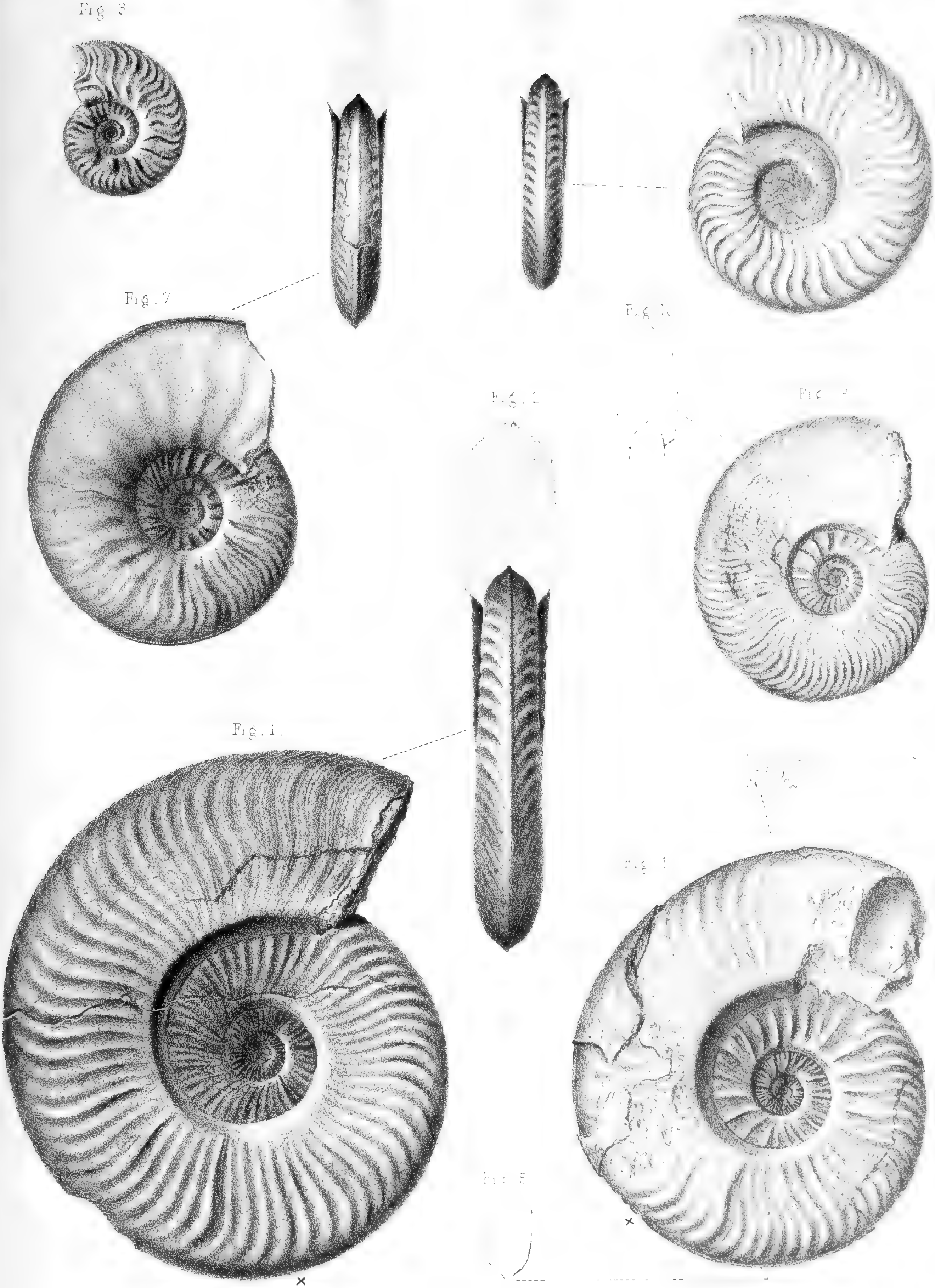

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PLATE XXXIII.

Opalinum-zone (Moorei-beds).

Figs. 1, 2.—GRAMMOCERAS DISTANS, *S. Buckman.*

Fig. 1.—Side view of a specimen without test. Haresfield Hill. My Collection. (Page 196.)

Fig. 2.—Front view of the same.

Figs. 3, 4.—GRAMMOCERAS COSTULATUM (*Zieten*).

Fig. 3.—Side view of an example with test partly preserved. Frocester Hill (Coaley Peak). My Collection. (Page 197.)

Fig. 4.—Front view of the same shell.

Figs. 5—10.—GRAMMOCERAS LEURUM, *S. Buckman.*

Fig. 5.—Side view. Only the inner layer of test is preserved. Coaley Peak. My Collection. (Page 195.)

Fig. 6.—Front view.

Fig. 7.—Suture-line taken from the same specimen.

Fig. 8.—Side view of a more adult, and not quite so smooth an example. Coaley Wood. My Collection.

Fig. 9.—Front view of the same specimen.

Fig. 10.—Suture-line of the same.

Jurense-zone (Dispansum-beds).

Figs. 11, 12.—GRAMMOCERAS DOERNTENSE (*Denckmann*), variety.

Fig. 11.—Side view of a very nicely preserved variety. Coaley Wood. My Collection. (Page 182.)

Fig. 12.—Front view of the same showing the small carina.

Murchisonæ-zone.

Figs. 13—16.—GRAMMOCERAS NANNODES, *S. Buckman.*

Fig. 13.—Side view showing the trenchant hollow carina. Stoford, Somerset. My Collection. (Page 213.)

Fig. 14.—Front view of the same.

Fig. 15.—Side view of another example. From the "Paving-bed," Bradford Abbas, Dorset. Collected by my father.

Fig. 16.—Back view of the same specimen.

Jurense-zone (Dispansum-beds).

Figs. 17, 18.—GRAMMOCERAS FALLACIOSUM (*Bayle*).

Fig. 17.—Side view of a half-grown example. Coaley Wood. My Collection. (Page 204.)

Fig. 18.—Front view of the same specimen showing the ventral area with the hollow carina present—and absent. The aperture has not been drawn quite long enough ; and therefore it appears too oval, and not sufficiently compressed.

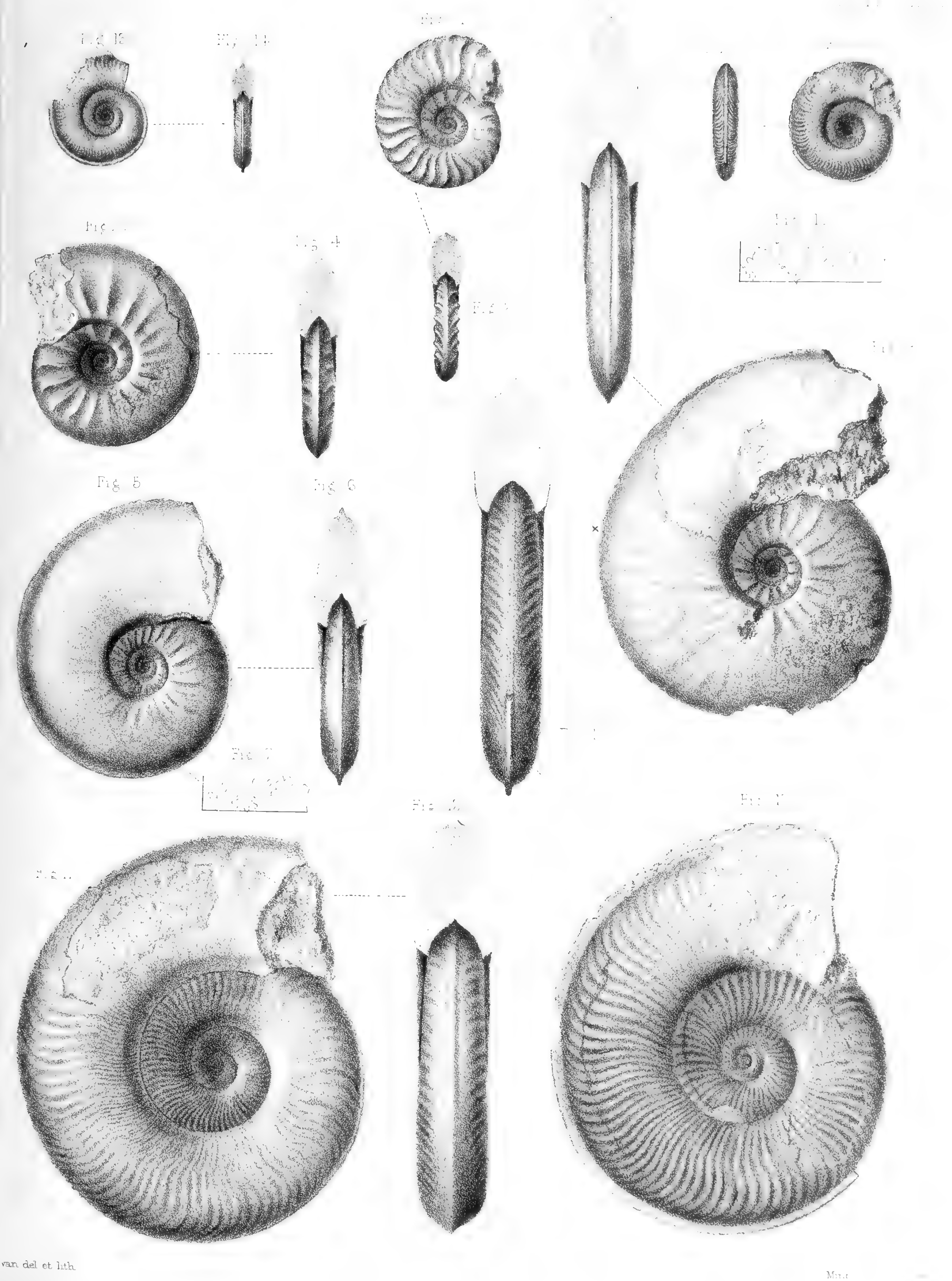

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PLATE XXXIV.

Jurense-zone (Dispansum-beds).

Figs. 1, 2.—Grammoceras Sæmanni (*Dumortier*), var. β.

Fig. 1.—Side view of a specimen with greater part of test preserved, but without the hollow carina. Cam Down. My Collection. (Page 203.)

Fig. 2.—Back view of the same specimen showing a slight "false" carina on the core, the hollow carina having become detached.

Figs. 3—5.—Grammoceras fallaciosum, *var.* Bingmanni (*Denckmann*).

Fig. 3.—Side view of a specimen without test on the outer whorl, showing unequal, sometimes very broad, ribs. Coaley Wood. My Collection. (Page 204.)

Fig. 4.—Aperture (in outline) of the same specimen.

Fig. 5.—Sutures of the same.

Figs. 6, 7.—Grammoceras quadratum (*Haug*).

Fig. 6.—Side view of a young example. Coaley Wood. My Collection.

Fig. 7.—Front view of the same. (Page 201.)

Figs. 8, 9.—Grammoceras Muelleri (*Denckmann*).

Fig. 8.—Side view of a young example without test. Collected by Mr. E. Wilson, F.G.S. Stinchcombe. My Collection. (Page 209.)

Fig. 9.—Front view of the same. Only a portion of the hollow carina remains.

Figs. 10, 11.—Grammoceras fallaciosum, *var.* Cotteswoldiæ, *S. Buckman.*

Fig. 10.—Side view of a young specimen with very fine ribs. Coaley Wood. My Collection. (Page 204.)

Fig. 11.—Front view of the same.

Jurense-zone (Striatulum-beds).

Fig. 12.—Grammoceras toarcense (*d'Orbigny*), variety.

Fig. 12.—Side view of a specimen with a very wide umbilicus, and showing ribs joined in pairs occasionally. Buckholt Wood. My Collection. (Page 172.)

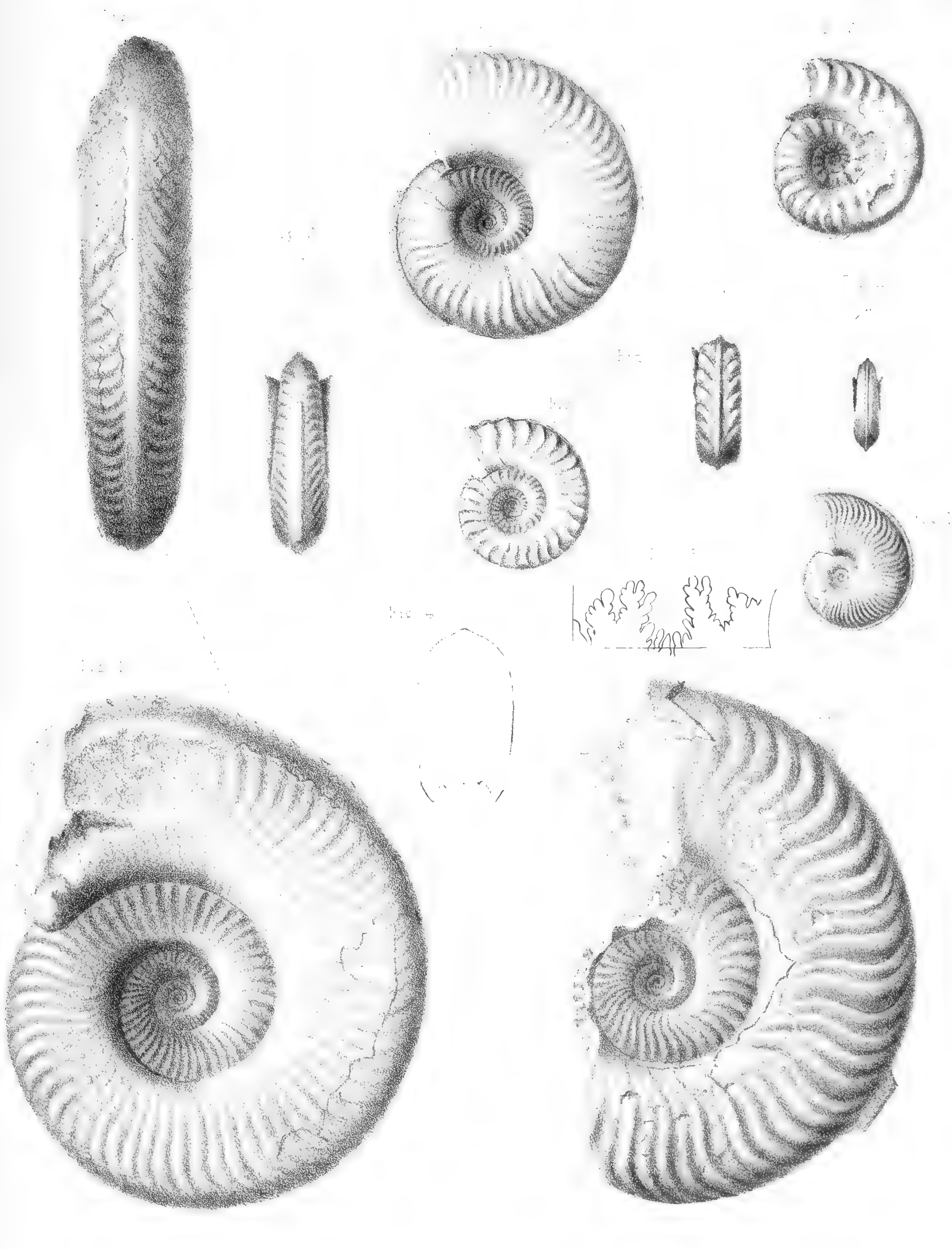

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PLATE XXXV.

Jurense-zone (Dispansum-beds).

Figs. 1—3.—Grammoceras Muelleri (*Denckmann*).

Fig. 1.—Side view of an adult specimen without test. Stinchcombe. My Collection. (Page 209.)

Fig. 2.—Front view of the same showing the partition band and part of the infilling of the hollow carina remaining attached to the ventral area.

Fig. 3.—Suture-line of the same specimen.

Jurense-zone (Striatulum-beds).

Figs. 4—7.—Grammoceras fallaciosum, *var.* Cotteswoldiæ, *S. Buckman.*

Fig. 4.—Side view of a specimen with neither test nor hollow carina preserved. Buckholt Wood (Section X, bed 6, p. 164). My Collection. (Page 204.)

Fig. 5.—Front view of the same.

Fig. 6.—Suture-line of the same specimen from both sides of the whorl, showing the siphonal lobe to one side of keel-line, and a general want of symmetry.

Fig. 7.—Portion of another specimen showing the front aspect of lobes and saddles.

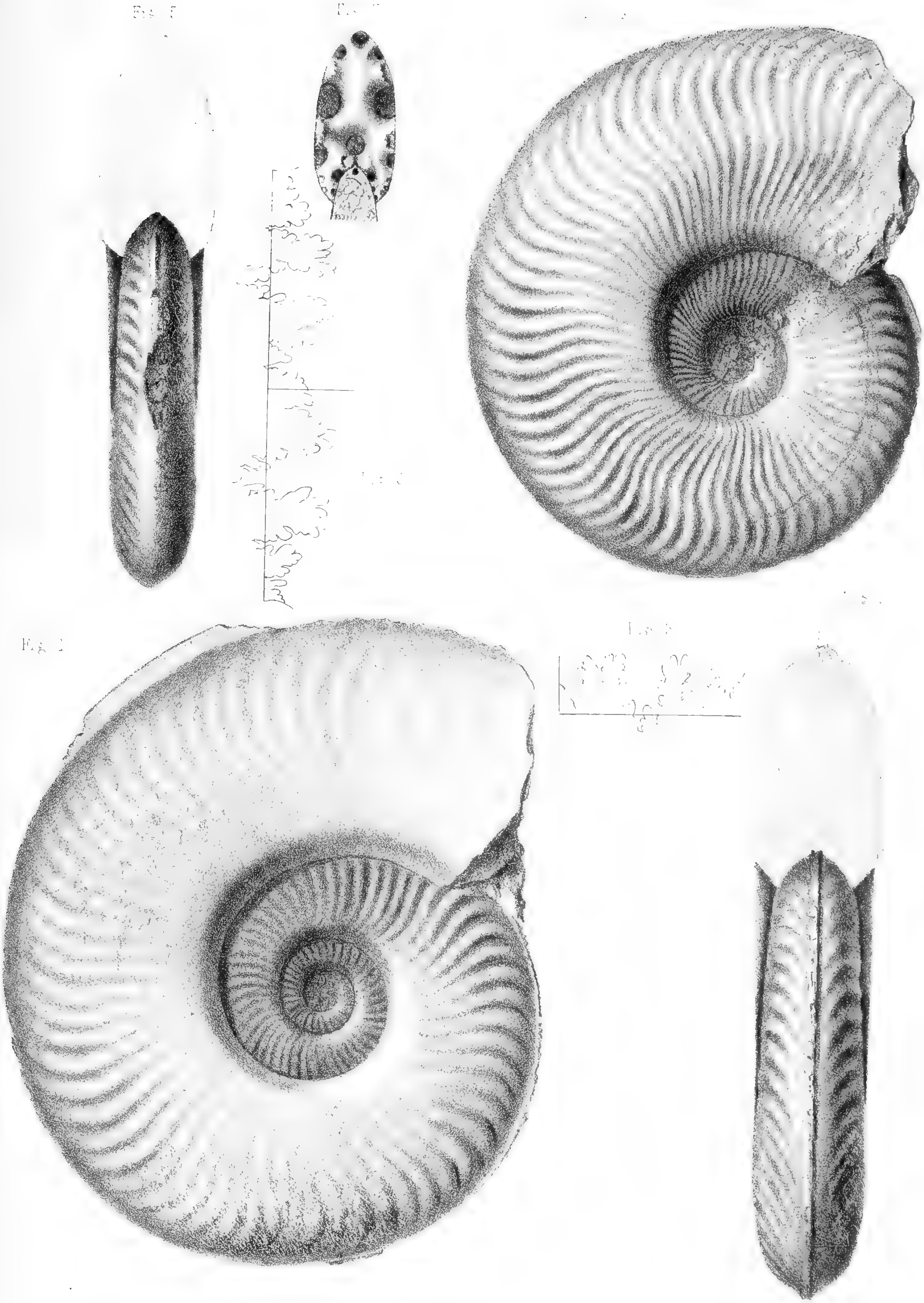

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PLATE XXXVI.

Jurense-zone (Dispansum-beds).

Figs. 1—2.—GRAMMOCERAS METALLARIUM (*Dumortier*).

Fig. 1.—Side view of a specimen with test preserved. Buckholt Wood. My Collection. (Page 210.)

Fig. 2.—Front view of the same.

Figs. 3—5.—GRAMMOCERAS SUBQUADRATUM, *S. Buckman*.

Fig. 3.—Side view of a well-preserved specimen. Cam Down. My Collection. (Page 202.)

Fig. 4.—Back view of the same.

Fig. 5.—Half-section of whorls.

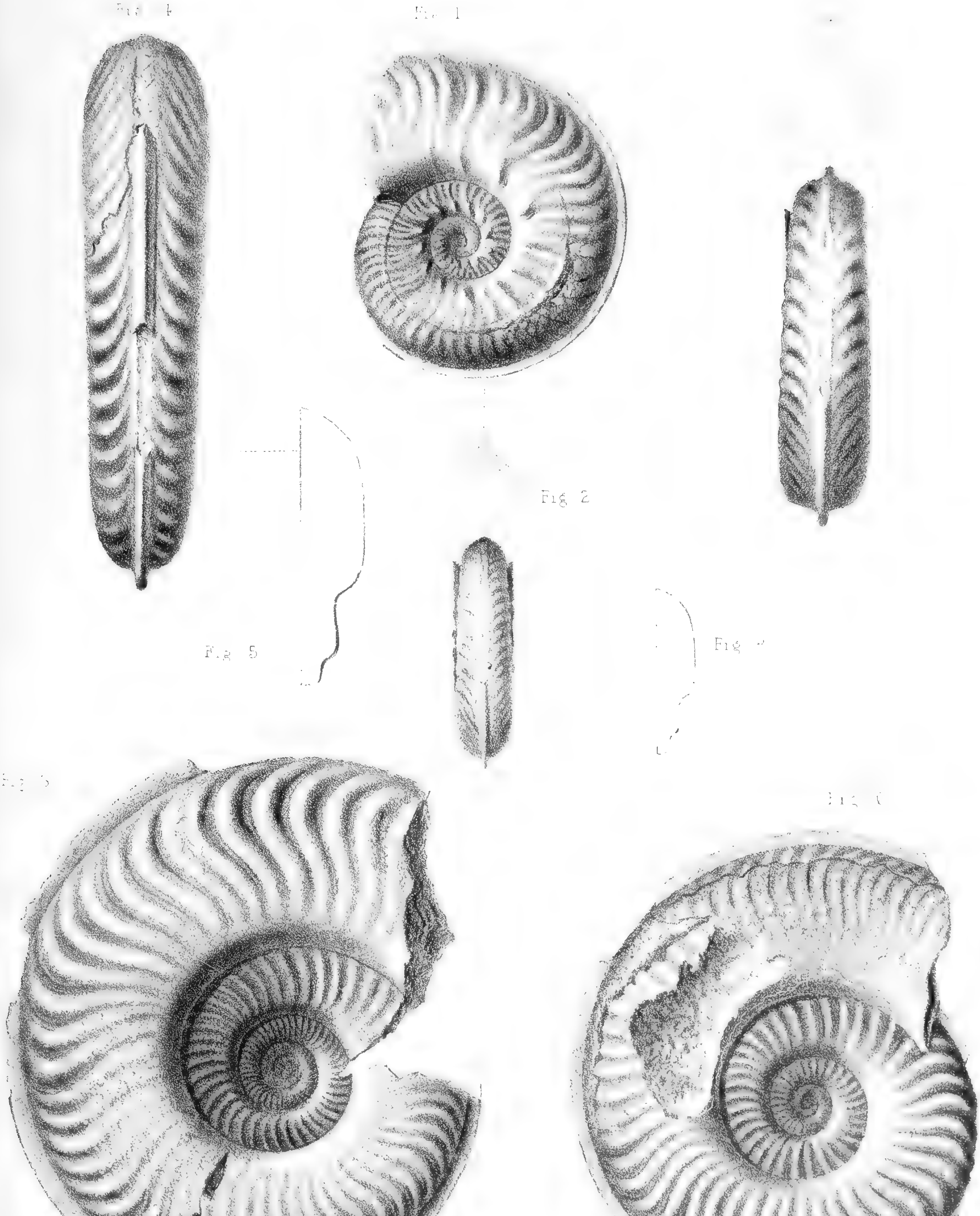
Figs. 6—8.—GRAMMOCERAS SÆMANNI (*Dumortier*), var. *a*.

Fig. 6.—Side view of a specimen with most of its test preserved. The ribs run down the inner margin. Coaley Wood. My Collection. (Page 203.)

Fig. 7.—Front view of the same.

Fig. 8.—Half-section of whorls.

PLATE XXXVI



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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1889.

LONDON:

MDCCCXC.

A MONOGRAPH

OF THE

DEVONIAN FAUNA

OF THE

SOUTH OF ENGLAND.

BY

G. F. WHIDBORNE, M.A., F.G.S.

PART II.

THE FAUNA OF THE LIMESTONES

OF

LUMMATON, WOLBOROUGH, CHIRCOMBE BRIDGE, AND CHUDLEIGH.

Pages 47—154; Plates V—VIII, VIII A, IX—XV.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1890.

PRINTED BY
ADLARD AND SON, BARTHOLOMEW CLOSE.

Size.—3·5 mm. in length. (Magnified 5 diameters in the figures.)

Locality.—Lummaton.

Remarks.—This obscure little fossil may perhaps be referred to as an analogue of *Cypridinella Cummingii*, Jones, Kirkby, and Brady,[1] which has a much deeper notch, but is otherwise not unlike it.

3. *Genus.*—Cypridella, *De Koninck*, 1844.

See Jones and Kirkby, 'Proc. Geol. Assoc.,' vol. ix, p. 499, 1886, for a note upon this genus.

1. Cypridella ? sp. Plate IV, figs. 5 *a*, 5 *b*, 5 *c*.

Description.—This somewhat obscure specimen reminds us of such forms of Cypridinads as have a subacute posterior margin, well-rounded dorsal and ventral edges, and a bluntly projecting anterior end with an indication of a large notch below. This front margin is much obscured in the specimen under notice by adherent matrix, and we cannot, therefore, be certain as to its generic position. In some respects it resembles in outline some *Cyprellæ* and *Cypridellæ*, but the absence of a tubercle and the uncertainty about its front margin leave the matter doubtful. The valve is in outline sub-rhombic and very convex, especially at the posterior third. The upper and lower edges are slightly turned in, as if overlapped by the other valve. The edge-view of the carapace is ovate; the end-view oval. A portion of the valve retains indications of a minute, shallow, irregular punctation.

Locality.—Lummaton.

Size.—7 mm. in length.

II. *Family.*—Polycopidæ, *Sars.*

1. *Genus.*—Polycope, *Sars*, 1865.

The small animals belonging to this genus are found living in the Atlantic Ocean, and fossil in the Carboniferous, Devonian, and Silurian strata. As the general result of the examination of the fossils from the localities under notice tends very considerably to reduce the number of species that can be regarded as common to the two latter systems, it is interesting to find one, if not two, of the three Middle Devonian species of this genus occurring also in the Carboniferous Limestone.

[1] 1874, 'Monogr. Brit. Carb. Entom.,' pt. 1 p. 21, pl. ii, fig. 23.

1. Polycope simplex, *Jones and Kirkby*. Plate IV, figs. 8 *a*, 8 *b*, 8 *c*.

1871. Polycope simplex, *Jones and Kirkby*. Trans. Geol. Soc. Glasgow, vol. iii, Suppl., p. 26; and 1874, Monogr. Brit. Carb. Entom., pt. 1, pl. ii, figs. 1, 10, 12 (not pl. v, fig. 1?).

Description.—A unique specimen from Lummaton very closely approaches the figures given by Messrs. Jones and Kirkby of this Carboniferous species. In these figures the antero-ventral sinus is not so concave as in the little fossil under notice. In its relative convexity it approaches fig. 10 of the Monograph more than the others, and it is rather blunter posteriorly than any of them.

Size.—5 mm.

Locality.—Lummaton.

2. Polycope Devonica, *Jones*. Plate IV, figs. 7 *a*, 7 *b*, 7 *c*, and 9.

?1874. Polycope simplex (pars), *Jones and Kirkby*. Mon. Brit. Carb. Entom., pt. 1, pp. 55, 56, pl. v, figs. 1 *a*—*d* (only).
1881. — Devonica, *Jones*. Geol. Mag., dec. 2, vol. viii, p. 340, pl. ix, figs. 4 *a, b, c*.
1888. — — *Etheridge*. Foss. Brit., vol. i, Pal., pt. 1, p. 430.

Description.—Carapace bivalved, oval, very convex. Margins of the valves rising almost perpendicularly from the edges, and then arching rather suddenly over the centre. Curvature of the anterior and posterior edges much greater than that of the dorsal and ventral edges. Surface minutely and obscurely punctate.

The specimen shown in fig. 7 has a rather more elliptic form than the type specimen, fig. 9, and differs from it slightly in convexity. The mark in its front extremity appears to be only an accidental crack due to pressure. If, however, this mark is not merely a breakage, the nearest published figure would be *Cylindroleberis* (*Asterope*) *teres*,[1] and it would then have to be removed from the genus *Polycope*.

Size.—5 mm.

Locality.—Lummaton.

3. Polycope Devonica, var. major. Plate IV, figs. 13 *a*, 13 *b*, 13 *c*.

Description.—Valve ovately oblong, almost uniformly convex, bending down steeply at the margins, especially in the posterior and the dorsal directions.

[1] 1868, Brady, 'Trans. Linn. Soc.,' vol. xxvi, p. 465, pl. xxxiii, figs. 6—9.

This fine fossil differs from the type in the more elongate and subcuboidal shape of the whole carapace, and from *P. Hughesiæ* in being larger and more symmetrical in outline and in not possessing the well-marked hinge. The marginal edges seem to have a tendency to turn inwards (not seen in the figures), and the surface of the test looks smooth near the edge, but appears to have been obscurely and minutely punctate towards the centre of the valve. The convexity, as seen in the end-view (fig. 13 *c*), is greatest above the median line of the shell, a feature which seems not unusual in this genus (see also figs. 11 *c*, 12 *c*).

Size.—7 mm. in length.

Locality.—Lummaton.

4. Polycope Devonica, var. obliqua. Pl. IV, figs. 12 *a*, 12 *b*, 12 *c*, 12 *d*.

Description.—Valve oval, rather narrow, obliquely rounded at the ends, excepting that the superior part of the anterior extremity is slightly broken. Moderately and evenly convex, marginal parts steep. Muscle-spot, remaining in the figured specimen where the shell is locally broken away, prominent and ovate, and consisting of an irregular double series of low, granulated, radiating ridges.

The breakage at the anterior end is too limited to allow the supposition of any more beak than such a slight process as is seen in *Polycope orbicularis*, Brady,[1] and probably there was none at all.

Size.—5·5 mm. in length.

Locality.—Lummaton.

5. Polycope Devonica, var. concinna. Pl. IV, figs. 17 *a*, 17 *b*, 17 *c*.

Description.—Valve slightly more orbicular and in outline less symmetrical than in *P. Devonica* (type), which has steeper marginal slopes, and is almost oval in outline.

Size.—6 mm. in length.

Locality.—Lummaton.

Remarks.—Since the description of this species was first published by Prof. Rupert Jones (1881), I have found a few more specimens of detached valves, but, as far as my experience goes, the species must be regarded as rare. Although there are few details to describe in it, its peculiar contour renders it sufficiently distinguishable; but on the other hand, as in the case of the Carboniferous members of

[1] Ibid., p. 471, pl. xxxv, fig. 53.

the genus, it seems to be subject to a considerable amount of specific variation, and until further material has been collected it will be impossible to determine the true value of the varieties which are recorded above. One of the specimens described by Jones and Kirkby under the head of *Polycope simplex* is now regarded by Prof. Rupert Jones and myself as very possibly belonging to the present species.[1]

6. Polycope Hughesiæ, n. sp. Pl. IV, figs. 11 *a*, 11 *b*, 11 *c*.

Description.—Carapace small, spheroidal, slightly inequivalve. Dorsal margin bearing a slight prominence at its anterior third, marking the position of a definite hinge, behind which the dorsal line is for a short distance straight, before it curves round posteriorly, and in front of which the antero-dorsal margin slopes with a delicate curve towards the front. Ventral margin gently curved. Right valve thickened and apparently overlapping along the antero-dorsal region. Carapace broadly ovate, with valves imperceptibly compressed along the sides. Edge view sub-oval; end view short, obovate, the greatest thickness being above the median line of the valves. Test thin and sub-punctate.

Size.—4 mm. in length. This has been magnified in the figures at a larger scale than the other *Polycopes.*

Locality.—Lummaton. A single specimen in my collection.

Remarks.—The beautiful little specimen here described was found, and given to me on the spot, by Mrs. Hughes, the wife of Professor T. McKenny Hughes, and herself a keen geologist. I have the honour of naming after her the species which she thus discovered. Although capitally preserved, free from matrix, and with both valves in contact, the details of this charming little fossil are at first sight difficult to decipher. Its valves are perhaps a little squeezed, and the sub-crystalline limestone of which it is composed has a tendency both to mask and to mimic structure. I should not have ventured to separate it from *P. Devonica* had not Prof. Rupert Jones, who has repeatedly examined it, informed me that he feels assured of its being distinct in its features. It seems to be more angulated, less uniform, and to have less steep sides than that species. It is of a less circular form than *P. Burrovii*, J., K., & B.,[2] more convex than *P. simplex*, Jones and Kirkby, and more convex than and differently ornamented from *P. Youngiana*, Jones and Kirkby.[3]

[1] It may be of interest to remark that M. Barrande's *Primitia socialis* ('Syst. Sil. Bohèm.,' vol. i, Suppl., p. 551, pl. xxvi, fig. 11, Ét. F) has very much the aspect of a suborbicular *Polycope.*

[2] 1874, Monogr. Brit. Carb. Entom.,' pt. 1, p. 54, pl. ii, fig. 2.

[3] Ibid., p. 56, pl. v, figs. 2 *a*—*f*.

III. *Family.*—ENTOMIDIDÆ, *Jones.*

1. *Genus.*—Entomis, *Jones*, 1873.

Defined chiefly by its striking dorsal furrow, this genus appears to extend from the Cambrian to the Coal-measures. It is well represented in the German Devonians by *Entomis serrato-striata* (Sandb.),[1] which, with other similar forms, gave its name to the *Cypridinen-Schiefer.* The same species is stated to have been found by Fr. Adolph Römer in Devonshire, in a series of red schists and limestones near Bickerton, at the south-eastern foot of Ramshorn Down (' Neues Jahrb. f. Min.,' &c., 1853, p. 812.) More recently, in 1888, it was rediscovered in red shale near Ugbrooke Park by my friend, Herr Tschernyschew, when on a visit to Devonshire at the time of the International Congress.[2]

1. Entomis peregrina, *Whidborne.* Plate IV, figs. 14 *a, b, c, d* (right valve); 15 *a, b, c* (left valve).

1889. Entomis peregrina, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Valves oval, convex, divided into two unequal portions by a deep furrow rising from the narrow, flattened, median portion of the dorsal margin, and running obliquely forwards, with a backward curve. Contour, before this sulcus, evenly convex ; and behind it the convexity merging into the narrow, flattened, dorsal area, and extending to, and losing itself at, the posterior end, while rising centrally to an elevated, rounded knob, having its apex near the middle of the furrow ; this posterior portion being thus much more elevated than the anterior part. Edges of valve nearly straight dorsally, boldly arched ventrally, and unequally rounded at the ends.

Size.—One of the valves measures 5·5 mm. in length, the other 4·5 mm. in length. Inadvertently the latter has been figured on a somewhat smaller scale than the other.

Locality.—Lummaton. I only know of two specimens. An example of the left valve (fig. 15) was found by Mr. T. Roberts, F.G.S., last spring, and is now in the Woodwardian Museum, and a slightly larger example of the right valve (fig. 14) was found shortly afterwards by myself.

Remarks.—This little *Entomis* seems to be very distinct. It differs in several particulars from *E. tuberosa*, Jones, of which *E. pelagica*, Barr., is in all probability only a synonym, as was intimated by Prof. Rupert Jones in the ' Annals Mag. Nat. Hist.,' December, 1884, p. 391. That species is more elongate, its knob or nodule is smaller and more defined, its groove larger and more vertical,

[1] 1857, ' Quart. Journ. Geol. Soc.,' vol. xiii, p. 89.

[2] 1889, Kayser, ' Neues Jahrbuch f. Min.,' Band i, part 2, p. 189.

its posterior moiety more elevated, compared with the anterior, and its posterior end wider and more rounded. It was first described by Prof. Rupert Jones in 1861, in the 'Memoirs of the Geol. Survey of Scotland,' and in 1876 similar specimens from Australia were referred by Prof. de Koninck to *E. pelagica*, Barr., which had been described from Bohemia in 1872. In his paper in the 'Annals and Magazine of Natural History,' above referred to, Prof. Rupert Jones supports this identification, but retains the earlier name, *E. tuberosa*. Having examined the specimens now under description, he agrees with Mr. Roberts and myself in regarding them as distinct from his species,[1] which, though often deformed by pressure, is always recognisable.

Among the Entomides described in the last-mentioned paper, two other species may be compared with the specimens from Lummaton. (1) *E. reniformis* (Kolmodin) is nearly semicircular, and its evenly convex valves are only half divided by the furrow, at the umbilical end of which is an obscure tubercle. (2) *E. Angelini*, Jones, is much larger, and is much less convex on one side of the furrow than on the other, although it shows no tubercle. *E. Lindstrœmi*, Jones,[2] agrees with the form under notice in its narrow, flattened, mid-dorsal area, whence the furrow arises; but it differs as to shape and convexity and in other particulars. *E. amygdaloides*, Tschernyschew,[3] is much more elongate, is flatter, and has a more oblique furrow. None of the Entomides described by Jones and Kirkby in the 'Monograph on British Carboniferous Entomostraca' (Palæont. Soc.), Part I, at all resemble the present species.

IV. *Family*—CYPROSINIDÆ, Fam. nov.

The easily distinguished genus *Cyprosina* requires, in the opinion of Prof. Rupert Jones, to be placed in a distinct family, the characters of which are in general the same as of the genus founded by him in the 'Geol. Mag.' of August, 1881. Especial importance is to be attached to the ventral furrow as a distinctive

[1] The following synonymy of *E. tuberosa* has been furnished me by Prof. Rupert Jones:

1861.	ENTOMIS	TUBEROSA,	*Jones.*	Mem. Geol. Surv. Scotland, Explan. Map 32, p. 137, pl. ii, fig. 5.
1873.	—	—	—	Ann. Mag. Nat. Hist., ser. 4, vol. xi, p. 415.
1884.	—	—	—	Ibid., ser. 5, vol. xiv, p. 391, pl. xv, fig. 1.
1872.	—	PELAGICA,	*Barr.*	Syst. Sil. Bohêm., vol. i, Suppl., p. 515, pl. xxiv, figs. 1—6.
1876.	—	—	*De Kon.*	Foss. Pal. Nov. Galles du Sud., p. 49.

[2] 1888, Jones, 'Ann. Mag. Nat. Hist.,' ser. 6, vol. i, p. 407, pl. xxii, fig. 16.

[3] 1885, Tschernyschew, 'Mém. Com. Géol. Russ.,' vol. iii, pt. 1, p. 84, pl. l, fig. 1.

mark. The somewhat similar furrow in the *Entomididæ* is dorsal. The form described below is, I believe, the only species of this group which is at present known.

1. *Genus*—Cyprosina, *Jones*, 1881.

1. Cyprosina Whidbornei, *Jones*. Pl. IV, figs. 1 *a—c*, 2 *a—c*, 3, 4.

1881. Cyprosina Whidbornei, *Jones*. Geol. Mag., dec. ii, vol. viii, p. 338, pl. ix, figs. 1—3, 5.
1888. — — *Etheridge*. Foss. Brit., vol. i, Pal., pt. 1, p. 430.

Description.[1]—Carapace bivalved, large, ovoid, slightly narrower at the anterior end. Test thick. Surface smooth, furrowed by a short transverse sulcus slightly behind the centre of each valve, indenting the ventral margin, and extending half way upwards across the long diameter. Margin of valve steep, incurved. Dorsal edge evenly convex; posterior edge slightly tapering; ventral edge nearly straight; anterior margin bearing a beak which is rounded above and indented below, distinct though not large, varying in its prominence according to the contour of the front margin (figs. 1 *a* and 2 *a*), and formed, as it were, by a slight but definite lateral pinching in of the middle of the front extremity of the two valves, rather than by a notch cut out of their curved and projecting end. Dorsal edge of the left valve overlapping that of the right, with a small groove and very fine hem at the posterior edge; dorsal margin of the right valve having a linear groove along its whole length, where the overlapping valve meets it. The antero-ventral margin of each valve turning sharply inwards and upwards to a slight extent, and having a feeble marginal hem, an antero-ventral longitudinal furrow being thus caused in the closed carapace continuous with the antennal notch. Ventral margins meeting apparently without overlap.

Muscle-spot irregularly circular, consisting of a more or less distinctly reticulated centre with numerous (more than twenty) alternately opaque and sub-translucent radiating plumose lines (the former having sometimes the appearance of low ridges), longer on the upper side, shorter below, obsolete posteriorly, and passing into a local reticulation in front (figs. 3 and 4).

Size.—The larger figured specimen (fig. 2) measures 19 mm. long. Another specimen (fig. 1) measures 17·5 mm. long.

Localities.—Lummaton, where it is common. A single specimen from Wolborough is in Mr. Vicary's Collection.

[1] This description is partly taken from the notes published by Prof. Rupert Jones in the 'Geol. Mag.,' loc. cit.

Remarks.—Although this fine Ostacod occurs not infrequently, it is very difficult to get a specimen showing all the characters of a valve at once, and I have hitherto never obtained the two valves in apposition, although in two or three cases they have been found together. At the same time it is a very well characterised fossil, and easily distinguishable from any of the other organisms of the quarry whence it comes. Since my friend Prof. Rupert Jones founded the species on specimens which I sent him in 1880, I have met with numerous other examples, but none which give much more information about it, and consequently the description here given has been copied to a large extent from his original description.

The muscle-spot approaches one condition of that of Entomoconchus, as figured in the 'Monograph of Carb. Cypridinadæ,' Pal. Soc., 1874, Pl. I, fig. 4, *d*, but in the latter the radiating lines are much more symmetrical, and the middle portion not so reticulate.

The specimens differ considerably in the amount of their convexity and in their size, but otherwise, as far as can be judged, they do not vary much.

To one of the valves of this species in my possession is attached a tiny parasite, not more than 1 mm. in length. In shape it is the half of a prolate spheroid, and is smooth, but beyond this I can discover no characters, even through the microscope. It probably is a larval form.

Sedis incertæ. Pl. IV, figs. 19 *a*, 19 *b*, 19 *c*.

Description.—Univalve, extremely convex. Outline of the open base oval, with a raised margin along part of the edge. Surface apparently smooth, with the exception of two unequal tubercles some distance above the margin on one side. Longitudinal outline of elevation nearly semicircular.

Size.—17 mm. in length.

Locality.—Lummaton.

Remarks.—The specimen here described was at first thought to be a Cyclus, and as such was here figured, but it is now supposed more probably to be the injured remains of some Gasteropod such as Naticella, the hinder and higher tubercle being taken to give the indication of a spire. It is in a most unsatisfactory state of preservation, the surface is defaced, and the nature of the matrix is such as to render it almost impossible to distinguish it from the fossil itself. There are therefore no data for deciding its true position until the discovery of a better specimen.

Mollusca.

The localities with which we are at present dealing are, on the whole, very prolific in the remains of shells, but these remains are often both obscure and fragmentary. No doubt this is due for the most part to the effects of fossilization, and to the intractable nature of the rock, which renders it almost impossible to develop any part of a specimen that is covered with matrix. But it is also due to some extent to the animals having died before the deposition of the shells in their present places. The latter is especially the case in the upper part of the Lummaton Quarry, where multitudes of broken shells are crowded together in a way that shows that it must have been a shell-heap in the Palæozoic Sea.

While most of the Trilobites that we have described came from Lummaton and few from Wolborough, it will be seen that the contrary is the case with the Cephalopods and Gasteropods. The Pelecopoda are about equally divided between the localities; but a reference to Dr. Davidson's Monograph shows that in the Brachiopods Lummaton again takes the decided lead in the number of species. The shells from Chircombe Bridge are very few, but Chudleigh has yielded a fine series of Gasteropods to Mr. Vicary's persevering search, and it is interesting to find that the shells from this locality are in a very much better state of preservation than is usually the case. Mr. Vicary has exemplified this in a striking manner by placing a few specimens of recent shells in his drawers alongside of his fossils, and in one or two instances it is almost impossible at first sight to distinguish them by their general appearance.

Though not surpassing the average of other classes in the number of species, the Brachiopods far exceed them in the number of specimens, almost all the abundant shells belonging to that class.

Class.—CEPHALOPODA.

Phillips described nineteen species of Cephalopoda as occurring at Newton; but, of these, two appear to be repetitions, and another, *Nautilus germanus*, proves to be a Gasteropod. This number is now raised to fifty-five species from the two localities of Wolborough and Lummaton. These are divided between the genera Goniatites (15), Temnocheilus (1), Trochoceras ? (6), Gyroceras (7), Cyrtoceras (6), Phragmoceras? (1), Gomphoceras? (2), Poterioceras (3), Orthoceras (15), and Actinoceras (1). Clymenia is not represented in these beds.

It is often a matter of difficulty to decide the generic as well as the specific positions of these fossils. On account of the peculiar character of the Limestones, the species being generally of large size, perfect specimens are rare; and, as the characters frequently change in different parts of the same shell, as well as alter with the age of the specimen and vary in different examples of a similar age, it becomes sometimes very difficult to allocate the fossils to their proper specific place.

The perplexity becomes in some instances even greater when we try to decide the genus. The oral portion of the shell being unsupported by septal walls is the part most liable to destruction, and the aperture itself is consequently hardly ever preserved. Hence in the case of such genera as Gomphoceras and Poterioceras it is almost impossible to speak with any degree of certainty.

Order.—TETRABRANCHIATA.

Sub-order.—AMMONOIDEA.

I. *Family*.—Goniatitidæ.

1. *Genus*.—Goniatites, *de Haan*, 1825.

This large genus, which appears to be confined to the Devonian, Carboniferous, and Permian Rocks, has been divided by Beyrich, Sandberger, Hyatt, and others into groups, which are founded upon the shape of the suture-lines. Where possible, therefore, the suture-lines have been given in the accompanying plates, but they have proved very difficult to copy accurately for various reasons, and they have been observed in too few of the species to admit of their being grouped under these divisions in the present work. Those that are known, however, seem to belong to one of Beyrich's three divisions, Nautilini, Simplices, and Primordiales.

1. Goniatites obliquus, *Whidborne*. Pl. V, figs. 1—3.

1852. Goniatites planidorsatus, *Geinitz* (not *Münster*). Verst. Grauw. Sachsen, pt. 2, p. 39, pl. xi, figs. 4—6.
1889. — obliquus, *Whidb.* Geol. Mag., dec. iii, p. 29.

Description.—Shell large, discoidal, of four or five whorls. Umbilicus wide, shallow, about one quarter the diameter of the shell, scalariform, showing the convex dorsal portions of the whorls upon its side. Inclusion about half or three-quarters of the whorl. Side of the whorls rising almost perpendicularly from the flat surface of the whorl below, and then, after turning suddenly through an angle of more than 90°, sloping obliquely and almost flatly to the ventral area, and there bounded by a more or less distinct shallow groove, before again turning suddenly to form the keel or back, which is very wide and perfectly flat. Body-whorl apparently smooth. Inner whorls (as seen within the umbilicus) with numerous coarse radiating ribs. Suture-lines sloping obliquely forward in a concave curve across about seven-eighths of the sides, and then reflexed at a sharp angle backwards to the keel, on which they are invisible in the described specimens. Siphuncle small, in the centre of the flat keel.

Size.—A large defective specimen, measures about 100 mm. in height and 45 mm. in depth; a smaller but more perfect one is 37 mm. in height and 11 mm. in depth.

Locality.—Wolborough. There are four specimens in Mr. Vicary's collection, one of which is very large. To this fossil Mr. Salter had attached a label with the words "*Discites* (?) new and very fine species like *D. planotegas*." The other three specimens are fragments of similar large shells. In the Torquay Museum (Battersby coll.) is a smaller specimen showing the position of the siphuncle. There is also a specimen in the British Museum, another in the Bristol Museum, and another small but perfect example in the Museum of Practical Geology.

Remarks.—The present species seems very distinct from any other that occurs in Devonshire. It is well characterised by the broad umbilicus with step-like walls, the obliquely flattened sides, the narrow flat back, which may be almost regarded as a very broad keel, and by the definite ribs seen only on the inner whorls. The grooves running round the sides of the ventral area do not seem a constant character, Mr. Vicary's large specimen having no signs of them; and probably they vanish with age.

Affinities.—The English species which most nearly approaches it is *G. transitorius*, Ph., but this may be at once distinguished by its larger umbilicus and shorter and more convex sides.

Judging from the Vicary and Battersby specimens, it appears to be the same as the *G. planidorsatus*, Münster, as given by Geinitz, and to this species I was at first inclined to refer it; but, after a careful comparison of the English fossils with Münster's original figure[1] by Mr. Roberts and myself, we came to the conclusion that it could not belong to Münster's species, which has a smaller umbilicus and a broader and more sharply angled back, and the whorls of which are completely involute.

Neither does it seem referable to Münster's *G. falcifer*,[2] which approaches it

[1] 1839, Münster, 'Beitr.,' pt. 1, p. 21, pl. iii, fig. 7.

[2] 1840, ibid., pt. 3, p. 106, pl. xvi, fig. 7.

very nearly in many points. In that form the umbilicus seems rather small, the inner whorls are nodulous rather than ribbed, and the septal lines are more sickle-shaped. Münster describes the back as very small and flat, and probably it is much narrower than that of our species. None of the other species described by Münster, Geinitz, or Sandberger at all approach it.

Under *G. evexus*, von Buch, Kayser[1] unites many shells, including *A. Dannenbergi*, Beyr., *G. costulatus*, d'Arch. and de Vern., *G. transitorius*, Phil., and F. A. Römer, *G. expansus*, Vanux., and *G. verna* and *fecundus*, Barrande. It appears to me that our present form is clearly distinguished from von Buch's shell as described by Kayser by the shape of the septa, which are much more oblique and have a sharp angular central saddle before turning to the back, while Phillips's *G. transitorius* is also distinguishable by its more open umbilicus, more oblique septa, and more slowly increasing whorls. I am not of opinion that either of these English forms agree with von Buch's shell, although they evidently belong to the same group of Goniatites.

In *G. Dannenbergi* (Beyr.),[2] the section of the whorls is short and convex, and it is not at all involute. The suture-line, however, is very similar to that of the present species. *G. expansus*, Vanuxem,[3] afterwards described by Hall (who states it to be different from *G. expansus*, von Buch)[4] as *G. Vanuxemi*,[5] differs in having the lateral saddle much deeper, so that the sides of the chambers do not tend at once forwards as they do in *G. obliquus*. Hall gives a figure of a young specimen which almost exactly corresponds with our figured specimens of *G. transitorius*, Phil., and traces the changes of form in the American shell which occur with age. This may show that some at least of the American examples belong to Phillips's shell; but I do not regard it as at all likely that it indicates that the two English forms belong to a single species, for small shells of *G. obliquus* present the same characters as the larger specimens, and moreover appear very distinct from the examples of *G. transitorius* of a similar size. Hall remarks upon the proximity of his species to *G. Bohemicus*, Barr.,[6] and this differs from the present species still more than does the American shell, and indeed comes nearer to *G. fulguralis* than to *G. obliquus*. *G. Nœggerathi*, von Buch,[7] and *G. evexus*, von Buch,[8] appear, as far as can be judged from the evidently inaccurate figures by their original describer, to be

[1] 1878, Kayser, 'Abhand. Geol. Specialk. Preussen,' Band iii, pt. 2, p. 58, pl. viii, figs. 4—7.

[2] 1837, Beyrich, 'Beitr. Rhein. Übergangsg.,' p. 26, pl. i, figs. 5 *a*, *b*.

[3] 1842, Vanuxem, 'Geol. Surv. N. Y. Rept., 3rd Dist.,' p. 146, fig. 1.

[4] 1832, von Buch., 'Über Amm. und Gon.,' p. 31, pl. i, figs. 1, 2.

[5] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 434, pls. lxvi—lxviii; pl. lxix, figs. 3—6; pl. cix, figs. 7, 8.

[6] 1865, Barrande, 'Syst. Sil. Bohème,' vol. ii, p. 29, pl. i, figs. 1—13, and pl. iii, figs. 15, 16, Ét. G.

[7] 1832, von Buch, 'Über Amm. und Gon.,' p. 34, pl. i, figs. 6—8.

[8] Ibid., p. 33, pl. i, figs. 3—5.

kindred species, but their suture-lines are more undulating and much less oblique, and the lobes are rounded instead of sharp. The central lobe in these two species is apparently much narrower. In *G. discoides*, Waldsmidt,[1] the chambers are much less oblique so that the lateral saddle becomes more evenly concave. Its back is also more rounded and the shell flatter. Like the present form it is a large species. It differs from *G. fulguralis* in much the same respects, and, moreover, its umbilicus is smaller than in that species.

Of other less kindred Goniatites, *G. Becheri*, von Buch., as figured by Beyrich[2] is quite separated from ours both by its outward form and its possession of numerous lateral lobes. *G. tenuistriatus*, d'Arch. and de Vern.,[3] is a much flatter shell with its sides more rounded inwards.

G. Wurmii, F. A. Röm.,[4] and *G. intumescens*, Beyr., as given by Römer,[5] though presenting a general likeness, have rounded sides and back, and much hollower lateral saddles. The latter species as given by Tschernyschew[6] has a much smaller umbilicus and more evenly arched suture-lines.

2. Goniatites fulguralis, n. sp. Pl. V, figs. 4, 4 *a*.

Description.—Shell of medium size, discoidal, flattish, of three or four very rapidly increasing whorls, half involute. Umbilicus very wide and shallow, about one-third the diameter of the shell, scalariform, showing the dorsal parts of the inner whorls. Sides of the whorls rising steeply from middle of the whorl within, and before reaching their greatest height bending suddenly over, and tending in a slightly convex and oblique direction to the marginal region, where another sudden elbow is formed, after which they turn again suddenly, and form a low, broad, flat, or slightly concave, keel. Just within this elbow a very slight broad depression running round the sides of the whorls. Aperture slightly expanded (?) round the margins, laterally reflexed, and ventrally elongated.

Surface covered with fine, distant, sharp, elevated threads or striæ, which, starting from the inner elbow, tend at first backward, and then, turning in a sweeping curve forwards, advance obliquely to the outer elbow, where they again bend very suddenly backwards, and are then lost on the sides of the keel, to

[1] 1885, Waldsmidt, 'Über Devon. Schicht. Gegend Wildungen.,' p. 920, pl. xxxix, figs. 3 *a*, *b*.

[2] 1837, Beyrich, 'Beitr. Rhein. Übergangsg.,' p. 31, pl. i, figs. 7, 8.

[3] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, p. 343, pl. xxvi, figs. 7, 7 *a*.

[4] 1843, F. A. Römer, 'Verst. Harz.,' p. 33, pl. ix, fig. 7.

[5] Ibid., p. 33, pl. ix, figs. 8, 9, 15.

[6] 1887, Tschernyschew, 'Mém. Com. Géol. Russ.,' Band iii, pt. 3, p. 168, pl. ii, figs. 3, 5.

which they have now become nearly parallel. Suture-line and siphuncle unknown. Chambers very narrow and concave.

Size.—34 mm. high, 25 mm. wide, 12 mm. deep.

Locality.—A single perfect specimen from Lummaton is in my collection; and the polished section of about a whorl of a rather larger specimen which wants the surface, but shows the shape of the chambers, is in the Torquay Museum.

Remarks.—Though only two specimens of this beautiful fossil are known to me, one is so well preserved that the characters of the species may be considered fairly well known. It forms a link between *G. obliquus* and *G. transitorius*, presenting considerable difference from either form. It is unfortunate, as the suture-lines of both these forms can be traced, that those of the present fossil cannot be seen. It may, however, be distinguished by the highly ornamented character of its surface, in which point it shows some approach to the group of *G. inconstans*, Phillips.[1]

We find the nearest approach to it in some Bohemian forms, especially in *G. bohemicus*, Barrande,[2] which differs in the ornamentation being much finer and less arching, and the keel being broader. *G. tabuloides*, Barr.,[3] and *G. amœnus*, Barr.,[4] present the same differences, and are also much flatter shells. In *G. fecundus*, Barr.,[5] the ribs are coarser, fewer, and less arched, and the back is flattened and not keeled. In *G. Vanuxemi*, Hall,[6] which is closely allied to Barrande's shells, the ornamentation is again finer, and the spire more discoid. In *G. simulator*, Hall,[7] the margins of the chambers are first bent forward and then backward, so that the lobation was probably totally distinct.

In *G.* (*Tornoceras*) *subundulatus*, Frech,[8] the striæ are of quite a different character; the first bend forward is broader, the succeeding concavity is much wider and more shallow, and the advance forward at the ventral elbow is not nearly so great. Moreover, the umbilicus is smaller, the whorls are much wider, the shell is almost involute, and the back is broader, and, as far as the figure goes, shows no sign of a keel. Frech states it to be a very variable shell; but, though one of his described varieties may vary in the direction of the present species, there can be, I think, no doubt that the two forms are perfectly distinct. *G. lamellosus*, Sandb.,[9]

[1] 1841, Phillips, 'Pal. Foss.,' p. 123, pl. li, fig. 238.

[2] 1865, Barrande, 'Syst. Sil. Bohém.,' vol. ii, p. 29, pl. i, figs. 1—13, and pl. iii, figs. 15, 16, Ét. G.

[3] Ibid., p. 41, pl. iv, figs. 1—12, Ét. G.

[4] Ibid., p. 28, pl. iv, figs. 13, 14, Ét. G.

[5] Ibid., p. 32, pl. vii, figs. 10, 11; pl. xi, figs. 1—20, Ét. G.

[6] See under *G. obliquus*, p. 58.

[7] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 463, pl. lxix, figs. 1, 2, and pl. lxxiv, fig. 8.

[8] 1887, Frech, 'Zeitsch. Deutsch. Geol. Gesell.,' p. 465.

[9] 1851, Sandberger, 'Verst. Rhein. Nassau,' p. 85, pl. viii, figs. 1 *a—f*.

has much finer and less oblique striæ, wider sides, a less prominent keel, and an umbilicus with less sloping sides. In *G. Nœggerathi*, von Buch,[1] the median saddles seem much deeper, so that the median lobe is thrown much further back, and the sides of the shell seem shorter and flatter. Lastly, *G. intumescens* (Beyrich)[2] is deeper and more ovoid in section, has a smaller aperture, and is smooth. Sandberger figures[3] several extreme varieties of the latter species, none of which are at all like our Devonshire shell, and which show that the sides of the mouth were differently formed, and that the striæ had a different course.

3. Goniatites transitorius, *Phillips*. Pl. V, figs. 7—10; Pl. VI, figs. 8, 8 *a*.

1841.	Goniatites transitorius, *Phill.*	Pal. Foss., p. 140, pl. lx, fig. 227*.
1851.	— bicanaliculatus, *Sandb.*	Verst. Rhein. Nassau, p. 112, pl. xi, figs. 5, 6.
? 1843.	— æquabilis ? *F. A. Röm.* (non *Beyrich*).	Verst. Harz., p. 34, pl. ix, figs. 13 *a, b*.
1888.	— transitorius, *Etheridge.*	Foss. Brit., vol. i, Pal., p. 168.

Description.—Shell small, flattish, ellipsoidal, consisting of about four whorls. Umbilicus very open and rather shallow, nearly half the diameter of the shell in width. Whorls increasing rapidly, subtriangular in section, being truncated at the back and rounded at the dorsal corners, only slightly inclusive. Sides of the whorls rising at right angles to the whorl within, and immediately curving round the deepest part with an almost circular curvature, and thence becoming slightly convex as they converge towards the back, which is broad, subconvex, laterally angulated, and defined on each side by an indistinct lateral groove. Suture-line, crossing the sides in a deep concave curve, the ventral end of which is in advance of the dorsal end, and which, after reaching the back, is bent round suddenly to form a small, deep, rounded, median lobe. Margins of the mouth concave laterally, and then arched forward to form a sharp overhanging ventral apex.

Size.—28 mm. in length, 20 mm. in width, 9 mm. in depth.

Locality.—Wolborough. Phillips's original specimen, as well as another smaller one, is in the Museum of Practical Geology.[4] Mr. Vicary has five specimens; the

[1] 1832, von Buch, 'Über Amm. und Gon.,' p. 34, pl. i, figs. 6—8.

[2] 1837, Beyrich, 'Beitr. Rhein. Übergangsg.,' p. 32.

[3] 1851, Sandb., 'Verst. Rhein. Nassau,' p. 82, pl. vii, figs. 1—3.

[4] A large collection of Wolborough fossils, containing a certain number of Phillips's known types, was long ago presented to the Museum of Practical Geology by Mr. R. Godwin-Austen. On examining another of these specimens I was impressed with its likeness to a figure on one of his plates, and this led Mr. Newton, Mr. Sharman, Mr. Allen, and myself carefully to examine the collection with a view

only one of which that retained its exterior surface was labelled by Mr. Salter "Goniatites unnamed." In the British Museum are two finely preserved specimens retaining the shell.

Remarks.—Phillips's figure by no means conveys an intelligible idea of his original specimen. It is drawn obliquely in perspective, and is much restored. Hence there has been much confusion in naming the specimens in museums. A careful comparison with it, however, of the fossils enumerated above leads to a much more definite understanding of the species. It is a form with a very wide umbilicus, short convex whorls, very oblique chambers, simple suture-lines, a broad keel defined by lateral furrows, and a forward-arching mouth. There seems to be some amount of variability in the form, some of the specimens, as one in the British Museum (Pl. V, fig. 7) and one or two of Mr. Vicary's, having distinctly wider and less convex whorls, and thereby tending towards *G. obliquus*. I do not, however, think that this can indicate that the two are varieties of a single species, for, as well as can be made out, the suture-lines are different, that of *G. obliquus* being angulated on the side, and that of *G. transitorius* reaching the back in a single sweep.

I am unable to see any resemblance to it in *G. subnautilinus* (Beyrich), *Clymenia lævigata*, Münster, or other species to which it has been referred in collections.

It agrees evidently with *G. bicanaliculatus*, Sandb., as shown in Sandberger's figures; and indeed he himself identifies his species with Phillips', although for some reason he does not adopt the name. He remarks that having compared a specimen in the Museum of Practical Geology with his fossils, it proved to be so like a shell of his, *G. bicanaliculatus*, var. *gracilis*, that it might have been drawn from it. *G. Dannenbergi* (Beyr.),[1] however, with which he also identifies his species, appears to differ in not being at all involute, and in having more rapidly increasing whorls.

F. A. Römer's[2] figure of *G. æquabilis ?* (Beyr.)[3] comes much nearer to our shell than does Beyrich's original, but the umbilicus is slightly larger, the sides more oblique, the back narrower, and the surface smooth; though I have left it among the synonyms, my impression is that it represents Beyrich's and not Phillips's species.

to the possibility of its containing further unrecognised type-specimens. We based our examination on the cracks and other accidental marks on the fossils. The investigation was a matter of some difficulty as his figures are not always all that could be desired, but we were well repaid by recovering a large number of type-specimens, and in some instances, as in this case, getting much new light upon his species.

[1] 1837, Beyr., 'Beitr. Rhein. Übergangsg.,' p. 26, pl. i, figs. 5 *a*, *b*.

[2] 1843, F. A. Röm., 'Verst. Harz.,' p. 34, pl. ix, figs. 13 *a*, *b*.

[3] 1837, Beyr., 'Beitr. Rhein. Übergangsg.,' p. 34, pl. ii, figs. 1 *a*, *b*.

F. A. Römer's earliest figure[1] of *G. bicanaliculatus* differs (if it is accurately drawn) from Sandberger's species in being more definitely oval in the front view and in having no central lobe (but a deep saddle instead) in the suture-line. His later figure[2] more nearly approaches it, having, however, a decidedly smaller umbilicus. I am inclined to regard this, however, as a variety more nearly allied to *G. obliquus*, though apparently separated from it by its more convex back and less oblique suture-lines. It may be compared with the Brit. Mus. specimen (Plate V, fig. 7).

4. Goniatites inconstans, *Phillips*. Pl. V, figs. 5, 5 *a*, 6, 6 *a*, 6 *b*.

1841.	Goniatites inconstans, *Phil.*	Pal. Foss., p. 123, pl. li, fig. 238.
1842.	— costulatus, *d'Archiac* and *de Verneuil.*	Geol. Trans., ser. 2, vol. vi, pt. 2, p. 341, pl. xxvi, figs. 3 *a*, *b*.
1885.	— Wildungensis, *Waldsmidt.*	Über Devon. Sch. Gegend Wildungen, p. 921, pl. xl, fig. 1.
1888.	— inconstans, *Eth.*	Foss. Brit., pt. 1, Pal., p. 167.

Description.—Shell small, discoidal, of about four whorls, hardly involute. Umbilicus very large, shallow, displaying the greatest part of the interior whorls. Nucleus large, globose. Sides of the whorls rising steeply from the whorl below, and after rounding rapidly over the dorsal part sloping obliquely to the ventral region, where they bend over to form the broad and slightly convex back or keel. Surface ornamented with numerous coarse threads or small ridges, which arch forward toward the ventral part, where they become much finer. An obscure spiral constriction on the sides near the ventral region.

Size.—Height about 20 mm., depth about 10 mm.

Localities.—One imperfect but well-preserved specimen is in Mr. Vicary's cabinet from Wolborough, and two others in a more obscure state of preservation are in the Godwin-Austen collection in the Museum of Practical Geology.

The original specimens described by Phillips were from the neighbourhood of Exeter.

Remarks.—The specimens from Wolborough are not so large as some of those figured by Phillips, and vary from them in several particulars. Their whorls are rather more numerous, their ornamentation is less prominent, and the depressions by the sides of the keel are less deep. There can, however, be little doubt that they belong to the same species, which that author describes as being exceedingly

[1] 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 19, pl. iii, figs. 29 *a*, *b*.

[2] 1860, F. A. Röm., 'Beitr.,' pt. 4, p. 157, pl. xxiv, fig. 1.

variable, and most probably the slight differences mentioned above are due to the Wolborough specimens being younger shells. It will be seen on reference to the figures that the Wolborough specimens themselves show considerable variation. *G. costulatus*, d'Arch. et de Vern., appears to agree with the Wolborough specimens exactly, except that it is circular instead of being (as are two out of the three) elliptic, and that the sides are perhaps a little shorter; and there is no reason to question its identity with them. With Phillips's types, however, its agreement is more doubtful, though from the fact that the French authors describe the keel as striated in well-preserved specimens, and that Phillips's species varies so much with age it is most probable that they in common with our present fossils belong to it. Again, *G. Wildungensis*, Waldsmidt, has so much the character of Phillips's species that I believe it must be classed with it. From Mr. Vicary's fossil it chiefly differs in being flatter and not elliptic; but the Jermyn-Street specimens on the whole agree with it, though the suture-line of the English shells, being unknown, prevent a very positive identification.

Affinities.—*G. paucistriatus*,[1] d'Arch. et de Vern., has much fewer and more direct striations.

G. costatus, d'Arch. et de Vern.,[2] has much wider ribs. Sandberger[3] unites *G. tuberculosus* and *G. costatus* of d'Archiac and de Vern., calling the resultant species *G. tuberculoso-costatus*, d'Arch. et de Vern.; and in the shell which he thus figures the costæ are fewer and straighter, and the whorls more numerous than in ours. Tietze[4] agrees with Sandberger in this view, and gives a very similar figure, with ribs much straighter than in the species under consideration. Lastly, *G. anguliferus*, F. A. Römer,[5] has shorter whorls, and its costæ are fewer and as strong upon the back as upon the sides.

5. Goniatites molarius, n. sp. Pl. V, figs. 11, 11 *a*; Pl. VI, figs. 4, 4 *a*, 6, 6 *a*.

1841. Goniatites excavatus, *Phil.* Pal. Foss., p. 121, pl. l, fig. 232 (not Phillips, Geol. Yorks.).

1850. — discus?, *F. A. Römer.* Beitr., pt. 1, p. 39, pl. vi, figs. 7 *a*, *b*, *c* (juv.).

1888. — excavatus, *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.

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1 1842, d'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. ii, pt. 2, p. 339, pl. xxv, figs. 8 *a*, *b*.

2 Ibid., p. 340, pl. xxxi, figs. 1, 1 *a*.

3 1851, Sandberger, 'Verst. Rhein. Nassau,' p. 64, pl. iv, fig. 1; pl. viii, fig. 2.

4 1870, Tietze, 'Dev. Schicht. Ebersdorf.,' p. 28, pl. i, fig. 6.

5 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 40, pl. vi, figs. 12 *a*, *b*, *c*.

Description.—Shell discoidal, almost completely involute, more or less deep, with five or more whorls. Whorls increasing very slowly, the mouth being more than half-filled by the back of the next whorl. Sides flat and parallel for the greatest part of their diameters, then arching round in a bold curve to the back, which is nearly flat and very broad, and is sometimes defined by slight lateral excavations. Umbilicus about one fourth the diameter of the shell, very deep and trochiform, lined by a convex spiral ridge formed by the margins of the successive whorls. Suture-line with a broad blunt central lobe, smaller subtriangular central saddles and lateral lobes, and slightly concave lateral saddles.

Size.—Phillips's original specimen measures 50 mm. in height, 38 mm. in width, and 15 mm. in depth; another specimen measures 35 mm. in height, and 13 mm. in depth.

Locality.—Wolborough. Phillips's Devonian type-specimen is in the Lee Collection, now in the British Museum. There is a second specimen in the same Museum which is fractured so as to show the suture-line. There are four smaller shells in Mr. Vicary's Collection which were labelled *G. excavatus* by Salter, but some of which are not very typical. In the Torquay Museum (Battersby Coll.) are three specimens, one of which is very small but presents all the characters of the species. There are five specimens in the Museum of Practical Geology.

Remarks.—A comparison of the type-specimens in the British Museum shows most clearly that this species is quite distinct from the Yorkshire shell described under the same name by Phillips.[1] In that the section through the shell is almost ovoid, the back is narrow and deeply convex, the whorls increase very rapidly, the umbilicus is differently formed, and sulci are generally present. It is probable that Phillips himself did not intend to unite them, though giving them the same name, as he does not quote the 'Geology of Yorkshire' in his description in the 'Palæozoic Fossils.' Hence, as it was given first to the Carboniferous fossil it cannot be retained for the present species. Mr. Lee's original specimen, on the whole, agrees fairly well with Phillips's figure of it, but it is broader, and the whorls increase less rapidly (*i. e.* the mouth is shorter) than there represented, and in these respects it comes nearer to the generality of the Devonshire specimens. The species appears to have been rather variable, and the question which Phillips raised, as to the possibility of its being identical with the shell which he referred to *G. globosus*, Münster, is therefore not very easy to solve. Typical specimens of each are very different in shape, but some of the deeper forms of *G. molarius* approach very near to the specific confines of *G. globosus*. Their depth in some instances amounts to half the width. The excavation on each side of the back also seems sometimes almost invisible. But on the other hand, the suggestion that it may be the adult form of Münster's shell does not seem borne

[1] 1839, Phillips, 'Geol. Yorks.,' vol. ii, p. 235, pl. xix, figs. 33, 35.

out by the specimens we have seen. The latter and much smaller species is often deeper in actual measurement than the former, and, if the very small specimen in the Torquay Museum be rightly regarded as a specimen of the present shell, we learn that in the young state it is much less like *G. globosus* than it is in the adult. At that stage the whorls would appear to increase more rapidly, and to be more regularly convex than is the case in larger shells, and the umbilicus is comparatively smaller. In this state it is almost exactly like *G. discus*, F. A. Römer, except that the latter is not quite involute, and so shows the inner whorls in the umbilicus. A suture-line of his shell is figured by Römer, which is like what we might suppose *G. transitorius*, Phil., to have possessed. The similar characters are, however, too slight to make it safe to adopt Römer's name for the species, especially as it seems to be a similarity between the mature German shell and the young of the British form.

Affinities.—*G. subnautilinus,* von Buch, as interpreted by Sandberger,[1] is something similar in general shape, but the umbilicus is rather larger, the whorls are rather less involute, and their inner margins are rounded instead of angular. Von Buch's own figures[2] of it are poor, but they convey a very different impression, being much more ovoid in section, with more rapidly increasing whorls and an undulated surface on the cast. He certainly states it to be wholly involute, as is the English form; but his figures and description tend, on the whole, to prove that the two species are distinct. *G. carinatus* (Beyrich)[3] has more sloping sides and a higher and more defined keel. *G. reticulatus*, Phillips, as given by Römer,[4] is a more spherical shell with a reticulated surface, and without any flattening on the sides.

6. Goniatites aratus, *Whidborne.* Pl. VI, figs. 16, 16 *a*.

1889. Goniatites aratus, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell discoidal, flattened, inclusive, of rather small size, consisting of few whorls. Surface smooth (?). Umbilicus rather small, trochiform. Sides of the whorls at first flattened or slightly hollowed, and then gently arching to meet in the deeply convex back; marked by four deeply impressed sulci, consisting of a concave curve tending forward from the inner margin, across three-

[1] 1851, Sandberger, 'Verst. Rhein. Nassau,' p. 114, pl. xi, fig. 1.
[2] 1832, von Buch., 'Über Amm. und Gon.,' p. 35, pl. i, figs. 9—11.
[3] 1837, Beyrich, 'Beitr. Rhein. Übergangsg.,' p. 35, pl. ii, figs. 2 *a*—*c*.
1852, F. A. Römer, 'Beitr.,' p. 2, p. 94, pl. xiii, figs. 31 *a*, *b*.

fourths the width of the whorl, and then bent sharply back, so as to form a deep tongue upon the back.

Size.—26 mm. in height, 21 mm. in width, 10 mm. in length.

Locality.—Barton. Two specimens in the Lee Collection in the British Museum.

Remarks.—This shell is in general form more like *G. molarius* than any of the other accompanying species, differing, however, therefrom in the slope of its sides, and the greater convexity of its back as well as in the presence of its remarkable sulci, and the slight depression of the sides just beyond the margin of the umbilicus. My examination of it, both when it was in Mr. Lee's Collection at Villa Syracusa, and since it has found a lodgment in the British Museum, has led me to regard it as certainly not belonging to that species. To no other shell given by either Sandberger, Römer, or Phillips in their quoted works is it at all similar.

Goniatites subsulcatus, Münster,[1] presents a rather curious mimicry. The suture-lines in that species (as seen in the side view) are similar to the sulci in this, but its sulci themselves are straight and its umbilicus is minute. It is clearly a totally different shell.

Kayser's interpretation of '*Goniatites retrorsus*, Sandb., var. *Brilonensis* (Beyr.),'[2] however, comes very near it, and chiefly differs in the umbilicus being smaller and the sulci being less angulated, and being five instead of four.

Ammonites diadema, Goldf., as figured by Beyrich,[3] and *G. Oweni*, Hall,[4] are not very dissimilar in general shape, but their sulci are straight instead of angulated, and they are rather deeper shells.

In *G. truncatus*, Phillips, as given by F. A. Römer,[5] the sulci are direct and almost straight.

7. Goniatites globosus, *Münster?* Pl. V, figs. 12, 12 *a*, 12 *b*, and Pl. VI, figs. 5, 5 *a*.

1832. Goniatites globosus, *Münst.* Über Clym. und Gon. Fichtelgeb., p. 16, pl. iv a, fig. 4.
1841. — — *Phil.* Pal. Foss., p. 120, pl. l, fig. 231.
1851. — retrorsus umbilicatus, *Sandberger.* Verst. Rhein. Nassau, p. 107, pl. x, fig. 1, and pl. x b, figs. 11—13.

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[1] 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 17, pl. v a, fig. 2.

[2] 1872, Kayser, 'Zeitsch. deut. geol. Gesell.,' vol. xxiv, p. 664, pl. xxv, fig. 2.

[3] 1837, Beyrich, 'Beitr. Verst. Rhein. Übergangsg.,' pt. 1, p. 41, pl. ii, figs. 8—10.

[4] 1860, Hall, 'Thirteenth Rep. N. Y.,' p. 100, figs. 11, 12; and 1879, 'Pal. N. Y.,' p. 470, pl. lxxiii, figs. 3—8, and pl. lxxiv, fig. 9.

[5] 1852, F. A. Röm., 'Beitr.,' pt. 2, p. 94, pl. xiii, figs. 30 *a*, *b*, *c*.

1873. GONIATITES GLOBOSUS, *Kayser*. Zeitschr. Deutsch. Geol. Gesell., vol. xxv, p. 625.
1888. — — *Etheridge*. Brit. Foss., vol. i, Pal., p. 167.

Description.—Shell small, sub-spherical, slightly flattened laterally and slightly elliptic, of five or six whorls. Whorls increasing very slowly. Umbilicus from one-half to one-third the diameter of the shell, wide, deep, and trochiform, with a convex spiral ridge formed by the margins of the successive whorls. Sides short, rising in a short convex wall round the umbilicus, then turning through a right angle, and, after spreading almost flatly for a short distance, curving round to form the bluntly angulated back. Suture-line with a large triangular front lobe, a deeply concave front saddle of nearly the same width, a similar but rather smaller lateral lobe, and a small concave lateral saddle.

Size.—The specimen figured on Plate V measures 18 mm. long, 16 mm. wide, and 11 mm. deep.

Locality.—Wolborough. There are two specimens in the Torquay Museum (Battersby Coll.), two in the British Museum, five in the Museum of Practical Geology (Godwin-Austen Collection), and four in Mr. Vicary's Collection.

Remarks.—The shells in the Torquay and Jermyn-Street Museums I carefully compared, in company with Mr. Newton, with *G. molarius*, and could trace no such passage between them as was suggested by Phillips. At the same time we find that both species are subject to considerable variation, especially in regard to the size of the umbilicus. If, moreover, the rather doubtful specimen of *G. molarius* in the British Museum, figured on Plate VI, truly belongs to that species, its suture-line is very similar, differing chiefly in the lobes and saddles not being so deep as those of *G. globosus*, and thus it proves that they are closely allied species. On a comparison of the Wolborough examples with Münster's original figures[1] much doubt on the other hand must arise as to the correctness of Phillips's identification. The German shells are decidedly deeper and have quite rounded backs; and the lobes of the suture-line are much more acute and much narrower than the saddles, whereas in the British specimens they are apparently blunt, and almost equal in size. I am inclined to the opinion that his identification cannot stand, but in view of the extreme variability in the English shells, and the bare possibility of their having to be regarded as a variety of *G. molarius*, I hardly like to suggest a new name for them at present.

From *G. retrorsus umbilicatus*, Sandb.,[2] which Kayser regards as a synonym of *G. globosus*, the English shell is distinguished by the large size of the lobes compared with the saddles, in which respect Sandberger's shell is less like than is Münster's.

[1] 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 16, pl. iv, figs. 4 *a*—*e*.

[2] 1851, Sandb., 'Verst. Rhein. Nassau,' p. 107, pl. x, fig. 1, and pl. x B, figs. 11—13.

Affinities.—*G. Nœggerathi*, von Buch, as given by d'Archiac and de Verneuil,[1] presents a similar superficial appearance, but its back is narrower, and shows no signs of a keel, and its lobes are described as being more complicated.

G. globosus var. *Nehdensis*, Kayser,[2] is distinguished by the nodulated margin of its umbilicus.

Ammonities lateseptatus, Beyr.,[3] has a much larger umbilicus, no lateral lobes; and is a much larger shell. F. A. Römer[4] bears out the points in Beyrich's description, which distinguish it from our shell.

G. plebeius, Barrande,[5] has a more open umbilicus and no lateral lobe in the suture-line. It is regarded by Kayser[6] as a synonym of *G. lateseptatus*, Beyrich.

G. plebeiformis, Hall,[7] differs from ours in the same direction as, and to a greater degree than, does the last-named Bohemian species.

8. Goniatites Hughesii, *Whidborne*. Plate VI, figs. 1—3.

1889. Goniatites Hughesii, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell large, flattened, involute, slightly elliptic. Umbilicus closed by the upper whorl, but apparently existing, though minute, in the whorls below. Mouth somewhat expanding laterally, thickened near the umbilicus. Sides of the whorls gently rising just around the umbilicus, but soon after sinking, with a very slight convexity, to the ventral area, where they curve rapidly over the rounded back. Suture-line rising perpendicularly from the umbilicus, and going forward in a wide concave saddle over about two-thirds of the length of the whorl, when it forms a long, narrow, rounded lobe, and then bends sharply back in a steeper central saddle; central portion forming a narrow, elongate, central lobe. Surface covered with a microscopic and curious pattern of oblique and close discontinuous lines curving backwards from the dorsal margins much more obliquely than the suture-lines.

Size.—90 mm. in height, 65 mm. in width, 24 mm. in depth.

Locality.—Lummaton. There are two specimens in my collection, two others,

[1] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 337, pl. xxv, figs. 1, 1 *a*, *b*.

[2] 1873, Kayser, 'Zeitschr. deutsch. geol. Gesell.,' vol. xxv, p. 625, pl. xix, fig. 4.

[3] 1837, Beyrich, 'Beitr. Rhein. Übergangsg.,' p. 25, pl. i, figs. 1—4, and 1887, Frech, 'Zeitsch. deutsch. geol. Gesell.,' p. 732, pl. xxvii, figs. 12, 12 *a*.

[4] 1860, F. A. Röm., 'Beitr.,' pt. 4, p. 157, pl. xxiv, figs. 2 *a*, *b*, *c*.

[5] 1865, Barrande, 'Syst. Sil. Bohèm.,' vol. ii, p. 37, pl. v, figs. 1—25; pl. vi, figs. 1—5; pl. vii, figs. 3—9, Ét. F and G.

[6] 1878, Kayser, 'Abhandl. Geol. Specialk. Preussen,' Band 2, pt. 4, p. 50, pl. vi, figs. 1—7.

[7] 1879, Hall, 'Pal. N. Y.,' vol. v, ser. 2, p. 448, pl. xvi, figs. 25, 26; and pl. cx, figs. 3—9.

considerably smaller, but very fine, in the British Museum, and one in the Museum of Practical Geology.

Remarks.—It is to be regretted that, although the suture-lines are to be traced through the transparent surface of the shell in several of our specimens, their shape can only be made out, and that with the utmost difficulty, in a single case. Mr. Foord and I, however, convinced ourselves that there was only one central and one lateral lobe. The suture-lines approach each other at about two-thirds their distance from the umbilicus, so as to form a kind of tangent curve. The curious external markings appear to be due to the impression of the mantle.

Affinities.—From the other Devonshire species it is easily distinguished by its closed umbilicus, its flattened shape, and its very large size. Some of the Continental forms, however, approach it rather nearly in outward shape, although generally the character of the lobation proves the resemblance to be merely superficial. *G. ovatus*,[1] Münster, has a broader back, less oblique sides, and a smaller and less expanded mouth; its umbilical depression is also less distinct. *G. sublinearis*, Münster,[2] is a deeper and differently ornamented shell. *G. linearis*, Münst.,[3] is still further separated from it by its depth, its broad and more flatly rounded back, and its radiating lineations. *G. Munsteri*, von Buch,[4] has more evenly convex whorls, a broader rounded back, an open umbilicus, and two lateral lobes in the suture-line. *G. subbilobatus*, Münster,[5] is a deeper shell with a peculiar pinching-in at the centre, and has broader chambers and a concave central saddle in the suture-line.

G. bilanceolatus, Sandb.,[6] is a much deeper shell, with two lateral lobes. (In his plates Sandberger also gives the names *G. Munsteri* and *G. bidens*, but unites the three in the text.)

G. Bronni, Münster, as given by Geinitz[7] is more obliquely coiled, and has a second lateral lobe in the suture.

G. intumescens, Beyrich, as given by Tschernyschew,[8] has a larger umbilicus and a more angulated suture-line; as given by F. Römer,[9] it has a still larger umbilicus, a sharp keel, and angular lobes. *G. simplex*, von Buch,[10] comes, according to Tschernyschew,[11] much nearer, but has a much less undulated suture-line. The latter species so nearly approaches it in other respects, that it is doubtful whether it ought not to be regarded as a synonym.

1 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 14, pl. iv A, figs. 1 *a—d*.

2 Ibid., p. 17, pl. iv A, figs. 5 *a—c*.

3 Ibid., p. 17, pl. v A, figs. 1 *a—d*.

4 Ibid., p. 19, pl. v A, figs. 3 *a—c*; and 1870, Tietze, 'Dev. Schicht. Ebersd.,' p. 28, pl. i, fig. 7.

5 1839, Münst., 'Beitr.,' pt. 1, p. 21, pl. xvii, figs. 1 *a—c*.

6 1851, Sandb., 'Verst. Rhein. Nassau,' p. 71, pl. v, fig. 2; pl. viii, fig. 11, and pl. ix, fig. 7.

7 1852, Geinitz, 'Verst. Grauw. Sachsen,' p. 39, pl. x, figs. 8—10; and pl. xi, fig. 2.

8 1887, Tschernyschew, 'Mém. Com. Géol. Russ.,' vol. iii, pt. 3, p. 168, pl. ii, figs. 1, 3, 5.

9 1876, Ferd. Römer, 'Leth. Pal.,' pl. xxxv, fig. 10.

10 1832, von Buch, 'Über Amm. und Gon.,' p. 42, pl. ii, fig. 8.

11 1887, Tschernyschew, 'Mém. Com. Géol. Russ.,' vol. iii, pt. 3, p. 169, pl. ii, fig. 9.

9. Goniatites circumflexifer ?, *Sandberger*. Pl. VI, fig. 17.

1851. Goniatites circumflexifer, *Sandberger*. Verst. Rhein. Nassau, p. 111, pl. xi, fig. 8.

Description.—Shell small, involute, apparently globose. Umbilicus small, consisting of a hollow spire, with a rounded thread formed by the inner margins of the successive whorls. Sides of whorls rising inwards, and rounding abruptly to form this thread, and then becoming gently convex so that their deepest part is at some distance from the centre.

Size.—The only specimen is too incomplete for measurement.

Locality.—Barton. A single fragmentary specimen in the British Museum.

Remarks.—This small fossil appears to me to differ from the other British Middle Devonian Goniatites. Its umbilicus is formed on quite a different principle from that of *G. nuciformis,* being more in the shape of a screw with a sharp spiral thread separating a shallow concavity, and round its border the convex whorls are definitely depressed.

G. circumflexifer, Sandberger, is a small species, that might be exactly represented by the present defective specimen, which has no trace of either suture-lines or surface-marks, and which is rather less than half of a perfect shell, so that the form of its back cannot be exactly ascertained. I have therefore only provisionally identified it with this German species, which its describer appears to separate from his *G. retrorsus*, von Buch, on account of the large size and convexity of its lateral lobes, though some of the suture-lines which he gives of the latter species appear to have the same character.

Affinities.—This shell does not seem to be at all in the nature of *G. linearis*, Münster,[1] with which it has been identified in the museum lists, but it much more nearly resembles a small form of *G. orbicularis*, Münster,[2] except that its umbilicus is larger and that its size is so very much less. The latter shell was first regarded by Münster as a variety of *G. Munsteri*, von Buch,[3] but was afterwards separated from it by him on account of its greater rotundity, &c., in which respect it is more like our specimen. I am not, however, inclined to see more than a variety of von Buch's species in that of Münster. Sandberger[4] figures a fragmentary example of *G. Munsteri*, von Buch, which shows the suture-line, but gives no data for comparison with our fossil; but he afterwards separates this as a distinct

[1] 1832, Münster, 'Über Clym. und Gon. Fichtelgeb.,' p. 22, pl. v a, fig. 1.

[2] 1832, ibid., p. 20, pl. v a, figs. 4 *a—c*.

[3] 1832, von Buch, 'Über Amm. und Gon.,' p. 41, pl. ii, fig. 5, and 1832, Münster, 'Beitr.,' pt. 1 Supt., p. 19, pl. v a, fig. 3.

[4] 1851, Sandberger, 'Verst. Rhein. Nassau,' pl. v, fig. 2.

species, *G. bilanceolatus*,[1] which has a much smaller umbilicus than ours. Tietze,[2] however, remarks that Sandberger's *G. bilanceolatus* is without doubt the same species as *G. Munsteri*, and gives a good figure, which has no visible umbilicus, and shows that its whorls do not rise so convexly from the centre as they do in ours; and thus it is proved to be distinct.

G. Verneuili, Münster,[3] seems in some respects still more similar than *G. orbicularis*, as it is a much smaller shell, and has a comparatively larger umbilicus than that species. It has a definitely flattened back similar to that of *G. obliquus*, Whidborne. I doubt whether the British specimen has this feature, and it differs in being more completely involute.

G. orbiculus (Beyrich)[4] is distinguished by being only partially involute, thus having a wide umbilicus instead of a very small one, but in other respects it appears to correspond. It also resembles in some degree *G. Ungeri*, Münster,[5] but shows no trace of the radiating ridges seen in that species.

10. Goniatites psittacinus, *Whidborne*. Pl. VI, figs. 9—13.

1888. Goniatites psittacinus, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell oval, convex, elliptic, transverse; of small size. Umbilicus deep and minute, but almost always closed by the margin of the body-whorl. Whorls apparently few. Chambers narrow. Inner whorl occupying about two-thirds of the diameter of the mouth. Sides of the whorls flat for about half their diameter, and then rounding over the back with a nearly circular curvature. No signs of any keel. Surface apparently smooth. Suture-line with a small sharp central lobe, shallow arched central saddles, and very wide rounded lateral lobes coming much in advance of the central lobe, and being much steeper on the ventral than on the dorsal side; lateral saddles small and arched.

Size.—Mr. Vicary's largest specimen measures 45 mm. in height, 35 mm. in width, and 19 mm. in depth; but the general run of the specimens is not more than 20 mm. in height.

Locality.—Wolborough. There are thirteen specimens in Mr. Vicary's Collection, three in the Torquay Museum, three in the Museum of Practical Geology, and two in the British Museum.

Remarks.—This is a very curious and distinctive form. It appears sufficiently common at Wolborough, but I have never found any trace of it at Lummaton. It

[1] 1851, Sandberger, 'Verst. Rhein. Nassau,' p. 71, pl. viii, fig. 11, and pl. ix, fig. 7.

[2] Tietze, 'Devon. Schichten von Ebersdorf,' p. 28, pl. i, fig. 7.

[3] 1839, Münster, 'Beitr.,' pt. 1, p. 17, pl. iii, fig. 9.

[4] 1837, Beyr., 'Beitr. Rhein. Übergangsg.,' p. 36, pl. ii, figs. 4 *a*, *b*.

[5] 1840, Münster, 'Beitr.,' pt. 3, p. 107, pl. xvi, figs. 8 *a*—*c*.

is remarkable for its extremely elongate shape, the spiral formed by its whorls being of an elliptic and not circular character. This seems a constant character, as it exists in a greater or less degree in every specimen I have examined. Hence the measurements of the shell vary much according to the position on the ellipse which the mouth happened to have reached at the time of the animal's death. In the largest specimen known it is upon the longest diameter, but in a specimen in the Jermyn Street Museum, which nearly equals it in size, it is upon the shortest. The mouth seems slightly expanded laterally, and its margins appear to form a simple and gently advancing curve, so that it rather overhangs the aperture.

Unfortunately, in common with most of the Wolborough fossils, the surface of the specimens is decayed, and the suture-line is obliterated except in a few obscure examples. The former would appear, however, in all likelihood to have been smooth.

I formerly supposed that this was the *G. linearis* of Münster[1] and Phillips,[2] chiefly because Mr. Vicary's specimen had been so labelled by Salter. When, however, Mr. Roberts and I examined them carefully, he convinced me that it could not belong to their shell or shells. It is not globular, its mouth is larger, and the curvature of the suture-line is quite different. In fact, on referring to Münster's 'Beiträge' (in the 2nd edition of which his earlier paper is incorporated), Phillips's description becomes obscure, the more so as his references are inaccurate and interchanged, and all we can say is that Münster's pl. V A, fig. 1, seems to correspond with his larger figure (229 *a*) and that the latter certainly does not resemble our Wolborough shell, the identity of which must therefore be sought elsewhere.

Affinities.—Its constant elliptic form distinguishes it from all the other species given by Münster except *G. hybridus*,[3] which has a very zigzagged suture-line; *G. subbilobatus*[4], in which the central saddle is angulated and the lateral lobe acute; and *G. Bronnii*[5] which has two lateral lobes. *G. ovatus*, Münst.,[6] is slightly elliptic, but it is flatter, and the suture-line is almost like *G. linearis*, having very narrow side lobes and a very elongate central lobe. In *G. sublævis*, Münst.,[7] *G. undulosus*,[8] Münst., and *G. sublinearis*, Münst.,[9] the side lobe of the suture-line is also sharp and narrow. In *G. subsulcatus*, Münst.,[10] the mouth is smaller and the front view more squared.

1 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 22, pl. V A, fig. 1.
2 1841, Phil., 'Pal. Foss.,' p. 120, pl. xlix, figs. 229, *a*—*d*.
3 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 19, pl. IV A, fig. 6.
4 1839, ibid., 'Beiträge,' pt. 1, p. 21, pl. xvii, fig. 1.
5 1840, ibid., pt. 3, p. 108, pl. xvi, fig. 9.
6 1832, ibid., 'Über Clym. und Gon. Fichtelgeb.,' p. 18, pl. IV A, fig. 1.
7 Ibid., p. 20, pl. IV A, fig. 2.
8 Ibid., p. 20, pl. IV A, fig. 3.
9 Ibid., p. 22, pl. IV A, fig. 5.
10 Ibid., p. 23, pl. V A, fig. 2.

G. divisus, Münst.,[1] is a discoidal and not ellipsoidal form; its back is broader, and of a more subquadrilateral shape; it is marked with sulci; and its lobes are large and acute.

G. sulcatus, Münst.,[2] has a large elongate lateral lobe of the same size as the central lobe; the saddles are much deeper, and the section more squared. His other species have either larger umbilici or more lobes in the suture-line.

Turning to Sandberger, we find an approach in *G. amblylobus*,[3] which is to be distinguished by the presence of deep sulci and by a wide central saddle, and a dorsally steep side lobe. All the other shells figured by him under the name *G. retrorsus*[4] are circular, not elliptic, and their lateral lobes are never steeper ventrally than dorsally.

F. A. Römer[5] figures a variety of *G. retrorsus* with closed umbilicus, which differs from ours in not being elliptic, and in not having the sides of the aperture arched forward. In a later part of his work[6] he describes another example of *G. retrorsus typus*, from the "Disjuncta" beds, which differs in much the same particulars.

G. atratus, Goldf., as figured by Beyrich,[7] is a minute flat shell very similar to fig. 12 in shape, and has a closed umbilicus. This figure gives but few specific characters, and the description of the suture-line does not enable me to decide as to its identity. As far as I can judge, the shell seems flatter, much more rapidly increasing, and with a different suture-line.

G. Stachii, Frech,[8] and *G. inexpectatus*, Frech,[9] are ovoid shells which have broader backs and differ in the details of their suture-line, including a larger central lobe.

An American species, *G. discoideus*, Hall,[10] comes very near to it in general shape. It is, however, not ellipsoidal, and the suture-line is formed on a different pattern; the lateral lobes are closer, and not steeper ventrally than dorsally; and the lateral saddles are large, distant, and very deep. The shell appears flatter, and to be usually more compressed in the centre. Its general facies is different, especially in full-grown examples.

[1] 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 18, pl. iv A, figs. 6 *a—d*.

[2] Ibid., p. 18, pl. iii A, figs. 7 *a—c*.

[3] 1851, Sandb., 'Verst. Rhein. Nassau,' p. 108, pl. v, fig. 4; and pl. x B, figs. 1—6, 8, 14, 15, 18, 19, 21, 23, 25.

[4] Ibid., p. 100, pls. x, x A, and x B.

[5] 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 27, pl. iv, fig. 15.

[6] 1860, ibid., pt. 4, p. 163, pl. xxv, figs. 17 *a, b*.

[7] 1837, Beyrich, 'Beitr. Verst. Rhein. Übergangsg.,' pt. 1, p. 42, pl. ii, fig. 7.

[8] 1887, Frech, 'Zeitsch. deutsch. geol. Gesell.,' p. 733, pl. xxviii, figs. 9, 11, 11 *a*.

[9] Ibid., p. 733, pl. xxviii, figs. 10, *a, b*.

[10] 1879, Hall, 'Pal. N. Y.,' vol. v, ser. 2, p. 441, pl. lxxi, figs. 1—13; and pl. lxxiv, figs. 4, 5.

11. Goniatites, sp. Pl. VI, figs. 14, 14 *a*, 14 *b*.

Description.—Shell small, almost involute, discoidal, flattish. Umbilicus minute, deep, aciculate. Sides of the whorls flattened obliquely, and meeting in a narrow rounded back. Suture-line with a very small triangular central lobe (?), very oblique central saddles, large bluntly triangular lateral lobes which are very much in advance of the central lobe, and lateral saddles of a similar bluntly triangular shape, but smaller than the lobes.

Size.—15 mm. in height, 7 mm. in depth.

Locality.—Wolborough. A single specimen in the Museum of Practical Geology.

Remarks.—This beautiful little specimen appears to represent a shell which is, as far as I can see, unlike any of the accompanying species. I at first supposed the shells depicted on Pl. VI, figs. 13 and 15, to belong to the same species, but the former appears on closer examination to be an aberrant example of *C. psittacinus*, and the present form differs from it in the more arched character of its lobes, the retrogression of the central lobe, and in its greater flatness, while it is distinguished from fig. 15 by the different contour of the suture-line and the absence in it of a broad central convexity.

The surface of the specimen now under review is marked by raised lines which are misleading, as they are neither the external ornament nor the suture-line of the existing whorl, but the springing of the walls of the chambers of a vanished whorl. It was only when I recognised this fact that I was enabled to understand it, and to separate it from the fossils above mentioned. The suture-line is given by the termination of the specimen which has separated along the walls of one of the chambers.

Affinities.—*G. retrorsus*, von Buch,[1] is clearly distinct on account of the larger umbilicus, and because the character of its ornamentation would probably imply a differently shaped suture-line. That species has gone through many fluctuations. Beyrich's figure[2] much more nearly approaches our fig. 13, but is quite different from *G. psitticanus*, to which that specimen is found to belong; while the present fossil seems to differ from it by the rapid increase of its whorls, the greater sharpness of its lobes and saddles, and the backwardness of the central lobe. On the other hand, as interpreted by d'Archiac and de Verneuil,[3] *G. retrorsus* is very unlike, having a large umbilicus and a more acute back, but these authors give an indistinct figure of a variety of their species, which they assert to be the shell originally described by Beyrich.

[1] 1832, von Buch, 'Über Amm. und Gon.,' p. 49, pl. ii, fig. 13.

[2] 1837, Beyrich, 'Beitr. Rhein. Übergangsg.,' p. 30, pl. i, figs. 10 *a*—*c*.

[3] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 338, pl. xxv, figs. 3—5.

Under the same name Sandberger[1] figures a large group of shells, as named varieties, many of which have been established as different species by Kayser. Of these *G. retrorsus typus*, Sandb.,[2] most nearly corresponds with our fig. 13, but is evidently distinct from that species as shown by other specimens, not being smooth or elliptic, having more sloping sides and a narrower back, and having the lateral lobes situated much more on the sides of the shell, and more inclined outwards. This form is separated from *G. retrorsus*, von Buch, by Kayser,[3] who unites it with *G. simplex*, von Buch, under which head he also groups *G. ovatus*, Münst., *G. striatulus*, Münst., *G. retrorsus lingua*, Sandb., *G. strangulatus*, Keyserling, and *G. retrorsus var. Brilonensis*, Kayser. If this synonomy is correct, it only shows more clearly the distinctness of *G. psittacinus* and of the present species. *G. simplex*, von Buch,[4] is a shell with a very open umbilicus and a rapidly increasing spire, though the suture-line is more like that of *G. psittacinus* than that of the present form.

Hall[5] figures *G. uniangularis*, Conrad,[6] which looks very like *G. retrorsus*, but differs from the present form in the size of its lateral saddles, and the less forward position of its central lobe.

12. Goniatites, sp. Pl. VI, figs. 15, 15 *a*.

Description.—Shell rather small, discoidal, involute, flattened, and centrally depressed. Umbilicus minute, aciculate, deep. Sides of the whorls depressed centrally and then arching in a gently increasing curve to meet in a broadly convex back. Suture-line rising perpendicularly from the umbilicus, bending forward in a shallow saddle to form a small, sharp, lateral lobe, which appears to be followed by a narrow, deep, rather bluntly triangular central saddle, and this by a large, wide, almost semicircular, central lobe.

Size.—26 mm. in height and 12 mm. in depth.

Locality.—A single specimen in the Museum of Practical Geology.

Remarks.—The specimen described above has given me much trouble, as from its state of fracture the suture-line is very hard to understand. At first I was inclined to unite it with the specimens represented by figs. 13 and 14, but a closer examination has convinced me of its distinctness. Fig. 13 represents a specimen belonging to the same species as figs. 9—12, which is more nearly circular than

[1] 1851, Sandb., 'Verst. Rhein. Nassau,' p. 100, pls. x, x a, x b.

[2] Ibid., pl. x, figs. 14—16, and pl. x a, figs. 3—6, 10, 11.

[3] 1873, Kayser, 'Zeitschr. deutsch. geol. Gesell.,' vol. xxv, p. 620, pl. xix, fig. 6.

[4] 1832, von Buch., 'Über Amm. und Gon.,' p. 42, pl. ii, fig. 8.

[5] 1879, Hall, 'Pal. N. Y.,' p. 444, pl. lxxi, fig. 14; pl. lxxii, figs. 6 and 7; and pl. lxxiv, fig. 2.

[6] 1842, Conrad, 'Journ. Acad. Nat. Sci. Phil.,' vol. viii, p. 268, pl. xvi, fig. 4.

the general run of that species, and is very much decorticated, so that the umbilicus is uncovered, and is probably larger than it originally was.

Fig. 14, on the other hand, while at first sight very similar to our fossil, is really shown by the lobation to be quite distinct. It wants the body-chamber, and hence the terminal line really gives the suture, which is quite different from that of the present species.

The character of the suture-line in the present fossil is much obscured by the shell having been broken nearly, but not quite exactly, along it. Supposing the tracing I have given to be a fairly correct representation of it, as I imagine it to be, it will be seen that it is of a somewhat unusual contour and differs very widely from that of *G. retrorsus*, von Buch, and other species of that group. I have not met with any foreign species which seems to approach the present shell at all nearly, but as the specimen is so defective and obscure I have not ventured to give it a specific name.

13. GONIATITES NUCIFORMIS, *Whidborne*. Pl. VI, figs. 7, 7 *a*, 7 *b*; and Pl. VII, fig. 1, 1 *a*.

1889. GONIATITES NUCIFORMIS, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell small, spheroidal, quite involute. Umbilicus minute and very deep; the edges of the inner whorls hidden by the smallness of the aperture. Suture-line very simple, consisting of a bow-shaped line, bent slightly forward over the back. Sides of the whorls flattened dorsally, arching ventrally in a rather deep curve to the broad back, which again is rather flattened. Siphuncle large, situated so close to the median line of the back as to be included in the structure of the shell. Chambers broader than they are high. Walls of chambers concave, simple. Mouth more than half filled by the back of the next whorl.

Size.—17 mm. in height, 13 mm. in width, 12 mm. in depth.

Locality.—Wolborough. There are seven specimens in the Vicary Collection, three or four in the Torquay Museum, two in the Museum of Practical Geology (Godwin-Austen Collection), and one in the British Museum.

Remarks.—This is an interesting little species, which does not seem, if we may judge from the specimens we have examined, to have been subject to any very great amount of variability. The subquadrate shape of its section, the siphuncle buried in the shell-wall, and the deep aciculate umbilicus are distinctive features. In Mr. Vicary's largest specimen, which is probably an old or full-grown shell, the depth of the shell seems greater in the vental part than near the umbilicus, so that its profile might perhaps be well described as key-hole shaped. There is in the Torquay Museum the polished section of a Goniatite, which, as far as we can make out from its very defective exterior, belongs to this species, and if so the chambers are shown to have been very short and deep.

The large specimen figured on Plate VI, fig. 7, is the only one that shows the suture, and in that the shape, although generally clear, is not very easily made out in detail. On reference to the drawing, fig. 7 *a*, a rudimentary central lobe and central saddles will be seen to be there represented. Though the draughtsman thought he traced them, and I therefore permitted them to stand, I myself believe that they have no existence, and that they ought to be replaced by a continuation of the simple curve.

Affinities.—Phillips does not seem to have noticed this form. The two South Petherwyn Goniatites, *G. linearis*, Münst. (*fide* Phillips)[1] and *G. biferus*, Phill.,[2] are the only ones that resemble it, even in outward form; but in each case the shape of the sutures is so entirely different from what we have every reason to suppose those of our shell to have been, that we may, with perfect confidence, regard them as species belonging to a different section of the genus from the present shell. From Münster's original *G. linearis* it is altogether alien.

G. divisus, Münst.,[3] has sulci, a closed umbilicus, and acute lobes.

G. cancellatus, d'Arch. and de Vern.,[4] has the umbilicus entirely closed and a definite central depression.

G. bifer, Phillips, as given by Sandberger,[5] is very similar in outward form, but it differs entirely in its suture-lines, which are the same as in Phillips's shell.

G. micromphalus, F. A. Röm.,[6] also comes very near to our species. It seems rather a flatter shell, with a narrower back, and slightly oblique sides, and, according to his description, with a more undulated suture-line, as it is said to possess distinct central and side lobes.

G. circumflexifer, Sandb., as given by F. A. Römer,[7] is extremely like our species, but it has a narrower back, and its suture-lines have definite central and side lobes. I do not understand why Römer has separated it from his last-mentioned, *G. discus*.[8] Another small species, *G. tumidus*, F. A. Röm.,[9] has a still more complicated suture-line. Sandberger's own *G. circumflexifer* is, as we have already seen, a differently shaped shell.

[1] 1841, Phil., 'Pal. Foss.,' p. 120, pl. xlix, fig. 229.

[2] Ibid., p. 120, pl. xlix, fig. 230.

[3] 1832, Münst., 'Über Clym. und Gon. Fichtelgeb.,' p. 18, pl. 4 A, figs. 6 *a—d*.

[4] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 339, pl. xxv, figs. 6 *a b*.

[5] 1851, Sandb., 'Rhein. Nassau,' p. 72, pl. ix, fig. 4, and (var. *delphinus*) fig. 5.

[6] 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 19, pl. iii, figs. 30 *a, b*.

[7] 1852, ibid., pt. 2, p. 80, pl. xii, fig. 22.

[8] Ibid., p. 95, pl. xiii, figs. 35 *a, b*.

[9] Ibid., p. 94, pl. xiii, figs. 33 *a, b, c*.

14. Goniatites pentangularis, *Whidborne*. Pl. VII, figs. 2, 2 *a*.

1889. Goniatites pentangularis, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell small, flat, discoidal, hardly involute. Umbilicus very wide and shallow, so that the spire is almost wholly exposed. Sides of whorls rising in a curve from the whorl below, then horizontally flattened for about half their width, then curving suddenly, and again flattened obliquely so as to meet in a simple and sharp keel; the section of the whorl being thus almost regularly pentagonal, or heartshaped, only indented by the keel of the whorl next within. Surface of body-whorl ornamented with a few coarse radiating ridges; that of the inner whorls with small but very prominent, simple, erect, thread-like striæ, both of which start almost perpendicularly from the base of the whorls and then curve regularly and quickly back, so as to meet the keel at a very acute angle.

Size.—About 13 mm. in height, 10 mm. in width, 4 mm. in depth.

Locality.—Barton. A single fragmentary example in the Lee Collection is the only specimen of this shell which I have seen.

Remarks.—I am aware of nothing like it having been described by British or foreign authors, except *G. incertus*, d'Arch. and de Vern.,[1] which has the ribs direct instead of oblique, and *G. Zorgensis*, F. A. Röm.,[2] which has much coarser and fewer ribs, and is ventrally truncated.

Although the specimen is very fragmentary, it appears so well characterised and so distinctive that I do not hesitate to record it under a specific name.

15. Goniatites serpentinus? *Phillips.*

?1839. Goniatites serpentinus, *Phil.* Geol. York., vol. ii, p. 237, pl. xx, figs. 48—50.
1841. — — — Pal. Foss., p. 123, pl. li, fig. 237.

Description.—"General figure planorbiform, discoidally involute, the inner whorls exposed; surface not distinctly traceable in this specimen; section of each whorl elliptical and slightly emarginate internally; septa with linguiform lateral inflexions. Siphuncle?

"*Locality.*—Newton Bushel (?)"—*Phillips.*

[1] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 342, pl. xxvi, figs. 6, 6 *a*.

[2] 1866, F. A. Röm., 'Beitr.,' pt. 5, p. 9, pl. xxxiv, figs. 9 *a*—*e*.

Remarks.—I have not seen Phillips's figured example of this shell, nor have I met with any other Goniatites that could be referred to it; I can therefore only reproduce his description, observing that he appears to be in some doubt of the proper locality of his fossil.

Judging from the figure, it would appear to belong to Beyrich's group Æquales.

Sub-order.—NAUTILOIDEA.

I. *Family*.—Nautilidæ.

1. *Genus*.—Temnocheilus, *M'Coy*, 1844.

This sub-genus of *Nautilus* is defined by M'Coy as discoid, involute, umbilicate; a deep sinus in the middle of the upper lip; septa simple; siphuncle central. It is further defined by Meek and Worthen as having a trapezoidal section, a very broad back, and a tuberculated elbow. The suture-line is said to have a broad outer lobe, and the siphuncle to be central or external. It extends from the Devonian to the Trias.

It differs from *Hercoceras* by its uncontracted aperture, from *Gyroceras* by its united whorls, from *Nautilus* proper by the sinus on the lip, and by its trapezoidal and generally tuberculated whorls.

Mr. Foord informs me that he refers *Nautilus subtuberculatus*, Sandberger, to this genus; and the species described below evidently belongs to the same genus as that shell, although in it the tubercles are absent.

1. Temnocheilus inornatus, *Whidborne*. Pl. VII, figs. 3, 3 *a*.

1889. Hercoceras inornatum, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell large, nearly, if not quite, equilateral, hardly involute. Umbilicus very wide, with the inner whorls wholly exposed. Sides of the whorl rising from the back of the inner whorls slightly outside their highest lateral point, thence continuing in a gentle curve upwards and slightly outwards, till the greatest height is nearly reached, when they arch round with an almost semicircular curvature to the back, which is very broad and very slightly convex. Section of the whorls transversely oval, except that the inner margins are slightly depressed by the next whorl; the ratio of the diameters being as 3 : 5. Whorls increasing rapidly. Sutural line slightly concave laterally, roundly convex as it turns the angle of the sides, and again slightly concave on the back. Chambers fourteen in a whorl, very slightly convex at the highest lateral point. Body-chamber one half the whorl. Shell very thin, apparently of two layers, marked (near the mouth) with very fine and crowded concentric striæ, a few of which are more prominent than the rest. Mouth apparently bilobed, being somewhat excavate at the centre of the back.

Size.—100 mm. high, 80 mm. wide, 68 mm. deep.

Locality.—Wolborough. A single but very fine specimen in the Museum of Practical Geology in Jermyn Street.

Remarks.—This remarkable fossil is labelled Newton Bushel in the Jermyn-Street Collection, but it is not weathered in the peculiar manner of many of the other fossils from that locality, and therefore, whether it actually came from Wolborough Quarry or from some other locality in the neighbourhood is a matter of some uncertainty. The matrix is hard, shelly limestone, and the fossil is almost entirely decorticated, and is covered in places with patches of yellow ferruginous sand, thus differing considerably from the usual character of Wolborough deposits. As, however, the name Newton Bushel was formerly applied to all Wolborough fossils, the presumption is that it came from there. It is to be noted, however, that the name of the locality given by the label and the museum books is the sole evidence that it came from Newton.

Affinities.—The species appears to be very closely allied to *Nautilus subtuberculatus*, Sandberger,[1] agreeing with it in general shape and in the curvature of its chambers, but clearly distinguishable by the absence of tubercles, and by being comparatively deeper, with a less rapidly increasing spire, and without the slight ridge in the centre of the back seen in the German shell. That species has a small rounded tubercle on the lateral edge of every fourth chamber, and the ratio of the section of the whorls is 3 : 4, instead of, as in ours, 3 : 5. A fragment described by F. A. Römer[2] under this name differs from Sandberger's type in having no syphonal ridge on the back, and only a single tubercle, though it consists of nearly half a whorl. In its other features, however, it agrees with its type, and not with our shell.

Hercoceras mirum, Barr.,[3] is distinguishable by the presence of numerous horn-like lateral tubercles or spines, by the siphuncle being large and visible on the back of the cast, and by the greater width of the section of the whorls. On his

[1] 1851, Sandberger, 'Verst. Rhein. Nassau,' p. 133, pl. xii, fig. 3.

[2] 1860, F. A. Römer, 'Beitr.,' pt. 4, p. 158, pl. xxiv, figs. 5 *a*, *b*.

[3] 1865, Barrande, 'Syst. Sil. de Bohème,' vol. ii, p. 153, pl. xlii, figs. 1—8, and pl. cii, figs. 1—9, Ét. G.

later plate Barrande figures some large casts which present very little signs of tubercles, but show that the aperture was almost closed, and that the lip possessed two lateral sinuses corresponding in position to the spines, instead of having a single sinus on the back; and thus that it differs generically from the present species. He also gives a doubtful variety, *irregulare*,[1] which approaches the genus *Gyroceras* in having a slightly open spire.

II. *Family.*—Trochoceratidæ.

1. *Genus.*—Trochoceras, *Barrande,* 1848.

This genus was founded by Barrande for a group of the *Nautiloideæ*, which have oval or circular chambers loosely coiled in few volutions, which do not lie in one plane. As a rule the volutions are not contiguous, and the asymmetry is sometimes very considerable. The aperture is simple. The siphuncle is situated somewhere between the centre and the ventral margin, but not, as a rule, close to the margin. The shell is usually covered with transverse rings, inclining backwards, and crossed by finer spiral striations. It belongs to the Upper Silurian and Devonian formations.

Under this genus I have classed two groups of shells, neither of which can be regarded as certainly belonging to it, but which at the same time appear to agree better with its characters than with those of any other genus. In both the asymmetry is very small, but both have decided affinities to Bohemian shells placed by Barrande under this genus. The first group consists of a single English Devonian species, *Tr. Foordianum*, and may be classed with *Tr. arduense* (Stein.), *Tr. interstriale,* Barr., and *Lituites cornu-arietis*, var., Portlock, (not Murchison). These species agree in the character of both major and minor ornamentation. The second group contains four (or perhaps five) Devonshire forms, *Tr. Vicarii*, *Tr. pulcherrimum*, *Tr. obliquatum* (Phil.), and *Tr. reticulatum* (Phil.), besides several Continental, as *Tr. multistriatum* (F. Röm.), *Tr. tenuisquamatum* (Sandb.), and *Tr. nodosum,* Barr. These form a very definite and compact group, having many points in common, as, for instance, the character of the major and minor ornamentation, the slight asymmetry, the squarish shape of the section of the whorls, and the position of the siphuncle about half way between the centre and the circumference. Whether they should be regarded as a sub-genus of *Trochoceras* or of *Gyroceras* is not very certain. Barrande included the Bohemian species under the genus *Trochoceras*, but Mr. Foord is more inclined to regard them as belonging to *Gyroceras;* and this is supported by the fact, that, as we

[1] 1865, Barrande, 'Syst. Sil. de Bohème,' vol. ii, p. 153, pl. xliii, figs. 1—7, Ét. G.

shall see, there is a slight asymmetry discernible in some species of that genus. Nevertheless, they agree so nearly with *Trochoceras* in so many details of shape, siphuncle, and surface-marks, that I much hesitate to separate them for the one single difference of the amount of asymmetry.

I. *Group of Tr. arduense.*

1. Trochoceras Foordianum, n. sp. Pl. IX, figs. 9, 9 *a*.

Description.—Shell small, slightly asymmetrical, coiled elliptically in about three volutions, which appear contiguous but not inclusive. Surface bearing strong, steep transverse ridges, arching gracefully backwards from the dorsal to the ventral side, meeting in a blunt angle upon the back, and separated by concave surfaces. Traces of numerous fine spiral lineations crossing the transverse markings.

Size.—The coiled shell is 26 mm. in length, and 20 mm. in width.

Locality.—Wolborough. A single specimen is in Mr. Vicary's Collection.

Remarks.—This interesting fossil is, unfortunately, in a very bad state of preservation, and therefore neither its internal nor its external characters can be properly made out, though its general nature is sufficiently clear. The appearance of strong, sharp, and regular lineations crossing the ridges is just sufficiently distinct to show that they are not accidental marks. The ribs appear to meet in a loop behind, but this may be intensified by the crushing of the shell. The asymmetry is very slight, but is not, I think, wholly due to the effects of fossilization.

The termination is absent, and on the supposition that the body-whorl might have been more or less perpendicularly produced, Mr. Roberts and I were at first inclined to regard it as possibly belonging to the genus *Lituites*, but upon showing it to Dr. Kayser and M. Tschernyschew, these gentlemen suggested its comparison with *Trochoceras arduense* (Steininger)[1] which comes from the Lower Beds at Nuremberg, which Steininger calls Llandeilo Flags.

Salter in his examination of Mr. Vicary's Collection appears to have been much struck with the specimen, and he attached a label to it, "*Cyrtoceras*, new species, quite new." To this genus, however, it certainly does not belong. There is not a close resemblance in general aspect to *Lituites* or *Ophidioceras*, and no reason to suppose that it agreed with them in the character of its body-whorl and mouth. On the other hand, both in its asymmetry and in the style of its surface-markings, it agrees very closely with *Trochoceras*, and in this genus, I believe, it must be

[1] 1853, Steininger, 'Geogn. Beschr. Eifel,' p. 41, pl. i, fig. 1.

located, although from the number and contiguity of the whorls it must be regarded as an aberrant form.

Affinities.—To *Tr. arduense* (Stein.) it evidently is closely allied, but on comparing it with Steininger's original figure it is seen to be separable from it, as the curvature is greater, and the number of ribs very much less. *Tr. interstriale*, Barr.,[1] seems to come much nearer, and has longitudinal markings like those indicated in our shell. It differs, however, in being a stouter shell with a circular coil and rather more numerous ribs. *Tr. placidum*, Barr.,[2] and *Tr. trochoides*, Barr.,[3] are still stouter and much more asymmetrical, and these also want the elliptical coiling. All the other Bohemian species which at all approach it are clearly distinguished by the much greater number of the ribs, besides other differences. The figure which Portlock[4] gives of *Lituites cornu-arietis* (var.), Murchison,[5] has much closer ridges, has secondary striæ, and is larger and much flatter. There appears, however, a generic identity, and it is stated by Blake[6] to be undoubtedly a *Trochoceras*.

The Bohemian species of *Lituites* and *Ophidioceras* are all totally different, and prove that our Devonian shell belongs to neither of these genera. *Ophidioceras articulatum* (Sowerby)[7] has a circular and not elliptical spire, and direct ribs with only a slight backward direction towards the outside. That genus appears characterised by a ventral band, of which there is no trace in the present fossil.

II. *Group of Tr. obliquatum.*

Spire loosely coiled, of few whorls, not contiguous. Section sub-quadrate, broadest ventrically. Siphuncle situated on the ventral side between the centre and the ventral margin, generally midway between them. Chambers rather broad. Whorls with parallel transversely oblique ridges, often becoming nodes on the ventral elbow; surface ornamented with a fine network formed by numerous small longitudinal ridges crossed by finer transverse lines.

1 1865, Barrande, 'Syst. Sil. Bohèm.,' vol. ii, p. 107, pl. xv, figs. 1—7, Ét. E.

2 Ibid., p. 112, pl. xxiii, figs. 1—4, Ét. E.

3 Ibid, p. 116, pl. xxix, figs. 16—26, Ét. E.

4 1843, Portlock, 'Rep. Geol. Londonderry,' p. 383, pl. xxviii B, fig. 7.

5 1830, Sowerby in Murchison's 'Sil. Syst.,' p. 643, pl. xx, fig. 20.

6 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 217, pl. xxi, fig. 6, and pl. xxviii, fig. 5.

7 1830, Sowerby in Murchison's 'Sil. Syst.,' p. 622, pl. xi, fig. 5, and 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 230, pl. xviii, figs. 14, 15.

2. Trochoceras Vicarii, *Whidborne*, sp. Pl. IX, figs. 1, 1 *a*, 1 *b*.

? ? 1844. Cyrtoceratites multistriatus, *F. Römer*. Rhein. Übergangsg., p. 81, pl. vi, figs. 3 *a*, *b*.
1889. Cyrtoceras Vicarii, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell medium-sized, very rapidly increasing, coiled in a little more than a volution, leaving a wide, open, elliptic central space. Section nearly circular, becoming subquadrate on the body-whorl. Chambers apparently rather narrow; surface ornamented with very numerous, fine, sharp, longitudinal striæ, which seem imbricated by much more numerous indistinct transverse striæ, and bearing on the side, just below the shoulder, a row of very distant large bluntly conical nodules, which are elongated longitudinally, and point outwards, from which very indistinct bulges cross the sides, tending rather forwards, and becoming rather more prominent as they turn inwards to the dorsal side, where they probably vanish. Apex very small.

Size.—Length, 63 mm.; width, 51 mm.; depth, about 30 mm.

Locality.—Wolborough. A single specimen is in Mr. Vicary's Collection.

Remarks.—Mr. Roberts and I have come to the conclusion that this specimen must be separated from the succeeding species, chiefly on account of the position and fewness of its lateral tubercles. At the same time it is evidently very closely allied to several of the adjacent forms.

It comes so close to *Cyrtoceratites multistriatus*, F. Röm.,[1] that I am in a little doubt whether it may not prove ultimately to be only a variety of that shell. The nodes, however, in the English form are fewer, being only four where the German fossil has seven; and the longitudinal striæ do not seem so numerous, and are, moreover, crossed by much more frequent, though indistinct, transverse striæ. There are no marks corresponding to these transverse lineations in Römer's figures, but it is possible that they may have been overlooked if his specimens were not well preserved, as they can only be observed with difficulty in ours.

The shell described by Barrande under the name *Trochoceras nodosum*[2] evidently belongs to the same group, agreeing in a general way in the possession of nodes, the fine ornamentation, the slight asymmetry, the sub-quadrilateral section, and the position of the siphuncle. While, however, there is clearly a generic identity between the two shells, there is as clearly a specific difference. The spire of the

[1] 1844, F. Röm., 'Rhein. Übergangsgebirges,' p. 81, pl. vi, figs. 3 *a*, *b*.

[2] 1865, Barrande, 'Syst. Sil. Bohême,' vol. ii, p. 110, pl. xx, figs. 18—23, and pl. xxv, figs. 7—18, Ét. E.

Bohemian shell is much more closely coiled, and increases much less rapidly, and the transverse striæ are much more numerous and smaller than are the longitudinal.

3. Trochoceras pulcherrimum, *Whidborne*, sp. Pl. IX, figs. 2—4.

1889. Cyrtoceras pulcherrimum, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell medium-sized, highly ornamented, very much recurved so as to form nearly, if not fully, a volution; tapering slowly. Back and sides slightly convex, meeting in a blunt angle at the elbow, which is ornamented with a row of numerous rounded nodes, set transversely, and continued in an indistinct bulge on the back and sides. Surface, including nodes, covered by a fine network of numerous longitudinal and transverse lines, of which the longitudinal are the strongest, and the transverse rather the most numerous. Chambers rather broad.

Size.—The state of the specimens does not permit accurate measurements.

Localities.—There is a specimen from Lummaton in my Collection, and another probably from the same place in the Battersby Collection in the Torquay Museum. In Mr. Vicary's Collection is a specimen from Wolborough.

Remarks.—All these specimens are fragmentary, but they appear to belong to a sufficiently distinct form, which is defined by the row of numerous transversely-elongate nodes. It thus is intermediate between *Tr. Vicarii*, in which these nodes are much fewer and more erect, and are set longitudinally, and *Tr. obliquatum* and *Tr. reticulatum*, in which the more or less prominent and numerous transverse ridges show little or no signs of carrying any nodes.

4. Trochoceras obliquatum, *Phillips*, sp. Pl. IX, figs. 5, 5 *a*, 5 *b*, 6, 6 *a*.

1841. Cyrtoceras obliquatum, *Phil.* Pal. Foss., p. 115, pl. xlv, fig. 218.
1841. — nodosum, *Phil.* (not *Bronn*). Ibid., p. 116, pl. xlvi, fig. 221.
1844. Gyroceras cancellatum, *F. Römer.* Rhein. Übergangsg., p. 80, pl. vi, figs. 4 *a*—*c*.
1852. — — *Sandb.* Verst. Rhein. Nassau, p. 138, pl. xiii, figs. 2, 2 *a*.
1852. — quadrato-clathratum, *Sandb.* Ibid., p. 138, pl. xv, figs. 6, 6 *a*.
1888. — obliquatum, *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.
1888. — nodosum, — Ibid., vol. i, Pal., p. 167.

Description.—Shell medium-sized, much recurved, rapidly tapering, asymmetrical. Height, upon a chord of 25 mm., subtending the concave side, 10 mm. Section irregularly circular, the ventro-dorsal being as great as the transverse diameter, and the longest diameter being in an oblique direction. Siphuncle central near the apex, tending outwards half way towards ventral margin in the upper chambers. Chambers rather broad, very concave. Surface covered with numerous fine, rounded threads, about 1 mm. apart, which are crossed and interwoven with more numerous similar transverse striæ, forming a fine network. Shell encircled by large, but low, rounded, distant bulgings, which are visible dorsally, but are more prominent on the ventral elbow, and rather less so on the back.

Size.—Phillips's original specimen, which is about half a volution, measures 63 mm. in length, and about 30 mm. in the longest diameter of its widest end.

Locality.—Wolborough. There are five specimens in the Godwin-Austen Collection in the Museum of Practical Geology, three small specimens in the Torquay Museum, and one in the British Museum.

Remarks.—The material for defining this species is quite unsatisfactory. Phillips's original type is much injured and obscured by matrix, and none of the other specimens supply its defects, as for the most part they belong to the apical region or the immature shell. In one, which is evidently a young shell and retains the body-whorl, the apex is almost sharp, the contour of the ventral side a quarter circle, and the siphuncle central. In the larger specimens, the siphuncle, where seen, is midway between the centre and the margin.

The specimen in the British Museum is Phillips's figured type of *C. nodosum*, Bronn. I examined it carefully in company with Mr. Foord, and came to the conclusion that it evidently is a member of the group of shells to which *Tr. pulcherrimum*, *Tr. Vicarii*, *Tr. obliquatum*, Phil., sp., and *Tr. reticulatum*, Phil., sp., belong; and that it is in all probability identical with the present species. The specimen is an obliquely crushed shell, with a decayed surface, and with very few distinctive marks. The chambers are moderately narrow. The siphuncle appears to be ventrally subcentral. Phillips's figure gives a very misleading impression of it; the transverse marks are really far less prominent than there shown, and, especially when viewed in profile, they appear to be similar to those of the present shell. As far too as can be judged in its crushed state, it seems to agree with it in outline. Phillips identifies his *C. nodosum* with *Spirula nodosa*, Bronn.[1] This, however, distinctly differs in the transverse ridges being much fewer, straighter, and more horizontal, the section much more transverse, and the siphuncle marginal. *Hortolus convolvens*, Steininger (not Montfort),[2] is a synonym of Bronn's shell.

[1] 1835, Bronn, 'Lethæa Geogn.,' vol. i, p. 102, pl. i, fig. 4; and 1851, F. Römer in Bronn's 'Lethæa Geogn.,' 2nd edit., vol. i, p. 491, pl. i, fig. 4.

[2] 1834, Steininger (not Schlotheim), 'Mém. Soc. Géol. Fr.,' vol. i, pt. 2, p. 370, pl. xxiii, fig. 3.

Affinities.—*Tr. reticulatum*, Phillips, sp., differs in its flattened back and sides, and in the closeness of its wave-like markings, which are twice as numerous. *Tr. pulcherrimum* has distinct nodes upon the shoulder; and in *Tr. Vicarii* the back is more convex, and the ridges are fewer, and bear nodes which are elongated longitudinally.

Sandberger distinguishes, by a minute description of the external ornamentation, between three nearly allied forms. It appears to me that the differences mentioned in two of these, *C. cancellatum*, F. Römer,[1] and *G. quadrato-clathratum*, Sandberger,[2] are due only to the results of fossilization, and that it is also from the same causes that they appear to differ from the present species. We find in English examples of this group of shells considerable variation due to this cause. The transverse striæ are sometimes obliterated, sometimes they form regular hollow tesseræ, and sometimes the crossing of the markings "knot" the corners. It appears hence that we have in our English form both the kinds of markings described in the two German fragments; and the form of the coil, the number and prominence of the ridges, and the coarseness of the striation seem to be much the same in all three. Possibly Sandberger's shell has rather fewer cross striæ, as they do not seem more numerous than the longitudinal series. It is to be noted that the enlarged patterns of ornamentation given by Phillips give the impression of closely arranged beads rather than of distant crossing lines, and hence it would be little likely that the foreign authors would recognise the shell. The distinctions, moreover, which F. Römer draws between his *C. cancellatum* and the present shell seem due to the imperfections of Phillips's figure, in which the longitudinal lines are represented as fewer and more rounded, and the rate of tapering greater, than is really the case in his figured specimen. Sandberger's third species, *G. tenuisquamatum*,[3] is distinguished by its much finer and more numerous striations, and apparently by the almost entire absence of swellings upon the shoulders.

The fragments which Portlock[4] identifies with this species are clearly shown by his figure of the enlarged sculpture not to belong to it.

The Bohemian species which is most approximate is *Tr. trochoides*,[5] Barrande, which has a circular section and apparently coarser ornamentation, and has stronger and straighter transverse bulges, which slope obliquely backwards across the sides and back, without vanishing in either direction.

[1] 1844, F. Römer, 'Rhein. Übergangsg.,' p. 81, pl. vi, figs. 4 *a*—*c*.

[2] 1852, Sandberger, 'Verst. Rhein. Nassau,' p. 138, pl. xv, fig. 6.

[3] Ibid., p. 138, pl. xv, fig. 7.

[4] 1843, Portlock, 'Geol. Rep. Londonderry,' p. 384, pl. xxviii B, figs. 5 *a*, *b*.

[5] 1865, Barrande, 'Syst. Sil. Bohème,' vol. ii, p. 116, pl. xxix, figs. 16—26, Ét. E.

5. TROCHOCERAS RETICULATUM, *Phillips*, sp. Pl. IX, figs. 7, 7 *a*, 7 *b*.

1841. CYRTOCERAS RETICULATUM, *Phil.* Pal. Foss., p. 117, pl. xlviii, fig. 224.
1888. — — *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.

Description.—Shell much arched. Whorls very slightly convex on the ventral face, bent round suddenly to the sides, which are flat and perpendicular to the back; ornamented with numerous, fine, regular, longitudinal threads, distant about 1 mm., and crossed and knotted by twice as numerous, similar, transverse threads, rather bent back in the centre of the back. Sides ornamented by very frequent, elongated, strong, undulating, transverse waves or rounded ridges, which are most marked on the elbow and almost gradually vanish as they slope back across the ventral region.

Size.—The specimen is too imperfect for measurement.

Locality.—Wolborough. A single specimen, which is Phillips's type, is in the Museum of Practical Geology.

Remarks.—This specimen is a mere fragment, and gives but little insight into the character of the species. Its markings are, however, well preserved, and in its flattened side and in the nature of the major ornamentation it appears to be quite distinguishable from the adjacent species. Mr. Foord supports me in regarding the frequency and elongate character of these markings as sufficient reason for regarding it as in all likelihood distinct. Phillips's figure fairly represents it, save that the lines on the back of the fossil are much more obscure than he depicts them, and that the meshing of the enlarged surface is drawn very much too square.

Affinities.—The species which it most nearly approaches is *Tr. obliquatum*, Phillips, sp.

6. TROCHOCERAS, sp. Pl. IX, figs. 8, 8 *a*.

?1852. GYROCERAS, sp., *Sandberger.* Verst. Rhein., p. 139, pl. xiii, figs. 3, 3 *a*.

Remarks.—In Mr. Vicary's collection is a fragment of a Cephalopod which appears to belong to a species allied to *Tr. pulcherrimum.* It consists of about two chambers of an arching shell. The section is unsymmetrically sub-quadrate, and the ventro-dorsal diameter is less than the lateral diameter. At the ventral elbow are distant nodes slightly produced longitudinally, and about five-fourths times as numerous as the chambers. The walls of the chambers are very concave. The siphuncle is near the centre on the ventral side, but is situated a little unsymmetrically. The chambers are broad. The external layer is entirely absent.

This fossil does not appear to agree with any of the other Cephalopods from these beds. The nodes are larger and more numerous than in *Tr. Vicarii,* and the dimensions are different from that shell and from *Tr. pulcherrimum.* It is almost exactly like the *Gyroceras*, sp., figured by Sandberger (pl. xiii, fig. 3), though the back is more arched, and consequently the section is more rounded. At first sight I was inclined to refer it to *Orthoceras arcuatum,* Steininger,[1] as described from South Petherwyn by Phillips under the name of *Cyrtoceras rusticum,*[2] but this resemblance is only due to the two fossils being in a similar state of preservation. The chambers in the latter shell are much closer, the nodes fewer, and the siphuncle marginal. In fact, it belongs not only to a different species but to a different genus. A comparison with one of the specimens of *Tr. pulcherrimum* (fig. 4 *a*), which has the under layer of test exposed, enables us to imagine the character of the ornamentation, but the fragment is too imperfect to admit of specific description and determination.

Locality.—Wolborough.

III. *Family.*—CYRTOCERATIDÆ.

1. *Genus.*—GYROCERAS, *De Koninck*, 1844.

This genus is formed for Nautiloid shells whose chambers are bent into a spiral of one or two volutions, which lie in one plane, and are often discontiguous. It is distinguished from *Cyrtoceras* by the shell forming a distinct spiral and not simply an arch. From *Trochoceras* it is separated by the spire being in one plane. From *Lituites*, *Nautilus*, *Hercoceras*, &c., it is differentiated by its coils being loose and rapid. Its aperture is simple and sometimes lobed.

It will be seen in the following descriptions that these generic characters of *Gyroceras* fail sometimes at least in one respect. We find that many of the species are not actually symmetrical, though the deviation from the plane of symmetry is so slight as to have been unobserved. Such is the case with *G. ornatum* (Goldf.) itself; and this would point to *Gyroceras* being allied to *Trochoceras* rather than to *Nautilus.* A similar slight asymmetry is also to be noticed in certain species of *Cyrtoceras.* Thus portions of these three genera, *Cyrtoceras*, *Gyroceras*, and *Trochoceras,* are principally divided by the amount of curvature of the spire, a feature which is of little anatomical value.

Gyroceras is represented in the Silurian, Devonian, and Carboniferous formations.

[1] 1834, Steininger, 'Mém. Soc. Géol. Fr.,' vol. i, pt. 2, p. 396, pl. xxii, fig. 6.

[2] 1841, Phillips, 'Pal. Foss.,' p. 116, pl. xlvi, fig. 222.

1. GYROCERAS PRÆCLARUM, *Whidborne*, sp. Pl. VIII, figs. 1—3.

1841. CYRTOCERAS ORNATUM, *Phil.* (not *Goldfuss*). Pal. Foss., p. 115, pl. xlv, fig. 217.
1888. — — *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.
1889. — PRÆCLARUM, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell large, highly ornamented, tapering slowly, loosely coiled in an open elliptic spire of at least $1\frac{1}{2}$ volutions, of which only about one-third of the ventral side of the volution near the apex is in contact with the dorsal side of the external whorl. Spire somewhat unsymmetrical, but sunk much below the summit of the outer whorl. Section irregularly elliptic, being obliquely flattened on the ventral and dorsal aspects. Ratio of the ventro-dorsal to the lateral diameter as 2 : 3 or as 3 : 4; these axes being set rather obliquely to the plane of the whorls, and changing their direction from side to side with the growth of the shell. Apex spheroidal, rather swollen dorsally. Chambers shallow, concave. Siphuncle situated close to the ventral margin. Surface ornamented with thirty or forty low, rounded, small, and distant longitudinal ribs, sometimes with a smaller alternating series between them, which are crossed obliquely by very numerous close fine threads, and by a few rather distant prominent ridges or bulges, which rise on the lateral parts of the dorsal surface, cross the whorls rather obliquely, and are deeply but irregularly arched back over the syphonal area; these ridges forming in the apical portions (or in the younger shell) almost smooth folds, posteriorly sloping, anteriorly steep; but, as the shell grows, becoming more and more nodulous on the ribs, till in the aged shell they are occasionally developed into coarsely membranaceous horns or peaks on the sides of the whorls, which are represented in the cast by large transverse nodes.

Size.—The portion of the aged shell figured by Phillips measures 93 mm. in length, 35 mm. in ventro-dorsal, and 50 mm. in transverse diameter at the larger end. The young but nearly perfect specimen in the Museum of Practical Geology measures 50 mm. in length, 30 mm. in width of the spire, and about 25 mm. in depth; and Mr. Vicary's aged, almost perfect shell measures 77 mm. in length, 82 mm. in width of spire, and 48 mm. in depth.

Locality.—Wolborough. Phillips's original specimen, and a similar but smaller fragment, as well as a young but very perfect example, are in the Museum of Practical Geology; and there are seven other specimens in Mr. Vicary's Collection, two of which are almost perfect from apex to body-chamber, though they have for the most part lost their outer test.

Remarks.—Phillips's figure is a not very successful representation of a fine and aged shell, which from its shape and the position of the matrix, is peculiarly difficult to delineate. The shell itself has a rather less curvature, and has a less rugged appearance than is indicated in the drawing, and the interspaces of the longitudinal ribs do not possess the five or six coarse bands which are there represented between the main transverse ridges. It would indeed be almost impossible to recognise the species from this figure, and it was only by a careful comparison of the different specimens that I discovered that they all belonged to the same shell. Indeed, for a long time I imagined the youngest and most perfect specimen to be a distinct form; and as such I described it in a paper read at the Bath meeting of the British Association in 1888, taking for granted at that time the correctness of Phillips's identification of his fossil with the *Cyrtoceras ornatum* of Goldfuss. However, on comparing the English specimens of *G. ornatum* (Phill.) with the German examples of *G. ornatum* (Goldf.)[1] and *G. Eifelense* (d'Arch. and de Vern.)[2] in the British Museum in company with Mr. Foord, we came to the conclusion that it was clearly distinct from both these shells. It is coiled elliptically instead of in a circle; it tapers much more rapidly than the former, and much less rapidly than the latter; its ornamentation is of a different character, and it is much less symmetrical than either. It then occurred to me that the shell I had described as *C. præclarum*, although totally different from Goldfuss's shell, had much the same character as these other English specimens, and ought probably to be united with them; and upon consulting Mr. Foord he confirmed my impression of their identity. Its ornamentation is neater and more regular than that of the others, but this is at once accounted for by its youth and its better state of preservation. We also found that the two large and complete specimens in Mr. Vicary's collection clearly belonged to the same species. Hence we have arrived at the true shape of Phillips's shell, and this finally confirms its distinctness from the German species, which are of a very different habit of growth.

The question of its nomenclature next comes before us. Phillips and the French authors both quote Goldfuss's MS. name. In this Phillips has the priority, but his identification was formally uncertain, and was only made upon the authority of de Verneuil, who had seen his fossil. It appears, therefore, that the foreign authors must be considered to be the authoritative exponents of Goldfuss's species, and that therefore either Phillips's MS. name *C. foliaceum* must be taken for our species, or a new name sought for it. As, therefore, I have given a short description of a shell of this species under the name of *C. preclarum* it seems better to retain this than to sink it in order to revive a manuscript name which Phillips had himself discarded.

The change in the ornamentation with its growth is very great; indeed, so much

[1] Manuscript name in Bonn Museum.

[2] 1842, D'Arch and de Vern., 'Geol. Trans.,' ser 2, vol. vi, p. 349, pl. xxxi, figs. 2, 2 *a*, *b*.

so that it is difficult to recognise the species from fragments without the help of the perfect shell. At first the markings are fine, and there are no nodes; but, as it grows, the surface-ornament becomes coarse, and the nodes appear even on the under shell. These again become less conspicuous near the aperture of the mature shell. The character of the coiling is peculiar, the tangent planes of the opposite ventral areas being oblique but parallel, so that the coil looks distorted. This appearance is not, I believe, induced by compression, but is natural.

Affinities.—It is distinguished from *G. tredecimale* by its greater asymmetry and by the number of its longitudinal ribs, and from the other Devonshire species by the obliquity of its transverse ridges.

G. paucinodum, Hall,[1] is a narrower shell, with a circular spire in which the whorls never touch. Its nodes are fewer, and it has no signs of any minor ornamentation.

2. Gyroceras asymmetricum, n. sp. Pl. VIII, figs. 4, 4 *a*.

Description.—Shell large, highly ornamented, tapering rather slowly. Sections irregularly circular or elliptic in different parts. Rate of tapering about 2 in 5. Coil of spire apparently rising above the plane of the whorls. Surface marked with few prominent, low, rounded, longitudinal ribs, which become smaller and much closer on the dorsal side, and slightly alternate; the alternating rib upon the centre of the ventral area and those on the two shoulders being obsolete and so giving rise to a central and two lateral flat surfaces. Ribs nodulated by very distant oblique transverse ridges, which do not appear to be foliaceous.

Size of fragmentary specimen 77 mm. long, and 35 mm. in greatest diameter of the chamber.

Locality.—Wolborough. Two specimens are in Mr. Vicary's Collection, one of which is very fine, though only a fragment.

Remarks.—For a long time I considered this to be a specimen of *G. ornatum*, Phillips (not Goldfuss); but when the latter species became better known to me it became apparent that the present fossil differed considerably from it. The transverse ridges are much more distant and oblique, and they do not appear to have such a tendency to become foliaceous; the shell also appears to taper somewhat more rapidly, and the coil seems to be more spirally elevated. The section also is more evenly rounded at the sides. Until, however, more perfect specimens are known, it will not be possible to give its full characters, and hence it is possible that some unexpected relationship may be discovered.

[1] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 380, pl. liv, figs. 1—4.

3. Gyroceras ornatum, *Goldf. MS.*, sp. Pl. VIII a, figs. 1, 1 *a*.

.	Cyrtoceratites ornatus, *Goldfuss MS.*	Bonn Museum.
1842.	— — *D'Arch.* and *de Vern.* (not *Phillips*).	Geol. Trans., ser. 2, vol. vi, p. 349, pl. xxviii, figs. 5, 5 *a*, *b*.
1853.	Lituites ornatus, *Steininger*.	Geogn. Besch. Eifel, p. 42.
1865 ?	Gyroceras nudum, *Barrande*.	Syst. Sil. Bohème, vol. ii, p. 165, pl. xliii, figs. 8—12, Ét. G.
1889.	Cyrtoceras majesticum, *Whidborne*.	Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell large, much recurved, consisting of about one and a half volutions. Volutions slightly spiral, free. Apex apparently blunt. Apical portion touching but not indenting the outer whorl, the portion near the body-chamber becoming straighter, separated, and distant from the interior whorl. Section of whorls a regular depressed oval, narrowed laterally, the transverse diameter being to the ventro-dorsal diameter in the ratio of 23 : 15. Shell increasing very slowly. Siphuncle moderately large, circular, not inflated, situated close to the centre of the ventral margin. Septa very narrow, about twenty-eight to a volution, very concave. Sutural line slightly advancing from the dorsal region to the elbow, over which it passes in a shallow saddle, and then, after a very shallow lobe on each side of the back, forms another slight sinus over the siphuncle. Ventral surface showing indistinct signs on the cast of parallel lineations (about seventeen or eighteen). Shell apparently very thin.

Size.—Length, 145 mm.; width, 113 mm.; depth, 71 mm. Width of section at or near the apex, 14 mm.; height, 10 mm.

Locality.—A single specimen in the Godwin-Austen Collection in the Museum of Practical Geology is said to be from Newton, but it evidently is not an English specimen.

Remarks.—This fine specimen bears the name of Newton Bushel upon its label in the Museum, but the matrix is most unusual for that place, being of a coarse and rather crumbly nature, tinged with yellow, tending towards an oolitic structure, and showing occasionally ferruginous deposits on its surface. The surface has almost entirely disappeared, but there are upon it one or two small patches of Alveolites or some kindred Zoophytes. The body-chamber is entirely absent, but apparently it must have been hardly recurved in that portion. The apical surface is gone, but evidently closed immediately over the last chamber present. The ornamentation appears to have been in the form of low longitudinal threads, but the indications of it are too indistinct to be displayed by the draughtsman on the figure.

The spiral is not quite symmetrical, the central plane dividing the shell unequally, and though the shell has been broken in the extraction, and then mended, it would seem that this feature has been rather obscured than emphasised by that operation, the effort of the manipulator having naturally been to restore the fossil to a supposed uniformity.

In the 'Geol. Mag.' of January, 1889, I described this shell under the name of *Cyrtoceras majesticum.* At that time I had not discovered that the *C. ornatum* of Phillips was distinct from that of d'Archiac and de Verneuil, and it was clear that the present species was different from the English specimens of the former shell, that accompanied it. Subsequently, however, a closer examination has convinced me that de Verneuil's identification of Phillips's specimen with the German species was incorrect; and, moreover, a comparison of the German specimens in the British Museum with the present fossil have proved that it is really only the cast of a very large example of that shell. Unlike some of the adjacent species, the large nodes of the outer shell are not reproduced upon the cast. In its measurements, rate of tapering, and character of coiling it almost exactly agrees with the figure 5 *b* of d'Archiac and de Verneuil, and there is no reason to doubt its identity. Added to this the matrix agrees closely in character with that of the German specimens in the British Museum, and Mr. Etheridge and others agree with me that there is every reason to suppose that it must have been a foreign specimen placed by Mr. Godwin-Austen with his Devonshire specimens for reference, and that so it accidentally became incorporated in his Wolborough Collection. As this specimen is the only evidence of the true *G. ornatum,* Goldf., from these localities, it appears that the name must be removed from the present list. The plate, however, was drawn before I had arrived at this conclusion, and I have therefore inserted it, as it will be useful for comparison, especially as the figures given by the foreign authors are of fragmentary shells. Mr. Foord informs me, however, that the present species occurs at Mudstone Bay, and is represented in the British Museum by specimens from that locality which show its characteristic ornamentation. There is also a large series of German specimens in the British Museum, some of which are still finer than this figured one, and show more definite indications of tubercles.

Gyroceras nudum, Barrande, presents much similarity to this species, to which it may belong. In two of his figured specimens, however, the spire seems more completely coiled, and at the orifice (which I have not observed in the German shells) are two small lateral protuberances. The surface of the shell is not given, so that it is impossible to judge whether there may be a specific difference in ornamentation. In *G. alatum,* Barrande,[1] the whorls are entirely discontiguous, and much more rapidly increasing.

G. validum, Hall,[2] has much narrower septa.

[1] 1865, Barrande, 'Syst. Sil. Bohème,' vol. ii, p. 162, pl. xliv, figs. 8—18, and pl. ciii, figs. 15—20, Ét. F.

[2] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 385, pl. xlix, fig. 2, and pl. c, fig. 1.

4. Gyroceras tredecimale, *Phillips*, sp. Pl. X, figs. 5—7.

1841. Cyrtoceras tredecimale, *Phil.* Pal. Foss., p. 114, pl. xliv, fig. 215.
1888. — — *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.

Description.—Shell large, highly ornamented, and slightly inequilateral; moderately arched, the height upon a chord of 30 mm., subtending the concave side, being 5 mm.; much flattened, the ratio of the ventro-dorsal to the transverse diameter being 7 : 10; and rapidly expanding, the sides tending from each other at an angle of about 30°. Siphuncle situated close to the centre of the ventral margin. Chambers very concave. Surface ornamented with about thirteen prominent, distant, rounded ribs, divided by flat or slightly concave interspaces, of which that over the ventral or siphuncular area is much wider than the rest. Surface crossed at regular intervals by very distant, transverse ridges, which become tuberculous, and in the old shell even foliaceous, upon the ribs; and, between these ridges, marked, in the younger shell, with three or four distant membranaceous threads, which are deeply and regularly convex towards the apex, and, in the older shell, with crowded, coarse, convex striæ, or growth-lines. Shell-structure very thin except on the ribs. Section oval, regularly keeled or crowned by the ribs.

Apex small, recurved, with circular section, the two or three last transverse ridges being reduced to mere threads, between which are seen numerous, unarched and irregular growth-striæ, very similar to those visible in the full-grown shell; termination hemispherical.

Size.—Phillips's figured specimen measures 67 mm. in length, and 22 mm. in ventro-dorsal and 34 mm. in lateral diameter near the mouth.

Localities.—Wolborough and Lummaton. There are three specimens, including Phillips's type, in the Museum of Practical Geology, three specimens in the Battersby Collection of the Torquay Museum, and a large but poor fragment in my own Collection. There is also a specimen of the apical termination in the Museum of Practical Geology, and another in my Collection.

Remarks.—This is a beautiful and easily determined species, and has been well figured by Phillips from the finest specimen I know, although his figures are slightly larger than the original shell, and slightly out of true proportion. One of the specimens in the Torquay Museum is the top part of a much larger shell, and in that the character of the ornamentation has considerably changed, the nodular crossings of the ribs and ridges have become elongate membranaceous horns, and the whole surface is crossed by crowded growth-lines. It is to be noticed that faint indications of these growth-lines are visible in Phillips's type, though they are too slight for delineation; while on its dorsal side the distant thread-like loops have entirely disappeared, and therefore his figure is quite incorrect in showing them there.

The small specimen of the apical termination, which I obtained from Lummaton, long caused me considerable perplexity, but a rather larger though more decayed specimen in the Museum of Practical Geology from Wolborough proves that it belongs to the present form, and that the section, which is at first circular, becomes elliptic at a very short distance from the apical end. The rugged growth-lines in this part are remarkable, as they seem to vanish, as we have seen, in the median portions, and only to reappear when the shell becomes aged. I cannot, however, from the paucity of the material before me, say how far this is a general rule, or only the accidental character of a single specimen.

As far as can be judged from our material the species does not seem very variable, excepting that the ribs are not always accurately thirteen even in the type-specimen. Thus the specific name is liable to criticism.

Affinities.—*C. acuticostatum*, Sandberger,[1] is so like the apical portion of this species in its markings that in my earlier lists I referred the small Lummaton specimen, above mentioned, to it. It seems, however, to taper less rapidly than the present form. Very possibly it may be the terminal coil of a *Gyroceras* instead of a complete *Cyrtoceras*, and in that case may be identical with some unexpected species. *Gyroceras spinosum*, Hall,[2] has an almost circular section, and no longitudinal ribs. *Gyroceras cyclops*, Hall,[3] besides the difference in curvature, is distinguished by having low, close, rounded, longitudinal folds in place of the distant ribs which form so marked a feature of the English shell.

5. Gyroceras Eifelense, *D'Archiac* and *de Verneuil*, sp. Pl. X, figs. 8, 9, 9 *a*, 9 *b*.

? 1839. Cyrtocera tentaculata, *Münst.* Beitr., pt. 1, p. 34, pl. ii, figs. 2 *a*—*c*.
1842. Cyrtoceras Eifelense, *D'Arch.* and *de Vern.* Geol. Trans., ser. 2, vol. vi, pt. 2, p. 349, pl. xxxi, figs. 2, 2 *a*, *b*.
1852 ? Gyroceras costatum, *Sandberger.* Verst. Rhein. Nassau, p. 136, pl. xii, figs. 5 *a*—*d*.
1853. Lituites Eifliensis, *Steininger.* Geogn. Besch. Eifel, p. 42.

Description.—Shell flattened, much arched. Surface marked with thirty or forty distant, rounded, longitudinal ribs, separated by interspaces which are

[1] 1852 ? Sandberger, 'Verst. Rhein. Nassau,' p. 144, pl. xiii, figs. 5, 5 *a*.

[2] 1879, Hall, 'Pal. N. Y.,' p. 382, pl. xlvii, fig. 8; pl. xlviii, figs. 1—5; pl. xlix, fig. 1; pl. xcviii, figs. 1—7; and pl. xcix, figs. 1—8.

[3] Ibid., p. 287, pl. ci, fig. 1; pl. cii, fig. 1; pl. ciii, figs. 1, 2; and pl. civ, figs. 1, 2.

slightly convex, of which that over the siphuncular area is the broadest; the whole crossed by occasional transverse foliaceous ridges or flounces, presenting on each interspace a face convex towards the apex. Three or four smaller but similar transverse foliaceous threads between each of these major flounces.

Size.—A fragmentary specimen is about 28 mm. in ventro-dorsal, and 17 mm. in transverse diameter.

Locality.—Wolborough. There is a well-preserved fragment in the Museum of Practical Geology, and a larger but less distinct example in the Torquay Museum.

Remarks.—I have not been able to identify these specimens with any other Devonshire species. They evidently are very nearly allied to *G. tredecimale*, differing chiefly from it in the much larger number of ribs, especially on the dorsal side, the greater curvature of the shell, and the general fineness of the markings. In the extremely foliaceous character of the transverse ridges the species presents an approach to *C. fimbriatum*, Phillips, though definitely separated from it by their rarity and alternating size, and by the prominence of its longitudinal ribs. It is probable that all these major ridges were, both in this species and *G. tredecimale*, originally foliaceous, and that this feature is only obliterated by the accident of fossilization.

These fossils appear, as far as can be judged from the material at our command, to be the same as the shell described as *C. Eifelense* by d'Archiac and de Verneuil. This form is stated by its describers to be very similar to *G. tredecimale*, and indeed the distinctions which they draw between the two are not found to be constant even in the few specimens we have examined, and it is possible that the former may prove to be only a variety of Phillips's species, as hinted by them. At present, however, there is not sufficient evidence for uniting the two species. It would appear that the fourteen ribs on *G. Eifelense* were counted on the back of the shell, whereas the thirteen on *G. tredecimale* were counted all round. Hence the former is described as having much more numerous ribs. This and the difference in distance of the large transverse ridges are the separating features.

C. tentaculata, Münster,[1] from the Eifel appears to agree exactly with the casts of *G. Eifelense* in the British Museum. It is distinguished by the peculiar markings which Münster describes thereon. Though he figures the siphuncle as distinct from these, I am much inclined to believe that it is identical with them, and, therefore, to regard his species as the same as ours. It is to be noticed that it comes very near to the figure of *G. nautiloideum* (Phillips), with which indeed *G. Eifelense* was united by Mr. Foord, though he now agrees with me in regarding that shell as belonging to *G. ornatum* (Phillips).

Sandberger treats *G. ornatum* as only a variety of *G. Eifelense*, or, as he calls

[1] 1839, Münster, 'Beitr.,' pt. 1, p. 34, pl. ii, figs. 2 *a—c*.

it, *C. costatum*, giving a baseless priority to a manuscript name. There can, however, be no doubt of the distinctness of the two species, if from no other reason, from the very different rate of increase of the whorls, as may be seen in the fine series of each in the British Museum.

If *G. tentaculatum*, Münster sp., should prove identical, that name would of course have to supplant that of *G. Eifelense*, but I have not at present adopted it, as the question requires further elucidation before coming to an ultimate conclusion.

6. Gyroceras Crickii, n. sp. Pl. X, fig. 10.

Description.—Shell small, much arched, very rapidly increasing. Surface marked with about thirty distant, rounded, longitudinal ribs, separated by broad interspaces, that over the siphuncular area being slightly broader than the rest; the whole crossed by very numerous fine, regular, thread-like, transverse lines, which are convex to the apex upon the interspaces.

Size.—The fragment, which is about 31 mm. in length, measures 18 mm. in ventro-dorsal and 13 mm. in lateral diameter at its upper end.

Locality.—Wolborough. A single defective but beautifully preserved specimen of the chambered portion of the shell is in the Museum of Practical Geology.

Remarks.—I felt some doubt as to the way in which this beautiful little specimen should be treated, chiefly on account of its fragmentary condition. It appears, however, to me that even the small portion that remains of it proves that it must be distinct from either *G. Eifelense* or *G. tredecimale,* for it shows no signs of any major transverse ridges, and the minor transverse marks are much more regular and definite than in either of the former species. It would appear, moreover, to be more circular in section, and more rapid in its rate of tapering.

I have much pleasure in naming this species after Mr. Crick, who has given me much kind help in the examination of the Cephalopods in the British Museum.

7. Gyroceras armatum, *Phillips*, sp. Pl. XII, figs. 1, 1 *a*.

1841. Cyrtoceras armatum, *Phil.* Pal. Foss., p. 118, pl. xlviii, fig. 225.
1841. — nautiloideum, *Phil.* Ibid., p. 116, pl. xlvi, fig. 220.
1888. — armatum, *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.
1888. — nautiloideum, *Etheridge.* Ibid., vol. i, Pal., p. 167.

Description.—Shell large, flattened, almost or quite symmetrical, moderately arched about the body-chamber, and very rapidly reflexed in the lower part of the shell. Section roughly quadrilateral, the dorsal face being slightly convex, the two sides oblique, and the ventral face very wide and slightly convex, the ventro-dorsal being to the transverse diameter in the ratio of 2 : 3. Junction of the sides with the ventral face marked by a row of very large, regular, distant, and bluntly conical nodes or horns, set perpendicularly to the median plane. Traces of blunt ridges upon the sides, starting from these tubercles and sweeping upwards over the sides and then arching round suddenly so as to become transverse upon the dorsal surface. Chambers concave. Surface covered by numerous fine, regular, slightly undulating, longitudinal lines or threads upon sides and dorsal face.

Size.—Length 85 mm.; width of whorl 44 mm.; ventro-dorsal diameter, near mouth, about 30 mm.

Locality.—Wolborough. There are two specimens in the Museum of Practical Geology, one of which is Phillips's type, and two in the British Museum.

Remarks.—None of the specimens are perfect. The surfaces of all except one are decayed after the manner of so many of the Wolborough fossils, so that the finer markings of the surface cannot be made out. Phillips's type-specimen differs in some respects from his figure, being slightly smaller, having a sharper inferior bend and bearing more acute tubercles. It has been broken and injured since it was drawn in Mr. Godwin-Austen's Collection; but there is no doubt of its identity, for not only does the position of the encrusting matrix agree, but there are two specimens of *Davidsonia Verneuili* upon its back, which Phillips has represented in their correct positions, but did not otherwise allude to or describe. It is interesting to observe that two of Mr. Vicary's specimens of the kindred *G. præclarum* have these rare parasitic brachiopods upon their surface. The texture of the shell seems to have been thick in some parts and very thin in others.

The best preserved specimen in the British Museum had been identified by Mr. Foord with *G. ornatum*, d'Arch. and de Vern., but after comparing it in his company with Phillips's type we came to the conclusion that it agreed perfectly with that, and was distinct both from *G. ornatum* of Goldfuss and the *G. ornatum* of Phillips. We also concluded that the very poor specimen which was figured and named *C. nautiloideum* by Phillips, and which is the second of the two specimens in the British Museum, must be regarded as in all probability a specimen of this shell. It is a very much worn cast, and is only distinguishable from the other shells by the general (not entire) absence of nodes, and by its more regular section. These differences may, however, be fully accounted for by the great amount of surface-decay which it has undergone, if not also by such specific variation as we have already observed in *G. præclarum*.

8. Gyroceras Leei, *Whidborne*, sp. Pl. XII, figs. 2, 2 *a*.

1889. Cyrtoceras Leei, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell rapidly tapering, large, much recurved. Surface covered by numerous transverse rows of very foliaceous, undulating, irregular, and distant lamellæ, which stand out more or less perpendicularly from the shell sometimes to a distance of 7 mm., and between each of which are numerous similar but much less developed rows of foliaceous striæ; the whole being crossed by a few indistinct, rounded, shallow, longitudinal ribs, which are narrower than their interspaces.

Size.—Width, 45 mm.; length, as far as seen, 93 mm.

Locality.—Lummaton. A single specimen is in the Lee Collection in the British Museum.

Remarks.—This fossil is distinguished from *C. fimbriatum* of Phillips by the size and irregularity of its laminæ; and the same features separate it from *G. tredecimale* and *C. quindecimale*. Mr. Foord suggests that in its ornamentation it is like some American forms of the section of the family called *Zitteloceras* by Hyatt, and we certainly find numerous Transatlantic species which approach it more or less nearly in their style of marking. Its shape and curvature are very difficult to make out. At first sight it appears short and slightly arched; but Mr. Crick has convinced me that it must have been a long coiled shell so imbedded in the matrix that the two outlines seen in the Plate are oblique sections of the same side. Thus the larger portion of the shell is lost and would originally have been above the level of the Plate, and the apparent apex is only a point on the lower side of the whorl. Hence it follows that in all probability it belongs to the loosely coiled forms which are grouped under the genus *Gyroceras*.

In *Cyrtoceras Jason*, Hall,[1] the rings appear less foliaceous.

In *Gyroceras Nereus*, Hall,[2] these rings are more regularly and frequently undulating, and present no signs of being elongated into long fimbriæ; the minor ornamentation is similar, but perhaps rather coarser.

Gyroceras Matheri, Hall,[3] has the fimbriæ as elongated, but much further apart, and it has numerous and regular longitudinal rounded rays not seen in the English shell.

Cyrtoceras eugenium, Hall,[4] appears to be a straighter shell, with stouter and more distant lamellæ, which are more regularly and evenly horizontal.

[1] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 381, pl. l, figs. 1, 2.

[2] Ibid., p. 373, pl. li, figs. 4—6.

[3] Ibid., p. 377, pl. lv, figs. 1—6.

[4] Ibid., p. 369, pl. xxxvi, fig. 5; pl. xlvii, figs. 5—7; pl. xcvi, figs. 1—11; and pl. xcvii, figs. 10, 11.

C. æmulum, Hall,[1] is also straighter, and the fimbriæ seem more regular.

Gyroceras cyclops, Hall,[2] seems most nearly to approach it of the American forms in general facies and in the character of the lamellæ, and its curvature is probably the same; but its minor transverse ornamentation is coarser and more distant. It also has more defined, broader, and much more numerous longitudinal bands than those in *C. Leei*.

2. *Genus.*—Cyrtoceras, *Goldfuss.*

This is one of the largest genera of the Cephalopods. It contains forms with simple orifices, which are slightly and in general regularly arched, but not so much so as to form a spire. Its siphuncle is generally situated near the ventral margin, but occasionally is central or sub-central. It has been divided into genera and even families by Hyatt and others, but Barrande has reunited the various forms in the one great genus. It extends from the Lower Silurian to the Permian.

From the localities at present under review the number of forms that have come to my notice are comparatively few. They chiefly belong to the section of the genus which was separated by Hyatt under the name of *Zitteloceras*,[3] a genus, however, which is not upheld by Mr. Foord. Of this section *C. lamellosum*, Hall[4] (not d'Archiac and de Verneuil) is the earliest representative, occurring in the Trenton Limestone; and *C. quindecimale*, Phillips, *C. fimbriatum*, Phillips, *C. lamellosum*, d'Archiac and de Verneuil,[5] and *C. Jason*, Hall,[6] are Devonian species belonging to the same type.

The other species of *Cyrtoceras* belong to the section Brevicones, and are here represented, with one exception, by only a few poor and indistinct specimens.

1. Cyrtoceras quindecimale, *Phillips*. Pl. X, figs. 1, 1 *a*, 2, 2 *a*.

1841. Cyrtoceras quindecimale, *Phil.* Pal. Foss., p. 114, pl. xliv, fig. 216.
1842. Cyrtoceratites quindecimalis, *D'Arch.* and *de Vern.* Geol. Trans., ser. 2, vol. vi, pt. 2, p. 386.

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1 1879, Hall, 'Pal. N. Y.,' vol. v, p. 371, pl. xcvii, figs. 1—9; and pl. xcviii, figs. 4, 8.

2 Ibid., p. 387, pl. ci, fig. 1; pl. cii, fig. 1; pl. ciii, figs. 1, 2; pl. civ, figs. 1, 2.

3 1883, Hyatt, 'Proceedings Bost. Soc. Nat. Hist.,' vol. xxii, p. 84.

4 Hall, 1847, 'Pal. N. Y.,' vol. i, p. 193, pl. xli, fig. 2. As d'Archiac's name has the priority I should like to suggest the name of *C. Foordii* for Hall's species, which was pointed out to me by Mr. Foord.

5 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 348, pl. xxviii, figs. 4, 4 *a*, *b*.

6 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 1, p. 381, pl. l, figs. 1, 2.

1842.	CYRTOCERATITES LAMELLOSUS, *D'Arch.* and *de Vern.*		Geol. Trans., ser. 2, vol. vi, pt. 2, p. 348, pl. xxviii, figs. 4, 4 *a*, *b*.
1849.	CYRTOCERAS QUINDECIMALIS, *d'Orb.*		Prodrome, vol. i, p. 53.
1850.	—	UNDULATUM, *F. A. Römer.*	Beitr., pt. 1, p. 18, pl. iii, figs. 25 *a—c*.
1852 ?	—	LAMELLOSUM, *Sandberger.*	Verst. Rhein. Nassau, p. 144, pl. xv, figs. 3 *a*, *b*.
1852.	—	QUINDECIMALE, *Giebel.*	Fauna Vorwelt, Band 3, Abth. 1, p. 205.
1879.	—	MORSUM, *Hall.*	Pal. N. Y., vol. v, pt. 2, p. 367, pl. xlvii, figs. 4, 5.
1888.	—	—	*Etheridge.* Foss. Brit., vol. i, Pal., p. 167.
1888.	— ?	—	*Foord.* Cat. Foss. Ceph. Brit. Mus., vol. i, p. 318.

Description.—Shell more or less arched, tapering. Section elliptic; ratio of ventro-dorsal to transverse diameter as 15 : 18. Siphuncle close to ventral margin. Body-chamber at least about one-third of the shell. Walls of chamber definitely concave. Surface with twenty-five to thirty very indistinct longitudinal ribs, crossed by numerous close and prominent frills or membranaceous flounced ridges, which are divided occasionally by larger grooves so as to show a tendency to fall into sets of four or five, or in some specimens have every third or fourth ridge rather stronger. Ridges becoming obscured and apically deflected as they cross the siphuncular area.

Size.—Length, 55 mm.; width, 18 mm.

Locality.—Wolborough. There are two specimens in the Battersby Collection in the Torquay Museum, a third in Mr. Vicary's Collection, a fourth, which is supposed to be Phillips's type, in the Museum of Practical Geology, and one in the Lee Collection in the British Museum.

Remarks.—I do not feel certain whether the fossil in the Museum of Practical Geology is really the type from which Phillips's figure of the species is drawn. In the records of the Museum it is only treated interrogatively, and it certainly is very different from both his figure and description, and in fact differs far more from that than it does from *C. lamellosus*, d'Arch. and de Vern., especially in the distinctive points to which the latter authors draw attention. I have, in fact, no hesitation in regarding this German shell as belonging to the same species. The only difference between it and the Jermyn-Street fossil is in size, in the rather greater relative number and fineness of the frills, and in the presence of a still finer series of striæ between them. The state of preservation, however, of the English specimens would not permit of the latter character being preserved, supposing it to have been originally present in them.

The species seems to be very variable, both as to the curvature of its profile and as to the number and coarseness of its markings. More than this, the Battersby fossil shows to how great an extent the latter character may change in a single specimen. This specimen, which is far more like Phillips's figure, appears to be nearly perfect, and probably is a full-grown though small shell. Just before the commencement of the body-chamber the ribs become suddenly so much coarser as to approximate very closely to *C. fimbriatum*, Ph.[1]

It appears to me that, as far as can be judged from his figure and description, the *C. undulatum* of F. A. Römer belongs to the present form. He there describes the chambers as six times as wide as high, but this ratio decreases towards the apical end. In none of the English specimens which I have seen are the chambers shown, but in the kindred species they bear a similar relation.

Affinities.—*C. alticola*, Barrande,[2] is straighter, and its transverse ribs are straight, fine, and not foliaceous.

C. tessellatum, de Koninck, from the Carboniferous of Visé, has, according to Ferd. Römer,[3] very much stronger radiating ridges.

C. cinctum, Münster,[4] from Tournay, has very much closer, finer ridges, and shows no traces either of a ventral sinus or of longitudinal markings.

C. morsum, Hall,[5] is figured from a very much worn specimen. Its only distinction from the English species appears to be the absence of longitudinal lineations in the American form; should these prove to be present in better-preserved examples, Hall's name would have to be regarded as a synonym of Phillips's.

2. Cyrtoceras (?) fimbriatum, *Phillips*. Pl. X, figs. 3, 3 *a*, 4, 4 *a*.

1841. Cyrtoceras fimbriatum, *Phil.* Pal. Foss., p. 114, pl. xliv, fig. 214.
1842. Cyrthoceratites fimbriatus, *D'Arch.* and *de Vern.* Geol. Trans., ser. ii, vol. vi, pt. 2, p. 386.
1849. Cyrtoceras fimbriatus, *D'Orbigny.* Prodrome, vol. i, p. 53.
1852. — fimbriatum, *Giebel.* Fauna der Vorwelt, Band 3, Abth. 1, p. 206.
1888. — — *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.
1888. — ? — *Foord.* Cat. Foss. Ceph. Brit. Mus., pt. 1, p. 317.

Description.—Shell elongate, flattened, regularly tapering; considerably arched in the ventro-dorsal aspect, the curvature being greatest in the apical, and almost vanishing in the oral region; laterally deflected, so that the right-hand side is almost straight, and the left-hand side very oblique. Upon a chord of 55 mm. subtending the concave side the greatest curvature is 8 mm. Section having ventro-dorsal to transverse axis in the ratio of about 15 : 20, near the mouth, but becoming nearly circular at apex. Chambers about sixteen, narrow, very concave.

[1] See remarks under that species, p. 106.
[2] 1887, Frech, 'Zeitsch. deutsch. geol. Gesell.,' p. 730, pl. xxxviii, fig. 2, and pl. xxxix, figs. 13 *a*, *b*.
[3] 1876, Ferd. Römer, 'Leth. Pal.,' pl. xlvi, fig. 2.
[4] 1839, Münster, 'Beitr.,' pt. 1, p. 34, pl. ii, fig. 4.
[5] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 367, pl. xlvii, figs. 4, 5.

Siphuncle small, situated nearly but not quite close to the ventral margin. Surface ornamented with between twenty-five and thirty low, blunt, longitudinal ribs, separated by wider intervals, and crossed by regularly undulating membranaceous frills or flounces, set nearly perpendicularly, advancing towards the apex in the hollows and receding on the ribs. Ventral area marked by a wider (and perhaps slightly convex) interval between the two central ridges, and by an extra advance of the frills.

Size.—The approximate measurements of a specimen, which wants the body-whorl, are length, 60 mm; depth, 18 mm.; width, 24 mm.

Locality.—Wolborough. One of Phillips's figured specimens is in the British Museum. There is a finely preserved portion of the upper part of the shell in the Battersby Collection in the Torquay Museum, and three other specimens, one of the oral and two of the apical portions, in the Museum of Practical Geology.

Remarks.—I have been unable to find the more distinctive specimen of the two which Phillips figured; but, although evidently somewhat roughly and misleadingly drawn, there is no doubt of the present identification. The number of longitudinal ribs is stated by Phillips as fifteen, but his figure shows that there must have been between twenty and thirty upon his shell.[1] On the other hand, Phillips states the section to be elliptic, although this would not have been discovered from the figure. Of the figured specimen in the British Museum Mr. Foord remarks that it is far too imperfect "for any comparison of it to be made with other species. More than half of it is buried in the rock, and what is visible has been much decomposed by weathering." It is, moreover, not accurately represented by Phillips's figure, as the lamellæ are not so elongate or so perpendicular to the whorls as there shown, but agree with those of our other specimens, and its curvature is also less.

Comparing the specimens mentioned above, this species seems very variable, and there would seem some reason for questioning whether it is really distinct from *C. quindecimale* on account of the passage between them. It may therefore be well to notice some specimens of the two species in detail.

(1) The specimen of *C. fimbriatum* figured on Pl. X, fig. 4, is altogether like Phillips's fig. 214 *b*. Its apex is wanting.

(2) The specimen of *C. fimbriatum* figured on Pl. X, fig. 3, is similar, but is much worn. Its frills are as coarse, and it shows the apical end and the rate of tapering. Its section is much more circular, and thus approaches that of *C. quindecimale*.

(3) A large specimen of *C. fimbriatum*, showing the dorsal side of the oral

[1] It is probable that only a portion was exposed, and that thus he has under-estimated the number of ribs, for if his figure is to be trusted both this species and *C. quindecimale* must have had considerably more than the number he states. (Eight or nine are shown on the exposed face of each.)

portion, has the frills much finer, and more numerous and regular, and so nearly approaches *C. quindecimale* that I was almost inclined to class it with that species. The frills, however, would naturally appear closer on the dorsal side.

(4) The specimen of *C. quindecimale* figured on Pl. X, fig. 1, shows a rapid increase of the coarseness of the ornamentation near the mouth, so as to be like that of No. 3, except that it is not so undulating.

(5) The specimen of *C. quindecimale* figured on Pl. X, fig. 2, and supposed to be Phillips's type, though very unlike his figure, is clearly the same species as the last (No. 4). In it the ribs are very indistinct, and the frills are very close and prominent, and occasionally one is stronger than the others, so as to divide them into sets as described by Phillips.

(6) A specimen of *C. quindecimale* in the Lee Collection in the British Museum is exactly like Phillips's fig. 206 *a* of that species.

Affinities.—*Gyroceras Nereus*, Hall,[1] has similar transverse undulating bands, but differs in the absence of longitudinal markings and in its very much greater curvature.

3. Cyrtoceras difficile, n. sp. Pl. XII, fig. 3, 3 *a*.

Description.—Shell elongate, recurved, asymmetrical, slowly tapering, the curvature being greatest near the apex. Upon a cord of 38 mm., subtending the concave side, the greatest curvature is 11 mm. Section circular near the apex, transversely elliptical in the upper part of the shell. Chambers and siphuncle unknown. Surface ornamented with twenty or thirty low indistinct longitudinal ridges, crossed by regular, distant, slightly crenulated membranaceous frills, with a deep convex loop towards the apex on the ventral line, and distant from each other about 4 mm. on the average.

Size.—The portion of a shell 62 mm. in length measures about 16 mm. and 21 mm. on the ventro-dorsal and lateral diameters of its section at the upper end.

Locality.—Wolborough. A single broken specimen is in Mr. Vicary's Collection.

Remarks.—The fossil described above has caused me no small perplexity; for, while preserving some clear characters, its true form is obscured partly by fracture and partly by almost indistinguishable matrix. Its ornamentation bears considerable resemblance to two distinct species of shells, but I cannot satisfy myself that it can belong to either, and upon my showing it to Mr. Foord I understood him to have the same difficulty.

In the first place it bears very considerable resemblance to a portion of the inner whorl of *Gyroceras præclarum*, Whidb., but from that species it differs by its

[1] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 373, pl. li, figs. 4—6.

curvature and rate of tapering being very much less, by its transverse frills being, as far as can be judged in its state of preservation, more crenulated and membranaceous, and by their increasing in distance and changing in character much less rapidly. Thus it appears evidently not to be allied to that shell.

In the second place it shows much similarity to *C. fimbriatum*, Phillips. Compared with that species, however, its curvature appears decidedly greater its transverse frills are much further apart and less undulating, and its increase in size seems more rapid. Hence it does not seem possible to unite it with that species.

I am therefore obliged at present to treat it as a distinct form, although when more complete specimens are found they may prove that it ought to be reunited to some other species. It is to be noted that there are faint indications of a secondary series of transverse bands intermediate to the primary frills, and not foliaceous, and this character I have not noticed in any other species.

4. Cyrtoceras, n. sp. Pl. XII, fig. 4.

Description.—Shell small, decidedly recurved, very rapidly tapering. Ventral outline convex, dorsal outline very concave near the apex, but becoming straight near the body-chamber. Septa very concave, set obliquely. Siphuncle near the ventral margin. Surface unknown.

Size.—A specimen of the septal part of the shell, 27 mm. in length, measures about 21 in ventro-dorsal, and 20 in lateral diameter at the upper end, and 8 mm. in diameter at the apical end.

Locality.—Two defective specimens from Wolborough are in the Museum of Practical Geology.

Remarks.—This little species is evidently a brevicone *Cyrtoceras*, but its remains are too scanty to admit a very certain identification. There is, however, no other species from our Devonshire localities which is at all similar to it; nor have I met with any foreign species which appears to correspond.

Affinities.—*Cyrtoceras indomitum*, Barrande,[1] while agreeing with the smaller of the two specimens in the Museum of Practical Geology in general shape, differs in having its siphuncle subcentral instead of marginal. *C. cornucopiæ*, Sandberger,[2] *C. bilineatum*, Sandberger,[3] and *C. breve*, Sandberger,[4] are less recurved and more slowly tapering shells, and have more elliptic sections.

[1] 1866, Barrande, 'Syst. Sil. Bohème,' vol. ii, p. 700, pl. clxii, figs. 1—14, Ét. E.

[2] 1852 ? Sandberger, 'Verst. Rhein. Nassau,' p. 142, pl. xiii, figs. 4 *a*, *b*.

[3] Ibid., p. 143, pl. xiv, figs. 2 *a*—*f*.

[4] Ibid., p. 143, pl. xv, figs. 5 *a*—*c*.

5. CYRTOCERAS LINEATUM, *Goldfuss ?*

1832. CYRTOCERA LINEATA, *Goldf.* In De la Beche's Handbook (German ed.), p. 536.
1834. ORTHOCERATITES CALYCULARIS, *Steininger.* Mém. Soc. Géol. Fr., vol. i, pt. 2, p. 369, pl. xxiii, fig. 5.
1834. — VENTRICOSUS, *Steininger.* Ibid., vol. i, pt. 2, p. 368, pl. xxii, fig. 5.
1841. CYRTOCERAS MARGINALE, *Phil.* Pal. Foss., p. 115, pl. xlvi, fig. 219.
1842. CYRTOCERATITES LINEATUS, *D'Arch.* and *de Vern.* Geol. Trans., ser. 2, vol. vi, pt. 2, p. 351, pl. xxx, figs. 2, 2 *a*.
1843. CYRTOCERAS VENTRICOSUM, *Röm.* Verst. Harz., p. 35, pl. x, fig. 1.
1849. CYRTOCERATITES DEPRESSUS, *Quenstedt.* Petref. Deutsch., Band 1, pt. 1, p. 47, pl. i, figs. 17 *a, b*.
1849. CYRTOCERAS LINEATUM, *D'Orbigny.* Prod., vol. i, p. 53.
1850. — MULTISEPTATUM, *F. A. Röm.* Beitr., pt. 1, p. 38, pl. vi, fig. 2.
1852. — NESSIGI, *Giebel.* Fauna Vorwelt, Band 3, pt. 1, p. 201.
1852 ? — SUBCONICUM, *Sandberger.* Verst. Rhein. Nassau, p. 146, pl. xvii, figs. 1, 1 *a*.
1853. — LINEATUM, *Steininger.* Geog. Besch. Eifel, p. 41.
1888. — MARGINALE, *Etheridge.* Foss. Brit., vol. i, Pal., p. 167.
1888. — LINEATUM, *Foord.* Cat. Foss. Ceph. Brit. Mus., vol. i, p. 267.

Description.—Septa very large, close, slightly concave, distant about one-eighth or one-ninth of their diameter. Siphuncle large, about 6 mm. in diameter, close to margin, elliptic, diagonally elongate. Shell-structure very thick and massive.

Size.—Width of the septum, 55 mm.

Localities.—A single specimen from Lummaton is in my Collection. Phillips's figured specimen is from Wolborough.

Remarks.—The material for establishing this species in the present series is scanty in the extreme. Phillips described a single large septum, and the one in my possession, though still larger, is too imperfect even to define its shape. At the same time these two fossils give evidence of a very large Cephalopod, quite distinct from the other species of these localities.

In the British Museum is a specimen of a very large Cephalopod from "Ivy Bridge Quarry, near Newton," which probably is the same species, and which Mr. Foord has identified with *C. lineatum*, Goldf., with whose description our own fossil fairly agrees. From this species, however, as described by d'Arch. and de Vern., *C. marginale* (including our specimen) seems to differ in having the ventro-dorsal diameter slightly greater than the transverse, and in the siphuncle being elliptic in section. An examination of a good series of foreign specimens like those in the British Museum would probably solve this question, though our Devonshire material is not enough for final identification.

C. subconicum, Sandberger, is said by him to be the same as *C. lineatum*, Goldf. Its section seems more definitely triangular than the English specimens, and I am not sure of its identity. Why he changes Goldfuss's name does not appear.

C. multiseptatum, F. A. Römer, appears also to be a synonym.

Affinities.—*C. depressum*, Goldf., as given by d'Arch. and de Vern.,[1] has a more flattened dorsal side, and consequently a more triangular section. *Phragmoceratites subventricosus*, d'Arch. and de Vern.,[2] is a still larger species with a very elongate, elliptic section. In both cases the siphuncle is marginal.

Perhaps *Phragmoceras eximium*, Eichwald,[3] is most like the Lummaton fossil, chiefly differing in the sections being more elongate.

6. Cyrtoceras Robertsii, n. sp. Pl. XI, figs. 9, 9 *a*, 9 *b*, 9 *c*.

Description.—Shell small, tapering rather rapidly, slightly recurved. Section sub-circular, rather asymmetrical. Septa concave and distant? Ventral outline convex; dorsal outline slightly concave; lateral outlines unequally oblique. Siphuncle central? or close to ventral margin? Surface covered by crowded microscopical transverse striæ, slightly looped backward over the ventral line, and with occasionally one larger than the others.

Size.—Length without apex, 45 mm.; greatest width, 22 mm.

Localities.—One specimen in my Collection is from Lummaton, and two defective specimens from Wolborough, apparently belonging to the same species, are in the Museum of Practical Geology.

Remarks.—This species, as shown by my specimen, seems distinguished by its regularly tapering and slightly recurved and asymmetrical form, and I am not aware of anything resembling it described by foreign authors.

The position of its siphuncle is doubtful. At the apical end it appears to be central, but at the upper end there is an appearance that might indicate it to be marginal. I am very doubtful whether the latter appearance is not delusive, although at the time of drawing the plate we thought it sufficiently clear to indicate it in the section fig. 9 *b*.

[1] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. ii, vol. vi, pt. 2, p. 350, pl. xxix, figs. 1, 1 *a*.

[2] Ibid., p. 351, pl. xxx, figs. 1, 1 *a*.

[3] 1860, Eichwald, 'Leth. Ross.,' vol. i, p. 1274, pl. xlvii, fig. 2.

Affinities.—This species so much resembles *Cyrtoceras decipiens*, Barrande,[1] that I have been in some doubt about separating it from that species. The differences to be noted are that the English shell is rather more arched and is inequilateral and that the dorso-ventral diameter of the section is not so much greater than the transverse section as it is in Barrande's fossil. The surface markings also, which are similar (including the ventral sinus), do not seem so strong. The larger Wolborough specimen is decidedly more arched than is Barrande's shell. *Cyrtoceras intermedium*,[2] Barrande, is another very similar species, which, however, differs in the minor character of its ornament and looks more like *C. decipiens*, Barr., than do any of our fossils. *C. sporadicum*, Barrande,[3] differs from ours in having simple, equal transverse lines. Though coming very close to all these three species, I consider that the present must be regarded distinct from them on account of the obscurity and indistinctness of its markings. *C. distentum*, Barrande,[4] nearly approaches it in general shape, but the markings are not so equal, and the section is more regularly elliptic.

Gomphoceras Verneuili, Barr.,[5] is also very like, but is decidedly more elongate; and *G. mumia*, Barr.,[6] has a straight dorsal profile and coarser ornamentation.

Cyrtoceras negatum, Barrande,[7] appears to be a less elongate and more symmetrical form. *Cyrtoceras parvulum*, Barrande,[8] presents a very close resemblance in its ornamentation, but it is a more arched shell, and never shows any signs of asymmetry.

C. memorator, Barrande,[9] seems at first sight so similar as to raise a question of possible identity, but it presents important differences,—the sinus in the ornamentation is on the concave instead of the convex side, there is no asymmetry, and the transverse ornament is crossed by still finer and more numerous radiating lines.

1 1865, Barrande, 'Syst. Sil.,' vol. ii, p. 544, pl. cxlvii, figs. 30—38, and pl. cliv, figs. 25—33, Ét. E.

2 Ibid., p. 552, pl. cxlvii, figs. 27—29; pl. cxlix, figs. 13—17; pl. cl, figs. 1—27; pl. cli, figs. 22—27, Ét. E.

3 Ibid., p. 567, pl. cli, figs. 17—21, and pl. ccv, figs. 11, 12, Ét. F.

4 Ibid., p. 546, pl. cxiv, figs. 1—7, Ét. F.

5 Ibid., p. 330, pl. lxxi, figs. 1—9, Ét. E.

6 Ibid., p. 292, pl. lxx, figs. 10—13; pl. xcii, figs. 4—7, Ét. E.

7 1866, ibid., p. 705, pl. cxlv, figs. 14, 15, and 1877, ibid., Suppt., p. 168, pl. ccccl xvi, figs. 7, 8, Ét. G.

8 Ibid., p. 689, pl. clxxvii, figs. 12—18, and 1877, ibid., Suppt., pp. 39 and 169, pl. cccclxxxi, figs. 1—15, and pl. div, figs. 1—45, Ét. E.

9 1877, ibid., Suppt., p. 158, pl. dxvi, figs. 8—11, Ét. F.

IV. *Family.*—PHRAGMOCERATIDÆ.

1. *Genus.*—PHRAGMOCERAS, *Broderip*, 1839.

The shell in this genus is more or less arched, and is in general laterally compressed. The body-chamber is very large. The siphuncle is generally near the concave side, which therefore must be regarded as ventral. The surface of the shell has fine transverse markings. The mouth is very much constricted, the aperture being very narrow and of a complicated key-like shape, very similar to that of *Gomphoceras,* from which it is distinguished by its recurved form and the different situation of the siphuncle. It belongs chiefly to the Upper Silurian, but several typical forms occur in Barrande's Étage G, which belongs to the Devonian Age.

As the specimens of Cephalopods from the localities whose fossils we are now describing rarely retain the oral parts, it is extremely difficult to decide to what genus some of the species belong. This is the case in the present instance, where a single species appears to approximate the characters of the present genus, though from the slightness of its arching and other qualities it appears to be a somewhat aberrant form of it. In no case is the mouth of this species actually seen. There appears to be a considerable amount of constriction round the upper border, but it is quite doubtful whether this went on in the missing portions so far as to form such an aperture as is characteristic of *Phragmoceras*. As, however, the indications seem in favour of its having done so I have placed it provisionally under this genus.

1. PHRAGMOCERAS ? UNGULATUM, *Whidborne.* Pl. XI, figs. 5—8.

1889. PHRAGMOCERAS UNGULATUM, *Whidborne.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell recurved, pyriform, rapidly tapering. Dorsal outline nearly evenly convex, the convexity being considerable and increasing rapidly at the summit. Lateral outlines not very oblique. Ventral outline rather convex on the body-chamber, but becoming very concave in the septal part. Chambers apparently rather deep. Section near the apical extremity circular, near the oral extremity subquadrate. Aperture contracted considerably but defective in all the specimens. Siphuncle unseen.

Ornamentation consisting of multitudinous minute parallel transverse striæ or growth-lines which are slightly deflected over the median line.

Size.—Length, 55 mm.; ventro-dorsal diameter of body-chamber, 29 mm.; lateral diameter about 26 mm.

Localities.—From Wolborough there are four specimens (of which one is a large but doubtful fragment) in the Museum of Practical Geology, and two in Mr. Vicary's Collection. From Lummaton there is a specimen in my Collection.

Remarks.—The recurved pyriform contour and delicate ornamentation distinguish this species. Unfortunately the examples of this, as of some of the neighbouring forms, are peculiarly defective, and it is a matter of extreme difficulty both to discern their true characters and to determine their specific identity, and even to define their generic position. Thus the only specimen of those above mentioned which shows any indication of the siphuncle is one in the Museum of Practical Geology, which is a fragment showing the ventral part of the body-chamber, which is defective in the other specimens, and which therefore cannot be looked upon with any degree of certainty. Several of the specimens give evidence that the oral aperture was evidently much constricted, but its exact shape is impossible to surmise.

Affinities.—*Phragmoceras rimosum*, Barrande,[1] tapers more rapidly, and has more convex lateral outlines. Its ornamentation also seems less distinct.

Cyrtoceras corniculum, Barrande,[2] has a more arched outline on the concave side, and more expanded aperture. *Phragmoceras imbricatum*, Barrande,[3] is not contracted dorsally round the mouth, and is more arched. Its markings also are not so sharp.

V. *Family.*—Gomphoceratidæ.

1. *Genus.*—Poterioceras, *M'Coy*, 1844.

This genus is divided from *Gomphoceras* by its simple and less contracted mouth, its slight tendency to an arched form, &c. The siphuncle is subcentral or marginal and beaded between the septa. In two of the three species described below it is situated at the ventral margin of the shortest diameter of the elliptic section. The genus extends from the Lower Silurian to the Carboniferous. It was founded by M'Coy[4] for a Carboniferous species, but was treated as a synonym of *Gom-*

[1] 1865, Barrande, 'Syst. Sil.,' vol. ii, p. 230, pl. xlviii, figs. 1—7, and pl. xcviii, figs. 5—9, Ét. E.
[2] 1866, ibid., vol. ii, p. 492, pl. cxxi, figs. 1—23, Ét. E.
[3] 1865, ibid., vol. ii, p. 212, pl. xlvi, figs. 1—12; pl. clxxv, figs. 1—15, and pl. ccxvii, fig. 5, Ét. E.
[4] 1844, M'Coy, 'Synop. Carb. Foss. Irel.,' p. 6.

phoceras by Woodward,[1] and Zittel.[2] Barrande divided it between *Cyrtoceras* and *Gomphoceras*. Foord, however, following Hyatt, not only reconstituted the genus but treated it as a distinct family.

It seems to me that the three species described below may be placed in this genus without hesitation.

1. Poterioceras vasiforme, *Whidborne*. Pl. VII, figs. 5, 5 *a*, 5 *b*.

1889. Gomphoceras vasiforme, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell almost straight, pyriform, tapering quickly, rather large. Ventral outline slightly convex. Dorsal outline convex on the body-chamber, slightly concave near the apex. Lateral outlines oblique and nearly straight. Septa close, very slightly concave, rather oblique; ratio of septal height to width 1 : 8. Section elliptic, more or less flattened ventrally, the ventro-dorsal being to the lateral diameter in the ratio of 12 : 15. Siphuncle rather large, close to ventral margin, elliptic, apparently beaded in each chamber. Shell-structure not very thin; surface showing no sign of ornament.

Size.—The best specimen I know, though defective at both ends, measures 47 mm. in length, and 32 mm. in ventro-dorsal, and 36 mm. in lateral diameter.

Locality.—Wolborough. There is a good specimen in the Torquay Museum, and three much poorer examples in the Museum of Practical Geology.

Remarks.—This species is distinguished by its rapidly tapering, nearly straight pyriform shape, and by its siphuncle being upon the shorter axis of its section. The specimen in the Torquay Museum is the only one that gives the characters well; the two smaller specimens in the Museum of Practical Geology seem to agree with it but are mere fragments; the larger one appears more flattened on the ventral side, and probably belongs rather to *Poterioceras ellipsoideum* than to this species, but its state of preservation is so bad that very little can be learned from it.

Affinities.—*Orthoceratites subfusiformis*, Münst.,[3] and *O. subpyriformis*, Münst.,[4] both seem to be much more elongate forms with less swollen outlines.

Poterioceras Marri differs from it in its broader septa, its more elongate form, and its longitudinal markings, and *Poterioceras ellipsoideum*, Phillips, sp., in its more fusiform shape, its greater obliquity, its broader septa, and its less rapid dilatation.

[1] 1872, Woodward, 'Man. Mollusca,' ed. 2, p. 193.

[2] 1881—1885, Zittel, 'Handb. Pal.,' pt. 1, Band 2, p. 370.

[3] 1840, Münst., 'Beitr.,' pt. 3, p. 103, pl. xx, figs. 6—9.

[4] Ibid., p. 103, pl. xx, fig. 10.

2. Poterioceras Marri, *Whidborne.* Pl. VII, figs. 4, 4 *a*, 4 *b*.

1889. Gomphoceras Marri, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell almost straight, ovate above, tapering below, rather small. Ventral outline convex, becoming straight below. Dorsal outline concave near the aperture, then convex on the lower part of the body-whorl, and then straight on the septal part. Lateral outlines convex above, straight below. Septa straight, rather narrow, being distant from each other about one-eighth their height above; the proportion diminishing towards the apex, as their height remains constant, while their width decreases. Section elliptic, the ventro-dorsal being to the transverse diameter in the ratio of 5 : 6. Surface (of the cast or inner shell) marked with numerous fine, distant, indistinct, longitudinal, rounded lines, which vanish on the upper part of the body-whorl. Siphuncle doubtful.

Size.—Length, 46 mm. (apical end defective); greatest dorso-ventral diameter, 25 mm.; lateral diameter about 28 mm.

Locality.—Wolborough. A single specimen is in Mr. Vicary's Collection.

Remarks.—This seems a well-marked form, and is fairly definite, although the single specimen is rather crushed, and is injured at both extremities. The general contour, the longitudinal striæ, and the obliquity of the aperture distinguish it from the surrounding species.

Affinities.—*Gomphoceras amygdala*, Barrande,[1] has the body-chamber less swollen and the dorsal side straighter. It is similar in its section.

Cyrtoceras speciosum, Barrande,[2] and *C. aduncum*, Barrande,[3] have less convex lateral outlines, and much narrower chambers.

Orthoceras subarcuatum, Portlock,[4] which that author somewhat whimsically places between the genera *Orthoceras*, *Cyrtoceras*, *Phragmoceras*, and *Gomphoceras*, is more elongate than the present form.

Gomphoceras inflatum (Goldfuss) is, judging, from F. Römer's figure,[5] more elongate, ovoid, and with broader chambers.

Cyrtoceras imperans, Barrande,[6] is a very much larger species, being more than a foot in length. It evidently belongs to the same genus, and is closely allied,

[1] 1865, Barrande, 'Syst. Sil. Bohèm.,' vol. ii, p. 273, pl. lxxvii, figs. 23—26, and pl. lxxx, figs. 1—17, Ét. E.

[2] 1866, Ibid., p. 692, pl. clxx, figs. 1—7; pl. clxxviii, figs. 1—7, and pl. ccxvii, fig. 5, Ét. E.

[3] Ibid., p. 683, pl. clxix, figs. 9—14, and pl. clxxxi, figs. 10, 11, Ét. F.

[4] 1843, Portlock, 'Rep. Geol. Londonderry,' p. 374, pl. xxviii, fig. 9.

[5] 1876, Ferd. Römer, 'Leth. Pal.,' pl. xxx, fig. 6.

[6] 1877, Barrande, 'Syst. Sil. Bohème,' vol. ii, Suppt., p. 25, pl. ccccxii, fig. 1; pl. ccccxiii, figs. 4, 5; pl. ccccxxxv, figs. 1, 2, Ét. G.

but it is distinguishable by its more regular contour and the great obliquity of its septa. *C. lumbosum*, Barrande,[1] another neighbouring form, is more evenly convex ventrally, and is more constricted round the aperture. *C. reductum*, Barrande,[2] is much slighter and more elongate, and has a smaller body-chamber.

3. POTERIOCERAS ELLIPSOIDEUM (*Phil.*). Pl. XI, figs. 1, 1 *a*, 1 *b*.

1841. ORTHOCERAS ELLIPSOIDEUM ?, *Phil.* Pal. Foss., p. 140, pl. lx, fig. 205*.
1841. — VENTRICOSUM, *Phil.* Ibid., p. 230.
1842. ORTHOCERATITES SUBPYRIFORMIS, *D'Arch.* and *de Vern.* (not *Münster*). Geol. Trans., ser. 2, vol. vi, pt. 2, p. 347, pl. xxviii, figs. 3, 3 *a*.

Description.—Shell small, almost straight, tapering. Ventral, dorsal, and lateral outlines gently convex on the body-chamber, becoming straight on the septal part, except the dorsal outline, which is on that part very slightly concave. Section very ellipsoidal, with the dorso-ventral to the transverse diameter in the ratio of 4 : 5, the ventral side being somewhat flattened, so that the ellipse is not exact. Body-chamber apparently rather deep and considerably narrowed in its lower portion. Septa almost flat, rather broad, being distant about one-eighth their height, but becoming closer below. Siphuncle close to the ventral side. Surface unknown.

Size.—Height, 30 mm.; dorso-ventral diameter, 21 mm. in greatest width; lateral diameter about 25 mm.

Locality.—Wolborough. Two specimens in the Museum of Practical Geology.

Remarks.—The specimen from which the above description is taken is fairly distinct, but the other, though rather larger, is very poor and indefinite. I am in doubt as to whether it belongs to this species or to *Ph. vasiforme*, but the flattened back and general curvature incline me, on the whole, to class it with this one.

Phillips's figure and description of this species are very slight, and for a long time I felt unable to identify with it any of the Newton specimens which I knew.

A comparison, however, of his figure with fig. 1 *a* of the Jermyn-Street specimen shows the greatest similarity, both in general shape and in septal width. Hence I conclude that Phillips drew his fossil, not, as might have been supposed, in a ventral, but in an oblique, almost lateral, position, being probably led to do this from that being the best view of a defective specimen. We may, therefore, regard our figures as representing the shape of his species.

[1] 1877, Barrande, 'Syst. Sil. Bohème,' vol. ii, Suppt., p. 33, pl. ccccclxiv, figs. 1, 2; pl. ccccclxv, fig. 1, and pl. ccccclxx, figs. 1—3, Ét. G.

[2] Ibid., p. 42, pl. ccccclxxii, figs. 1—4, Ét. G.

The present species differs from *P. vasiforme* by its less arched dorsal outline, its more regularly and slowly tapering form, its more flattened ventral side, and its more elliptic apical section. By these points it seems pretty clearly distinguishable, but the finding of more numerous and better-preserved specimens may possibly modify this conclusion. It is only by the examination of a large series of specimens that two forms differing considerably on certain points can with safety be placed together as belonging to a single very variable species. And though to describe forms as distinct that may ultimately be found to belong together leads to the undue multiplication of specific names, this evil, great though it be, appears to be less in the end than that of the confusion caused by grouping two or three species under a single name; the consequence of which is that the information respecting them becomes hopelessly confused, and when in the future they are found to be distinct, erroneous notions are much more likely to be produced concerning them. Moreover, in the case of a fossil occurring in different formations, it is much easier to arrive at truth by having to identify two differently named and described fossils as the same, than by having to separate two species that bear one name in both formations. It would be, I think, a most useful and interesting task to compare carefully the kindred species of different formations, and the same species when occurring in several formations, with a view to discover how far their palæontological relations as at present received are accurate. The result of such a course of comparative palæontology would probably lead to many modifications in our present views.

Returning to the species under notice, I do not think that there is any reason to suppose that *P. vasiforme* will have to be connected with it. From *P. Marri* it is separated by its shape and by the absence of any signs of longitudinal ornamentation, and from the other similar Devonshire species by the position of its siphuncle.

O. subpyriformis, d'Arch. and de Vern., is clearly different from the shell described under that name by Münster,[1] and on the other hand it appears to me identical with Phillips's shell. The siphuncle is on the shorter diameter, and the contours and septa are similar. More of the shape of the aperture is shown in the French authors' figure, and this, unless it be a mere restoration, may help to determine the genus.

Affinities.—*Phragmoceras Brateri*, Münster,[2] is a more compressed and recurved shell and the septa seem rather more distant. Its body-chamber has a more arched outline, at least laterally, if our and Phillips's specimens are at all perfect in that portion.

Ph. ventricosum, Sowerby,[3] of the Upper Silurian, is much more recurved than either the present species or *P. Marri*.

[1] 1840, Münster, 'Beitr.,' pt. 3, p. 103, pl. xx, fig. 10.

[2] 1840, Münst., 'Beitr.' pt. 3, p. 105, pl. i, figs. 10 *a*, *b*, and *c*.

[3] 1838, Sowerby, 'Murch. Sil. Syst.,' p. 621, pl. x, figs. 4—6.

2. *Genus*.—Gomphoceras, *Sowerby*.

This genus contains fusiform or pyriform shells, with a much contracted aperture, and a tapering apex. The body-chamber is large; the other chambers narrow and with simple suture-lines. The siphuncle is most frequently near the ventral margin, but is occasionally subcentral. The surface is either smooth or with fine transverse ornamentation. It occurs in the Silurian, Devonian, and Carboniferous formations. The species described below are referred to it with hesitation on account of the defective nature of all the specimens.

1. Gomphoceras poculum, n. sp., Pl. XI, figs. 2, 2 *a*, 3, 3 *a*.

? 1842. Orthoceratites subfusiformis, *D'Arch.* and *de Vern.* (not Münster), Geol. Trans., ser. 2, vol. vi, pt. 2, p. 347, pl. xxviii, figs. 2, 2 *a*.

Description.—Shell conical, nearly straight, slightly constricted in the upper part of the body-whorl, and then gently swollen, and beginning to taper in the lower part of the body-whorl. Septal part tapering regularly; ventral outline very slightly convex, and dorsal outline very slightly concave. Septa gently concave and slightly arched, rather close, not oblique. Section oval, the ventro-dorsal being to the transverse diameter as 6 : 5. Siphuncle large, situated close to the ventral margin, but somewhat on one side of the longest diameter. Surface apparently smooth.

Size.—Length 43 mm. Greatest diameter about 30 mm. (Specimen imperfect and rather crusted.)

Localities.—From Lummaton there are two specimens in my Collection. From Wolborough, a very defective fragment in Mr. Vicary's Collection, and a still poorer one in the Museum of Practical Geology appear to belong to the same species.

Remarks.—Only the two Lummaton specimens supply specific characters, and these two fossils do not accurately agree, the swelling on the body-whorl of the smaller one being rather higher up, and the constriction above it more defined than in the other specimen. I think, however, that this may probably be due to age, and at all events it is too slight a difference to have any weight considering the paucity of our material. In the most perfect of the two, the body-chamber seems about the same length as the septal part, but the specimen is probably somewhat defective both at the oral and apical ends. The outside shell remains and appears rather thin, but no ornamentation can be distinguished upon it.

There is no definite sign in either specimen of any closing in round the aperture. On the other hand it would appear at first sight (*vide* Figs. 2, 2 *a*, 3) as though the aperture was low, wide, and simple. This appearance, however, is deceptive. The horizontal lines in the figures do not really represent the margin of the shell but only a line of ornament or of weakness where the specimens have been broken off; the shell was continued above it, and there are indications that then it became almost horizontal. A very similar appearance would be given by *G. consobrinum*, Barrande,[1] if the upper part of it were removed.

Affinities.—*Cyrtoceras superstes*, Barrande,[2] is very similar to it, but the body-whorl is wider below, and the shoulder is less defined. In section, and in the depth of the segment it agrees; and, as far as can be seen, in general shape.

Orthoceratites subfusiformis, Münst.,[3] and *O. subpyriformis,* Münst.,[4] seem more elongate forms, and have their outlines arched instead of nearly straight. *O. subfusiformis*, d'Arch. and de Vern., on the other hand, approaches it more nearly, and if the drawing, which shows some sign of idealism, be inaccurate, may be of the same species. Its section, however, is circular, and there is no sign or mention of any constriction in the body-chamber. It is moreover stated to be covered with fine striæ like those seen in *Phragmoceras ? ungulatum*, Plate XI, fig. 6. It is, however, quite possible that the smoothness of our specimens is due to surface obliteration during fossilization.

2. Gomphoceras, sp., Pl. XI, figs. 4, 4 *a*.

Description.—Shell rather large, straight, rapidly tapering. Profiles of the sides almost straight, very slightly convex on the body-chamber (as far as known) and very slightly concave on the septal part; the dorsal profile much more oblique than the ventral. Chambers rather deep, the distance between the septa being 4 mm. Section elliptic. Siphuncle small, close to the margin on the longer axis. Septa concave. Apex small.

Size.—About 60 mm. long.

Locality.—A single specimen from Wolborough is in Mr. Vicary's Collection.

Remarks.—The fossil upon which the above description is founded is very

[1] 1865, Barr., 'Syst. Sil. Bohèm.,' vol. ii, p. 281, pl. lxix, figs. 6—10, Ét. E.

[2] 1866, Ibid., p. 568, pl. cliv, figs. 11—13, Ét. G.

[3] 1840, Münst., 'Beitr.,' pt. 3, p. 103, pl. xx, figs. 6—9.

[4] Ibid., p. 103, pl. xx, fig. 10.

similar in many respects to the species last described. They cannot be easily compared, however, as the upper part of the present fossil is very defective, while in the former shells it is the septal part that is obscure. There seems to be a greater amount of obliquity in the present shell, and it also appears less elongate. I should, however, have united it with the former species but for the great apparent difference in the depth of the septa. As far as can be judged, their depth is twice as great in the present shell as it is in the last at a point where the sectional lengths are nearly the same. Therefore, taking into consideration the two other divergences mentioned above, there remains nothing but to regard it as distinct, and there is no other Devonshire species to which it approximates.

Affinities.—*O. subfusiforme,* d'Arch. and de Vern.[1] (not Münster), seems very like this shell, but differs in several respects. The sides of its septal parts are quite straight, its section is circular and its chambers are very much shallower. *Gomphoceras compressum,* F. A. Römer,[2] is much more elongate, and has closer septa; and *G. ficus,* F. A. Römer,[3] is more ovoid and elongate, and is marked with strongly raised rings.

VI. *Family.*—ACTINOCERATIDÆ.

1. *Genus.*—ACTINOCERAS, *Bronn,* 1837.

The chief characteristic of this genus is the large siphuncle, which is deeply beaded between the septa and contains a syphon of a very complicated structure. The septa are generally extremely close. It extends from the Cambrian to the Carboniferous. There is no very certain example of the genus occurring in the group of localities which we are now considering; but the specimens described below most probably belong to it. A shell in the Museum of Practical Geology shows that it undoubtedly occurs in the Devonian Rocks of Britain. *O. Ludense,* Phillips (not Sowerby), from South Petherwin and Lower Dunscombe, is placed in this genus by M'Coy and Foord.

[1] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 347, pl. xxviii, figs. 2, 2 *a*.

[2] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 4, pl. i, fig. 7.

[3] Ibid., p. 38, pl. vi, figs. 1 *a*, *b*.

1. ACTINOCERAS DEVONICANS, n. sp. Plate XII, figs. 8, 8 *a*.

Cf. 1840. ORTHOCERATITES ELLIPTICUS, *Münster*. Beiträge, pt. 3, p. 96, pl. xviii, fig. 2.
1841. ORTHOCERAS LUDENSE, *Phil.* (not *Sowerby*). Pal. Foss., p. 110, pl. xlii, fig. 206.

Description.—Shell large, smooth ?, tapering rapidly. Septa rather narrow, very convex.

Size.—34 mm. in greater and 28 mm. in lesser diameter.

Locality.—Lummaton.

Remarks.—There are in my Collection two specimens from Lummaton which show the convex wall of the chamber of a large Cephalopod, but which are in both cases too imperfect for any description. The section of one of them is very elliptic and its septa transversely oblique, but this possibly is due to distortion, from which the specimen has evidently to some extent suffered. The siphuncle is large and shows some indistinct and doubtful signs of radiation. The external surface appears to be smooth. A comparison of the two specimens would point to the presumption of an oblique, elliptic, and very conical shell. The most interesting point about them, however, is that they show rough deposits by the mantle of what originally was organic matter, as pointed out by Barrande[1] in his notes on some plates of *Orthoceras.* In *O. Ludense*, Phillips, not Sowerby, which is quoted by Phillips from Marwood and South Petherwin, the section given by Phillips shows the siphuncle to have been, as in ours, somewhat laterally excentric, and I see no reason for doubting that they specifically agree.

Affinities.—These specimens may be compared with *O. ellipticus*, Münster,[2] which is a very transverse species. The section in our fossils is more transverse than in Phillips's figure, but not nearly so much so as in Münster's, the ratios of the diameters being respectively four-fifths, three-fourths, and about two-thirds. *O. Ludense,* Sowerby,[3] is a perfectly distinct shell, and has a circular section.

O. omissum, Blake,[4] seems a kindred form, being elliptic in section, but the siphuncle is much nearer to the lateral margin.

VII. *Family.*—ORTHOCERATIDÆ.

1. *Genus.*—ORTHOCERAS, *Breyn,* 1732.

This is the largest and one of the best defined genera in the Nautiloidea. Foord thus defines it: " Shell straight or slightly curved, elongate-conical, circular

[1] 1865, Barrande, 'Syst. Sil. Bohème,' vol. ii, pl. ccxxviii, figs. 5—8, and pl. ccxxix, figs. 2—10.

[2] 1840, Münst., 'Beitr.,' pt. 3, p. 96, pl. xviii, figs. 2 *a*, *b*.

[3] 1839, Sowerby in Murchison's 'Sil. Syst.,' p. 619, pl. ix, fig. 1.

[4] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' p. 160, pl. xv, figs. 9, 9 *a*.

or sub-elliptical in cross-section. Septa concave, usually horizontal, sometimes a little oblique, widely separated as a rule. Siphuncle usually slender, cylindrical, central, sub-central, or eccentric. Body-chamber large, of variable length. Aperture simple." It extends from the Cambrian to the Trias, and contains, according to Barrande, 1146 species. Its greatest development is in the Silurian System, but the Devonian forms are very numerous.

Barrande divides the genus into two sections, *Brevicones* and *Longicones.* The former is represented in these strata by a single species, *O. rapiforme*, Sandberger. The Longicone species are much more numerous. Phillips recorded three from these beds, but it will be seen that we have now reason to increase the total number in the two sections to sixteen (or fifteen and one variety). Some of these fossils are in a beautiful state of preservation, but they are almost all fragmentary, and owing to the minute character of many of the specific differences in this genus, and their liability to change with the age of the shell, there is often much difficulty in discriminating the species. For the most part the shells are rare, but one or two, as *O. tubicinella, O. laterale*, and *O. Vicarii*, appear to have been fairly abundant.

1. Orthoceras rapiforme, *Sandberger.* Pl. XIII, figs. 14, 14 *a*, 15, 15 *a*.

1852? Orthoceras rapiforme, *Sandberger.* Verst. Rhein. Nassau, p. 167, pl. xix, figs. 4, 4 *a*.
1850. — rapæforme, *F. A. Römer.* Beiträge, pt. 1, p. 16, pl. iii, figs. 18, 18 *a*.
1858. — rapiforme, *Helmersen* and *Pacht.* In Baer's Beitr. Russ. Reich., vol. xxi, p. 85, pl. iii, fig. 5.

Description. — Shell straight, short, conoidal. Section almost circular. Siphuncle central. Rate of tapering, 3 in 7. Septa apparently narrow and rather oblique. Surface covered with fine, regular, rather distinct, impressed striæ, with finer imbrications. Apex very small.

Size.—Length, 58 mm., greatest width, 21 mm.

Locality.—Wolborough. A fine but worn specimen is in the Torquay Museum; another, rather smaller, in the Museum of Practical Geology (Godwin-Austen Collection); and two others, which are small and poor, in Mr. Vicary's cabinet.

Remarks.—These specimens are definitely distinguished from the other accompanying species by the large angle of their cone, but unfortunately they do not preserve many of their specific characters. The specimen in the Torquay

Museum is by far the finest, although its ornamentation is destroyed. That in the Godwin-Austen Collection adds something to our knowledge, as some signs of its surface ornament are to be discerned, although they are not very distinct.

I have referred these fossils to *O. rapiforme*, Sandberger,[1] as they appear to agree exactly with it both in the highly conical shape, and, if I interpret the Godwin-Austen specimen aright, in the narrowness of the chambers. The shell which F. A. Römer figures as *O. rapæforme*, Sandberger, is slightly elliptic, and perhaps tapers rather more rapidly.

Affinities.—This species differs from *O. conoideum*, Münster,[2] in being much more conical. *O. arcuatellum*, Sandberger,[3] is distinguished by having much deeper chambers; it would be interesting to know if the surface ornamentation on the body-chamber were of the character of those of that species.

O. transiens, Barrande,[4] appears somewhat less conical and is slightly recurved; its markings were probably similar. *O. deludens*, Barrande,[5] tapers less rapidly, and appears to have a more complicated ornament.

2. Orthoceras eutrichum, *Whidborne*. Pl. XIII, figs. 1, 1 *a*, and Pl. XIV, fig. 10?

Cf. 1853? Orthoceras tubicinella, *Sandb.* (not *Sow.* nor *Phil.*). Verst. Rhein. Nassau, p. 169, pl. xix, fig. 6.
1889. — comatum, *Whidb.* Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell elongate, slightly conical, moderate in size. Section apparently circular. Septa and siphuncle unknown. Surface covered with numerous distant, raised, thread-like, longitudinal lines, between which are one or two series of much finer similar lines, and crossed by very fine and numerous, irregular, rugose marks, and very indistinct and broad, transversely oblique bulges, the major series of longitudinal lines being alone visible on the cast.

Size about 23 mm. in width.

Locality.—A finely preserved specimen from Lummaton is in Mr. Champernowne's Collection, which shows the surface ornamentation very minutely. Another doubtful specimen from the same locality is in my Collection, which

[1] 1852? Sandberger, 'Verst. Rhein. Nassau,' p. 167, pl. xix, figs. 4, 4 *a*.

[2] 1840, Münster, 'Beitr.,' pt. 3, p. 96, pl. xviii, figs. 3, 4.

[3] 1852? Sandberger, 'Verst. Rhein. Nassau,' p. 166, pl. xix, figs. 2 *a*—*g*.

[4] 1868, Barrande, 'Syst. Sil. Bohêm.,' vol. i, pt. 3, p. 88, pl. ccxviii, figs. 8—11; pl. ccxxiv, figs. 17—23; pl. ccxcii, figs. 1—21; pl. ccxciii, figs. 1—12; and pl. cccci, figs. 12—15, Ét. E.

[5] 1870, Ibid., p. 47, pl. cccxcvii, figs. 5—9, Ét. E.

wants the outer shell and retains only the major series of longitudinal lines, which appear thicker and more rounded than when seen in the external layer.

Remarks.—These specimens appear to be portions of the body-chamber, and therefore nothing is at present known of the septal part of the shell,[1] but it seems to have very distinct features. It is quite unlike any of the other species described by Phillips from Devonshire, but approaches in some degree to the figure of *O. tubicinella*, Sowerby, given by Sandberger, so that Mr. Roberts and I were much inclined to refer it to that shell as distinct from the original *O. tubicinella* of Sowerby. As of the latter species, with one exception, the septal portion is only known, and as in the large specimen described below as *O. dolatum*, the rings become very indistinct toward the upper end, it might be questioned whether it might not be regarded as the body-chamber of that shell. I do not, however, think that there is really room for this presumption, as the bulges are very oblique, irregular, and confluent, so as to give the appearance of being divided by slight, accidental, linear constrictions, rather than of being definite swellings. The longitudinal lines, moreover, are very clear and prominent, and the transverse striæ are quite different from anything observable in *O. tubicinella*, Sow., or its allies. Finally, the one specimen which I know of the body-whorl of those shells preserves its specific characters with the exception that the rings have become indistinct bulges. As Barrande has described a Bohemian species under the name of *O. comatum*,[2] I am obliged to change the name which I proposed in the 'Geological Magazine' for the Devonshire form to *O. eutrichum*.

Affinities.—It is rather like *O. planicanaliculatum*, Sandberger,[3] but that shell differs in having only one series of longitudinal ribs, which are stouter than in ours, and in not having the transversely crumpled or tumid appearance described above. It also tapers more rapidly. *O. costellatum*, F. A. Römer,[4] which may be the same as *O. planicanaliculatum*, Sandberger, has fewer, stouter, and more regular radiations, and approaches in this respect nearer to the Lummaton cast than to Mr. Champernowne's shell. In *O. striato-punctatum*, Münster,[5] and *O. originale*, Barrande,[6] which taper more rapidly than do the English specimens, the longitudinal lines are much coarser and more regular and parallel, as is shown by examples in the British Museum. In the former of these shells they have a

[1] There is, however, in the Torquay Museum a small example of five segments of the apical end of a Cephalopod which may possibly belong to this species.

[2] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 401, pl. ccxcix, figs. 1—6.

[3] 1852 ? Sandberger, 'Verst. Rhein. Nassau,' p. 161, pl. xviii, figs. 4 *a*—*d*.

[4] 1852, F. A. Römer, 'Beitr.,' pt. 2, p. 92, pl. xiii, fig. 25.

[5] 1840, Münster, 'Beitr.,' pt. 3, p. 101, pl. xx, figs. 1—3.

[6] 1868, Barrande, 'Syst. Sil. Bohème,' vol. i, p. 206, pl. cclxvii, figs. 1—20, Ét. D (colony) and E.

tendency to become dotty near the apex. Blake[1] distinguishes Barrande's *O. originale* from Münster's shell, pointing out the curious formation of its test, which is quite unlike that of the present species. *O. spectandum*, Barrande,[2] has these rays still stronger and fewer and not alternate, and the surfaces between them closely barred. It presents no signs of transverse folds, and the tube is slightly recurved. *O. virgatum*, Sowerby,[3] from the Aymestry Limestone, has these rays still fewer and coarser, has transverse constrictions, and diminishes very rapidly and irregularly towards the apex. *O. polygonum*, Sandberger,[4] again has these longitudinal ribs much larger and stouter. *O. lineatum*, Hisinger, as figured by Portlock,[5] has a somewhat similar ornamentation, but Münster's[6] figures of his *O. tenuistriatum*, which Portlock regards as a synonym, and Hisinger's own figures,[7] are very different from our specimens. Their longitudinal markings are much finer, and they show no transverse ornamentation.

O. coralliforme, M'Coy,[8] seems similar in its minor ornament, but it has many fewer rays. *O. electum*, Barrande,[9] again has fewer rays, and its fine transverse imbrications are more regular and undulating, while there is an absence of the irregular transverse foldings, and the shell is slightly recurved. *O. Jonesii*, Barrande,[10] has closer, broader rays, and more regular and oblique transverse striæ. *O. Bacchus*,[11] Barrande, has fewer major rays, more strongly marked and numerous minor rays, no signs of transverse undulations, and a slight curvature.

3. Orthoceras tenuistriatum, *Münster*. Pl. XIII, figs. 2, 2 *a*, 2 *b*.

1840. Orthoceratites tenuistriatus, *Münst.* Beitr., pt. 3, p. 102, pl. xx, figs. 4, 4 *a*.

? 1843. Orthoceras tenuistriatum, *Portlock.* Geol. Rep. Londonderry, p. 370 (pl. xxviii, fig. 1 ?).

? 1852. — — *M'Coy.* Brit. Pal. Foss., p. 317.

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1 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 110, pl. vii, figs. 5, 10.

2 1868, Barrande, 'Syst. Sil. Bohème,' vol. i, pt. 3, p. 223, pl. cclxvi, figs. 5—17, Ét. G ? and E.

3 1839, Sowerby in Murch., 'Sil. Syst.,' p. 620, pl. ix, fig. 4.

4 1852 ? Sandberger, 'Verst. Rhein. Nassau,' p. 162, pl. xx, figs. 1 *a*—*c*.

5 1843, Portlock, 'Rept. Geol. Londonderry,' p. 370, pl. xxvii, figs. 3 *a*, *b*; pl. xxviii, fig. 1.

6 1840, Münster, 'Beitr.,' pt. 3, p. 102, pl. xx, figs. 4, 4 *a*, 4 *b*.

7 1837, Hisinger, 'Leth. Suec.,' p. 29, pl. ix, fig. 6.

8 1846, M'Coy, 'Syn. Foss. Sil. Irel.,' p. 8, pl. i, fig. 3.

9 1868, Barrande, 'Syst. Sil. Bohème,' vol. i, pt. 3, p. 243; pl. cclx, figs. 1—27, and pl. ccclxii, figs. 1—3, Ét. E.

10 Ibid., p. 200, pl. ccliii, figs. 1—7; pl. cccciv, figs. 10, 11, and pl. ccccliii, figs. 3—7, Ét. E.

11 1866, Ibid., p. 237, pl. ccxiii, figs. 10—13; pl. cclxx, figs. 1—16; and pl. cclxxi, figs. 1—21, Ét. E.

? ? 1870. ORTHOCERAS LINEATUM, *Barrande*. Syst. Sil. Bohême, p. 704, pl. ccccxxxviii, figs. 1—5.
? 1882. — — var. TENUISTRIATUM, *Blake*. Mon. Brit. Ceph., p. 128, pl. vii, figs. 7, 13.
1889. — TENUISTRIATUM, *Whidb*. Geol. Mag., dec. 3, vol. vi, p. 30.

Description.—Shell straight, elongate, conical. Section circular. Siphuncle central. Ratio of tapering 1 : 6. Surface covered by very fine and regular sharp longitudinal striæ, divided by concave interspaces, visible only through a lens, and numbering about 150 near the mouth.

Size.—The figured specimen measures 45 mm. in length and 12 mm. in diameter at the upper extremity.

Locality.—Wolborough ? There is a single specimen in the Torquay Museum, which, as far as can be judged from the matrix, came from that locality.

Remarks.—This unique specimen is in a fine state of preservation; the minute ridges come out clearly under a lens, in spite of their great number, and there are even indications of a still finer cross lineation beading the rays.

Mr. Roberts has kindly verified this identification for me, and believes it to be correct. In fact, in the shape, size, and character of ornamentation Münster's figure appears to us to agree perfectly with the present shell.

The only species that approaches it at all nearly among those found in Devonshire is, as far as we know, *O. eutrichum*, Whidborne, but this is distinguishable by the much greater coarseness and fewness of its markings, which are visible to the naked eye. Although the chambers are not seen, there are indications in the specimen leading to the belief that they were extremely narrow, and hence it would have been satisfactory if we had a specimen of the exterior of the British shell referred by Phillips to *O. imbricatum*, Wahl.,[1] with which to compare it.

Münster points out that it differs from his other species, *O. striato-punctatum*,[2] in its much more elongate shape, though he thinks that young specimens of the latter, deprived of their outer shell, might be confused with it. *O. conoideum*,[3] Münster, as represented by a specimen in the British Museum, differs from it by being quite smooth, and *O. semiplicatum*, Münster,[4] in being, according to the description, smooth on one side and having transverse folds on the other, but without longitudinal markings.

O. Darwini, Billings,[5] has much coarser lineations, and is slightly curved. It is from the Silurian of Canada.

1 1821, Wahl., 'Nova Act. Soc. Upsal.,' vol. viii, p. 89.

2 1840, Münst., 'Beitr.,' pt. 3, p. 101, pl. xx, figs. 1—3.

3 Ibid., p. 96, pl. xviii, figs. 4, 5.

4 Ibid., p. 98, pl. xviii, fig. 7.

5 1862, Billings, 'Pal. Foss.,' vol. i, p. 161; and 1888, Foord, 'Cat. Ceph. Brit. Mus.,' vol. i, p. 76, fig. 8.

O. lineatum, Hisinger, is given by Portlock[1] as a synonym of *O. tenuistriatus*, Münster; Portlock's species, however, is very much more coarsely ribbed than is the present form, while that species as figured by Blake[2] is of a much less regular conoidal shape (being more dagger-like).

Blake separates Portlock's species, or rather a portion of it having finer ribs, from that of Münster because the latter is stated to have a thick shell, whereas in the former it is thin. The test of ours appears thick, but is somewhat confused with the matrix. It appears to me, however, that unless this distinction be well marked, which is not proved, it might easily be accounted for on other than specific grounds, and the other reason Blake gives, the difference in geological age, is in itself no reason for separating them. As, therefore, in his so-termed variety the number of rays are the same, and the shape of the figured fragment agrees, it must be regarded as a possible synonym pending further evidence, especially as it occurs in the Wenlock as well as in the Bala beds. Barrande[3] describes some Swedish examples of *O. lineatum*, Hisinger, which are very much larger than the English fossil. These taper much less rapidly, and have rather deep chambers. The ornamentation, which appears to be much the same in character, is just visible to the naked eye, but this may perhaps not indicate that it is coarser, as the size of the specimens is so much greater. On the whole, it appears most probable that, in spite of the apparent resemblances, Münster's fossil will prove to be distinct from those of the latter authors.

4. Orthoceras Robertsii, n. sp. Pl. XIII, figs. 10—13.

Cf. 1840. Orthoceras irregulare, *Münster*. Beitr., pt. 3, p. 99, pl. xix, fig. 11.

Description.—Shell straight, very elongate, large, tapering at the rate of about 1 : 13. Section circular. Septa very concave, hardly if at all oblique, distant about one-third of their width. Syphon very large, about one-eighth the width of shell, definitely constricted by the septa, but cylindrical or even slightly narrower between them. External layer of shell very thin or papyraceous, and of a black colour. Surface marked with multitudinous, rather irregular, fine, and slightly arching transverse lines, about $\frac{1}{3}$ mm. apart, a few of which are slightly larger than the rest, the irregularity being in some specimens excessive, owing to injury or imperfection of formation, and there being occasionally extremely indistinct, longitudinal inequalities, and a slight tendency in the rings to become

[1] 1843, Portlock, 'Rep. Geol. Londonderry,' p. 370, pl. xxvii, figs. 3 *a*, *b*; and pl. xxviii, fig. 1.
[2] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 128, pl. vii, figs. 2, 11.
[3] 1870, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 704, pl. ccccxxxviii, figs. 1—5.

foliaceous, as well as to be very slightly crenulated by the longitudinal marks. The transverse marks equally well seen upon the inner shell.

Size.—The largest specimen measures 35 mm. in width.

Locality.—From Wolborough there are two finely preserved specimens in the Museum of Practical Geology, and two in Mr. Vicary's Collection, only one of which shows the transverse striation. From Lummaton there is one specimen in my Collection. In the Torquay Museum is a fine and instructive specimen, which probably came from Lummaton, but might have come from Wolborough.

Remarks.—These shells seem to come very near to *O. cinctum*, Sow.,[1] as figured and described by Münster[2] as well as the closely allied *O. linearis*, Münster,[3] with neither of which, however, Mr. Roberts or myself think they can be identical, on account of the inequality and irregularity of their striation, and because of their septa being distant one-third of their width instead of one-fifth, as in the German shell. The original *O. cinctum* is very vaguely described, but both Sowerby's figure and description would point to the annuli being very much fewer and coarser than they are in the fossils we are now considering. I think also there cannot be a doubt that they are distinct from the *O. cinctum* of Phillips[4] from Devonshire, inasmuch as one of the type-specimens of that species shows that the surface, of which it retains a fragment, is smooth. Phillips's Yorkshire *O. cinctum*[5] seems to belong to Sowerby's original species, and it differs from the present species in the regular, undulating, and more defined character of its annuli.

Mr. Roberts and I consider that this species comes much nearer to *O. irregulare*, Münst.,[6] but that still it is probably distinct from it, as in that species the markings are much more irregular than in ours. Judging from its description, it is the species which is most like it of any that I know; but a doubtful specimen of it in the British Museum is very distinct, having much fewer and more distant impressed striæ.

From Sandberger's version of *O. lineare*, Münster, it differs in its striæ not being equal and regular. Sandberger's figure, 7 *c*, of this shell,[7] though it approaches it almost exactly in ornamentation, has the septa very much closer together.

From *O. arcuatellum*, Sandb.,[8] it is distinguished by its much less conical figure and its less undulating striæ.

[1] 1829, Sow., 'Min. Conch.,' p. 168, pl. dlxxxviii, fig. 3.

[2] 1840, Münster, 'Beitr.,' pt. 3, p. 99, pl. xix, fig. 4.

[3] Ibid., p. 99, pl. xix, fig. 1.

[4] 1841, Phillips, 'Pal. Foss.,' p. 109, pl. xli, fig. 204.

[5] 1836, Phillips, 'Geol. Yorks.,' pt. 2, p. 236, pl. xxi, fig. 1.

[6] Münst., 'Beitr.,' pt. 3, p. 99, pl. xix, fig. 11.

[7] 1852 ? Sandb., 'Verst. Rhein. Nassau,' p. 164, pl. xviii, figs. 7 *a*—*c*.

[8] Ibid., p. 166, pl. xix, figs. 2 *a*—*g*.

There is a close approach in its ornamentation to the specimens of *O. subannulare*, Münst., from Wolborough, from which it differs in the absence of raised rings.

O. Dannenbergi, d'Arch. and de Vern.,[1] has decidedly narrower chambers, the septa being distant less than a quarter, instead of more than a third, of their width. It is not very easy to say whether the striæ of ours are oblique to the septa as in that shell. Sandberger describes the same species under the name *O. undato-lineolatum*, Sandb.,[2] and there the shell is seen to be much more tapering, and the concentric striæ are much more regular and have a second series of minor striæ, which are moreover clearly shown on a German specimen of that shell in the British Museum.

In *O. vittatum*, Sandb.,[3] the striæ are much finer and perfectly regular and equal, and their curvature also seems different.

In *O. crassum*, F. A. Römer,[4] the striæ seem more oblique and the chambers are much narrower.

In *O. Moctreense*, Sow., as given by F. A. Römer,[5] the striæ are more regular and sharper, and are more defined. As the width of the chambers is not seen, the question of its identity cannot be settled from F. A. Römer's first work, and Sowerby's original figure[6] does not help. It looks somewhat angulated in section. There are, however, some fine specimens in the British Museum which show that the striæ are much fewer and more distant, and that the shape of the shell is quite different, being short and irregularly lumpy. Römer[7] afterwards refigured his shell, identifying it with the *O. lineare* of Münster and Sandberger. As thus shown, it differs from ours in having much more distant septa.

In *O. virgo*, Giebel,[8] the septa are far more distant.

The section figured by Portlock as *O. maximum*, Münst.,[9] agrees with that of our shell, but this can only give generic identification.

O. pendens, Blake,[10] increases much more rapidly.

O. expansum, Blake,[11] has the striæ more undulating, and *O. argus*,[12] and

[1] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, p. 345, pl. xxviii, figs. 1, 1 *a*.
[2] 1852 ? Sandberger, 'Verst. Rhein. Nassau,' p. 163, pl. xviii, figs. 6 *a*—*d*.
[3] Ibid., p. 165, pl. xx, figs. 9 *a*, *b*.
[4] 1843, F. A. Römer, 'Verst. Harz.,' p. 35, pl. x, fig. 6.
[5] Ibid., p. 36, pl. x, fig. 11.
[6] Sow. in Murch. 'Sil. Syst.,' p. 616, pl. vi, fig. 11.
[7] 1850, F. A. Römer, 'Beiträge,' pt. 1, p. 17, pl. iii, fig. 23.
[8] 1858, Giebel, 'Sil. Faun. Unterharz.,' p. 16, pl. iii, fig. 2.
[9] 1843, Portlock, 'Rept. Geol. Londonderry,' p. 472, pl. xxxv, fig. 3.
[10] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 122, pl. xi, figs. 2, 5.
[11] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 118, pl. vi, fig. 15.
[12] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 476, pl. cccxxv, figs. 1—18, &c., Ét. F.

O. capillosum, Barrande,[1] *O. recticinctum*, Blake,[2] and *O. Grindrodi*, Blake,[3] have them very much closer and finer.

The indistinct longitudinal ornamentation, sometimes to be seen, approximates it to *O. araneosum*, Barrande,[4] but that species differs in the size of the siphuncle, the narrowness of its chambers, its generally curved form, and in other respects.

O. nobile, Barrande,[5] is very similar in many respects, but its siphuncle is generally more excentric; its septa are much more distant; and its minor markings are more regular. It has close ribs in the apical part (not seen in any of our specimens); and there are no signs of any longitudinal marks, which, though indistinct, exist in the English specimens; and for these causes I cannot unite them. *O. Duponti*, Barr.,[6] and *O. severum*, Barr.,[7] besides presenting similar divergences, with the exception of having no rings, have the additional difference of the siphuncle being still more excentric. The chambers of the last species are deeper than in the English fossil.

O. palus, Barrande,[8] seems to have finer closer markings and a smaller siphuncle; the septa are not shown. *O. asparagus*, Barrande,[9] as seen from a specimen in the British Museum, is exactly similar in ornament, but its septa are very much more distant, being more than half the diameter of the shell apart.

5. Orthoceras Vicarii, *Whidborne*. Pl. XIII, figs. 3—7, 9, 9 *a*, 9 *b*.

cf. 1888. Orthoceras Dannenbergi, *Foord*. Cat. Foss. Ceph. Brit. Mus., p. 84.
1889. — Vicarii, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell very elongate, straight, very slightly conical. Section circular. Shell-structure thin. Siphuncle small and slightly excentric. Chambers very concave, moderately deep, their height being to their width in the ratio of

[1] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 486, pl. cccxxv, figs. 19—33; pl. ccclvii, figs. 4—7; and pl. cccxciv, figs. 16—19, Ét. E—H.

[2] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 121, pl. xi, fig. 4.

[3] Ibid., p. 122, pl. ix, fig. 9.

[4] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 283, pl. cccxxxvii, figs. 1—9; pl. cccxxxviii, figs. 1—14; pl. cccxxxix, figs. 1—14; and pl. cccxl, figs. 1—17, Ét. E.

[5] 1866, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 336; pl. ccxxviii, figs. 2—4; pl. cclxxxiv, figs. 1—19; pl. cccxi, figs. 1—7; pl. cccxii, figs. 1—7; and pl. cccxiii, figs. 1—10, Ét. E.

[6] Ibid., p. 324, pl. cclxxxv, figs. 1—17; and pl. cccxxiv, figs. 7—10, Ét. E.

[7] Ibid., p. 384, pl. ccci, figs. 1—5; also pls. ccxix, ccxxi, &c., Ét. E.

[8] 1870, Ibid., p. 535, pl. ccclxiv, figs. 12—14, Ét. F.

[9] 1868, Ibid., p. 428, pl. cccxvii, figs. 1—5, Ét. E.

about 1 : 4. Surface bearing distant transverse fine angular rings, situated 1 mm. or 2 mm. apart, gently arching as they cross the shell, and numbering three upon each chamber. Interspaces between the rings gently concave, marked with numerous fine parallel microscopical striæ, which are frequently obliterated. Colour black.

Size.—None of the specimens known are sufficiently perfect to give any idea of its proportions. One in the Battersby Collection is $4\frac{1}{2}$ inches high by about $\frac{1}{2}$ inch in diameter. The shell is stated by the quarry-men sometimes to reach the length of 7 or 8 inches. The largest specimen I know is about 23 mm. in diameter.

Localities.—This Cephalopod appears to be not uncommon at Lummaton; I have obtained several small specimens from the shelly bed at the top of the quarry, and specimens of a large size are found by the workmen in the massive rock. I have seven or eight fragmentary specimens. There is a good specimen in Mr. Lee's Collection, and a fine specimen in the Battersby Collection in the Torquay Museum, which is in a sandy matrix, but may perhaps have come from the same place. Mr. Vicary has five specimens from Wolborough, and there is another in the Godwin-Austen Collection in the Museum of Practical Geology from the same locality. A specimen in the British Museum, which has been labelled by Mr. Foord "*Orthoceras* cf. *Dannenbergi*," is stated to come from Torquay.

Remarks.—This is an interesting and characteristic species. The test appears to be very thin, and it is remarkable for the frequency with which it retains a blackish colour. This colour is, of course, no criterion of its original tint, but doubtless is indicative of some peculiarity, as at least at Lummaton it is only observable in two or three other species of fossils, especially in *Capulus*. The surface markings seem always to retain very much the same character; the ribs becoming only slightly more distant as they approach the upper portion. It is, however, curious to observe how little their width varies in different-sized shells. Thus in a specimen 23 mm. wide the rings are distant 2 mm., while in one only 5 m. wide they are distant 1.2 mm. A comparison of numerous specimens leads me to regard this as of little importance, and indeed a similar variation is apparent in other species, as in *O. tubicinella*. Unfortunately, the septa can very rarely be seen, and therefore the relation they bear to the ribs either in number or in curvature cannot be positively asserted. In the small specimen, however, in the Museum of Practical Geology their relation, as well as the position of the siphuncle, is clearly shown, and there it is seen that the rings are three times as numerous as the septa, and agree with them in outline. There appears to be some amount of variation in the arching of these ribs, as well as in the tapering of the shell. It is also to be noted that in Mr. Vicary's large specimen, which probably includes the body-whorl, the ribs and striæ are as prominent and definite as in any of the smaller specimens.

Affinities.—Of the Devonshire shells described by Phillips, *Orthoceras lineolatum*, Phil.,[1] is the species which comes nearest to the present fossil. This differs apparently in its rings being much further apart and more definitely oblique, and in the smaller ornamentation being gently undulating; the siphuncle appears to occupy a similar position. The specimen, however, figured in the "Palæozoic Fossils" is evidently a poor and distorted fragment, and is identified by Phillips with a Yorkshire shell,[2] *O. annulatum*, Phillips (not Sow.), which strongly emphasises these distinctions.

O. tentaculare, Phil.,[3] if it be an *Orthoceras*, may be distinguished from the present form by its curved shape, and by the greater size and prominence of its rings.

In *O. striolatum*, H. von Meyer,[4] from the *Posidonomyen-Schiefer*, the rings are altogether closer, finer, and more numerous.

O. Dannenbergi, d'Arch and de Vern.,[5] which, according to Mr. Foord,[6] is the same as *O. undato-lineolatum*, Sandb.,[7] appears to be decidedly different, as its rings are undulating and oblique to the septa, and are crossed and imbricated by the finer striæ.

O. pulchellum, F. A. Röm.,[8] differs from it in having a very elliptic section, a marginal siphuncle, four rings instead of three on each segment, and in its segments being three, and not four, times as wide as they are deep.

O. inæquistriatum, F. A. Römer,[9] from the Culm of Grund, seems a very nearly allied form, which may, however, be distinguished by the rings being much more numerous and minute, and arranged in an alternating series, and by the chambers being as high as they are wide.

O. perannulatum, Portlock,[10] is larger, more conical, and has more rugose and rounded annulations.

O. elongato-cinctum, Portlock,[11] has the rings finer and closer and is more conoidal.

[1] 1841, 'Phil. Pal. Foss.,' p. 111, pl. xliii, fig. 209.

[2] 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 239, pl. xxi, figs. 9, 10.

[3] 1841, 'Phil. Pal. Foss.,' p. 112, pl. xliii, fig. 210.

[4] 1831, H. von Meyer, 'Nov. Act. Acad. Leop.-Carol.,' vol. xv, pt. 2, p. 59, pl. lvi, figs. 1—12, not pl. lv; and 1852?, Sandberger, 'Verst. Rhein. Nassau,' p. 165, pl. xix, figs. 3 *a*, *b*.

[5] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 345, pl. xxxviii, figs. 1, 1

[6] 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' vol. i, p. 84.

[7] 1852?, Sandb., 'Verst. Rhein. Nassau,' p. 163, pl. xviii, figs. 6 *a*—*d*.

[8] 1850, F. A. Röm., 'Beitr.,' pt. 1, p. 39, pl. vi, fig. 5.

[9] 1852, F. A. Römer, 'Beitr.,' pt. 2, p. 92, pl. xiii, figs. 23 *a*, *b*.

[10] 1843, Portlock, 'Rep. Geol. Londonderry,' p. 367, pl. xxv, figs. 5, 6.

[11] Ibid., p. 372, pl. xxvii, figs. 2 *a*, *b*.

O. Maclareni, Salter, as given by Blake,[1] has larger and coarser ribs with less defined interspaces.

O. argus, Barrande,[2] and *O. capillosum*, Barrande,[3] have very much finer lineations.

6. Orthoceras Vicarii, var. eductum. Pl. XIII, fig. 8.

Two or three of the small specimens which I have collected from Lummaton, differ from the species described above in the much greater comparative distance of the transverse rings, and in being almost perfectly cylindrical. These rings are half their diameter apart, instead of, as in the generality of the larger specimens, being separated by only about one tenth the width of their diameter. We have seen, however, that the species varies considerably in these particulars; and as in the figured specimen of the present variety the distance of the rings varies considerably in different parts of the shell, there is no reason for regarding these points as of specific importance. In all probability the present specimens are either very young animals or a dwarfed form of the present species.

Locality.—Lummaton.

Affinities.—*O. pauper*, Barrande,[4] seems very similar, but the ribs seem closer and stouter, and facing upwards instead of having equal slopes.

7. Orthoceras dolatum, *Whidborne*. Pl. XIV, figs. 1—3.

1852 ? Orthoceras tubicinella, *Sandberger* (not *Sowerby*). Verst. Rhein. Nassau, p. 169, pl. xix, figs. 6 *a—d*.
1889. — hastatum, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 29.

Description.—Shell large, straight, conical, slowly but definitely tapering at the rate of 1 mm. in width to about 9 mm. in length. Septa concave, rather narrow, oblique. Siphuncle sub-central, large. Section elliptic. Surface bearing low, broad, rounded, and very oblique rings of about the same size as the inter-

[1] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 105, pl. vi, figs. 7—10.

[2] 1868, Barrande, 'Syst. Sil. Bohême,' pt. 3, p. 476, pl. cccxxv, figs. 1—18, &c., Ét. F.

[3] Ibid., p. 486, pl. cccxxv, figs. 19—33; pl. ccclvii, figs. 4—7; and pl. cccxciv, figs. 16—19, Ét. E—H.

[4] Ibid., vol. i, p. 340, pl. cclvii, figs. 10—13, Ét. F.

spaces, corresponding in number with the septa, and becoming more and more obscure towards the summit of the shell. Both rings and interspaces crossed by numerous, distant, rounded, longitudinal threads, between which is a second series of much less prominent lines.

Size.—The largest specimen known, though wanting both the body-chamber and the apical portion, measures 153 mm. in length. Its diameters at the summit (which may be slightly compressed) measure respectively 32 mm. and 26 mm.

Locality.—Wolborough. There is a fine, though worn, specimen of the aged shell, as well as two other fragments which agree with it, in Mr. Vicary's Collection. In the Torquay Museum is another fine and beautifully marked example, which has more prominent ribs than the former, and this comes nearer to *O. tubicinella*, as well as a fragment of the body-chamber, in which the rings are shown to be almost obliterated. In the Museum of Practical Geology are two fragmentary specimens, which respectively correspond in ornamentation to the two last mentioned.

Remarks.—The fine and aged shell in Mr. Vicary's Collection, which is the type of this species or variety, was identified by Salter with *O. ludense,* Sow.[1] With that species, however, it has certainly no affinity. Neither is it at all similar to *O. striatulum*, Sow.,[2] which is a far more conical form. There appeared no reason at first for imagining it to be at all connected with *O. tubicinella*, from which it presents numerous differences; but on comparing it with the above-mentioned specimen from the Torquay Museum and with the numerous specimens of *O. tubicinella* which will be noticed below, its relationship comes out. Though Mr. Vicary's shell differs much from the Torquay specimen, its lower portion is so worn that the nature of its markings cannot be made out, and at the upper extremity of the latter there appears to be a change of ornamentation, leading to the supposition that if more of the upper part had been preserved it would have shown similar features. The specimen of the body-chamber shows that these characters are even more developed in that part, the rings having almost entirely disappeared. For this reason I have placed it under this head, but it is quite possible that in *O. tubicinella* itself the rings may be obliterated on the body-chamber.

Owing to the great amount of variation in the specimens of these two species and of *O. sub-tubicinella*, and their fragmentary condition, it has been very difficult to decide whether they really are distinct forms, or simply belong to one large and very variable species; at times I have been much inclined to group them together, but, after repeated examinations and consultations, it has seemed best to regard them as three distinct forms. As far as can be judged by the specimens examined, which, though fine, are all more or less fragmentary, there appear to be certain definite distinctions between them, and it only remains to see whether

[1] 1839, Sowerby, Murch. 'Sil. Syst.,' p. 619, pl. ix, figs. 1 *a*, 1 *b*.

[2] 1840, Ibid., 'Geol. Trans.,' ser. 2, vol. v, pt. 3, p. 703*, pl. liv, fig. 20.

these distinctions will be preserved when more numerous and perfect fossils are discovered. Thus *O. dolatum* differs from *O. tubicinella*, in tapering more rapidly, in having fewer, lower, more oblique and confluent ribs, stronger radiations, and a more elliptic section. *O. sub-tubicinella* differs from *O. tubicinella* in having more numerous, less oblique and more defined ribs, and a circular section; while it becomes cylindrical about the body-chamber. Thus it differs from the present species still more than does the latter shell.

O. tubicinella, Sandberger[1] (not Sowerby), differs slightly in the number and fineness of its longitudinal marks, and its circular section, but it probably belongs to the species now under consideration.

As Billings[2] had already used the name *O. hastatum* for a Canadian species, it has been necessary to change the name suggested in the 'Geological Magazine' for the present form.

Affinities.—*O. dolatum* appears to be very similar to *Orthoceratites calamiteus*, Münster,[3] but the swellings seem much narrower than in that species, and it has no indications of fine transverse striæ, while the longitudinal threads seem to be much fewer and coarser.

8. Orthoceras tubicinella, *Sowerby*. Pl. XIV, figs. 4, 4 *a*, 5, 5 *a*.

1840. Orthoceras tubicinella, *Sow.* Geol. Trans., ser. 2, vol. v, p. 703,* pl. lvii, fig. 29.
1841. — — *Phil.* Pal. Foss., p. 112, pl. xliii, fig. 211.
1843. — — var., *Portlock.* Rep. Geol. Londonderry, p. 367, pl. xxv, fig. 4.
? 1843. — tubicinella, var. subnodosum, *Portlock.* Rep. Geol. Londonderry, p. 367, pl. xxv, fig. 3.
? 1843. — gracile, *Portlock* (not *Blumenbach*). Rep. Geol. Londonderry, p. 366, pl. xxv, fig. 2.
1888. — tubicinella, *Etheridge.* Foss. Brit., vol. i, Pal., p. 168.
1888. — — *Foord.* Cat. Foss. Ceph. Brit. Mus., vol. i, p. 87.

Description.—Shell elongate, large, slowly tapering. Rate of tapering about 1 in 12. Section slightly elliptic, the diameters being in the ratio of about 9 to 10. Septa very concave, oblique, distant from each other between a fourth and a fifth of their diameter. Surface ornamented with regular, prominent, transverse, rounded and defined rings, considerably narrower than their interspaces, corre-

[1] 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 169, pl. xix, fig. 6.
[2] 1857, Billings, "Report of Progress," 'Geol. Surv. of Canada,' p. 333.
[3] 1839, Münster, 'Beitr.,' pt. 1, p. 59, pl. xvii, figs. 5 *a*, *b*.

sponding in number with the septa, and crossing the shell in a boldly curved oblique line; the whole of both rings and interspaces crossed by about thirty regular prominent threads, which usually have more or less distinct indications of a subsidiary series of less prominent lines between them. Siphuncle central.

Size.—A typical example of the septal part of this shell in the Museum of Practical Geology, which is 89 mm. in length, measures 17 mm. by 15 mm. in section at its upper end.

Locality.—Wolborough. This beautiful and highly ornamented species appears to have been common. There are eight specimens in Mr. Vicary's Collection, eight in the Museum of Practical Geology, four in the British Museum, one in the Battersby Collection of the Torquay Museum, and one in the Bristol Museum. I have not met with Sowerby's or Phillips' figured specimens, but their figures exactly correspond with these fossils.

Remarks.—There seems to have been a considerable amount of variation in this species, both in the prominence and frequency of the rings and in the obscurity or occasional absence of secondary threads, and perhaps also in other features. It appears, however, to be distinguished, besides by other features, by the defined character of its rings, which rise almost suddenly from the flattish interspaces. Although rarely, if ever, seen, it is probable that the surface was covered by fine concentric striæ in addition to its other markings. The only direct evidence of this is one of Mr. Lee's specimens in the British Museum, which, while wanting the secondary series of longitudinal lines, is covered by very numerous fine and regular transverse threads. The locality of this specimen, however, is not given, and I do not think it came from Devonshire.

The obliquity of the rings is peculiar. It appears to lie along the shorter axis of its section, and thus suggests that this was the dorso-ventral direction, and consequently that the shell was transversely dilate. The section appears to have been circular near the apex and only to have become elliptic as the shell increased in growth.

Affinities.—The specimen from Lummaton, described under the name of *O. oryx*, presents some similarity to the present species, but is to be distinguished by its prominent transverse striation, its very elliptic section, and some other features. *O. sub-tubicinella* is separated by its much more numerous rings and by other points mentioned under that heading.

O. annulatum, Sow.,[1] is distinguished from the present shell by its more distant ribs, its numerous sharp, undulating, transverse threads, and the indistinctness of its longitudinal markings. *O. dulce*,[2] Barrande, has no longitudinal marks, and the transverse threads are generally river-like. It is also often slightly arched in

[1] 1816, Sowerby, 'Min. Conch.,' vol. ii, p. 73, pl cxxxiii.

[2] 1868, Barrande, 'Syst. Sil. Bohême,' vol. ii, pt. 3, p. 321, pl. ccxciv, figs. 1—14; pl. ccxcv, figs. 1—29; pl. cccclxxxviii, fig. v, 1—3, Ét. D (colony) and E.

shape. *O. subannulare*, Münster,[1] has the ribs closer and less defined, no longitudinal threads, and regular coarse and parallel transverse marks, about nine times as numerous as the ribs. *O. ibex*, Sowerby,[2] comes very close to the last-mentioned species, but in it the transverse threads are very much finer and the ribs smaller and more definite. In these two species the ornamentation merges on the body-chamber into irregular parallel transverse lines. Lastly, of the proximate forms of which there are examples in the British Museum, *O. pseudo-calamiteum*, Quendst.,[3] and Barrande,[4] has distant and direct ribs, few regular and wall-like, lamellar longitudinal lines, and eight or nine indefinite, concentric, transverse lineations between each rib. Though distinctly different from the present form, it is closely allied to it, and appears to be its representative in the Bohemian Rocks.

O. nodulosum, Schlotheim, as figured by d'Archiac and de Verneuil,[5] is very different in its ornament. It has no longitudinal striæ; and the rings are broken into rounded nodules.

In Sandberger's figure (6 *a*) of his *O. tubicinella*,[6] the transverse striæ are represented as exceedingly fine, there being between twenty and thirty for each ring. The indications in our specimens would lead to the supposition that in them the striæ were much fewer and coarser. Sandberger's figure differs, moreover, in the indefiniteness and fewness of its rings, so that probably it should be referred to *O. dolatum* rather than to the present species. *O. tenuilineatum*, Sandberger,[7] is distinguished by the longitudinal striæ being much finer and more numerous, the rings being fewer and narrower, and the septa being, according to his description, distant.

In the report on the Geology of Londonderry, Portlock gives three species, *O. gracile*, Blumenbach,[8] *O. tubicinella*, Sowerby, and *O. calamiteum*, Münster,[9] all of which Blake[10] regards as one species, "*O. gracile*, Portlock," differing from both Sowerby's and Münster's shells. Blake's shell appears to be a very variable species and one which is very similar to *O. tubicinella*. The differences which Blake insists upon, viz. more direct ribs and more regular and constant rays, neither hold well. The former appearance seems due to the aspect of the figures drawn; and certainly

[1] 1840, Münster, 'Beitr.,' pt. 3, p. 99, pl. xix, fig. 3.
[2] 1839, Sowerby in Murch., 'Sil. Syst.,' p. 613, pl. v, fig. 30.
[3] 1852, Quenstedt, 'Handbuch Petref.,' p. 342, pl. xxvi, fig. 8.
[4] 1868, Barrande, 'Syst. Sil. Bohême,' vol. ii, pt. 3, p. 261, pl. cclxxviii, figs. 1—33, &c., Ét. E, F, G.
[5] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, p. 347, pl. xxxi, figs. 4, 4 *a*.
[6] 1852?, Sandberger, 'Verst. Rhein. Nassau,' p. 169, pl. xix, figs. 6 *a*—*d*.
[7] Ibid., p. 168, pl. xix, figs. 7, 7 *a*.
[8] 1803, Blumenbach, 'Specimen Archæologiæ Telluris,' p. 21, pl. ii, fig. 6.
[9] 1839, Münster, 'Beitr.,' pt. 1, p. 59, pl. xvii, figs. 5 *a*, *b*.
[10] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 85, pl. iii, figs. 5, 9.

in our shell the ribs are oblique, though not so much so as in Blake's figures. A more distinctive character may be found in the greater acuteness and distance of the longitudinal ribs; but, where two species from such different formations and so variable in themselves are evidently so closely allied, it is difficult to decide their identity until their representative in the intermediate Upper Silurian can be traced. It is to be noted that Blake's name of "*O. gracile*, Portlock," will not hold good, as that name had been already applied by Blumenbach to a very different shell. The same species has, however, been described under the name of *O. annellatum* by M'Coy,[1] and this name will therefore take its place. *O. Nicholianum*, Blake,[2] from the Upper Silurian, agrees with ours in the sharpness of its rays, but distinctly differs in the closeness of its septa.

O. pulchrum, Barrande,[3] is a very similar form; but in it the ribs are more rounded, lower, and broader than the interspaces, and the longitudinal rays are much more numerous.

O. Lorieri, d'Orbigny,[4] as given by Barrois,[5] differs in being more cylindrical, in its ribs being quite horizontal, and in its longitudinal threads being rather more numerous, and without any intermediate series of lines. In Barrois' figures very fine transverse striæ are seen; there is no clear evidence of the existence of such striæ in the English shell.

9. Orthoceras sub-tubicinella, n. sp. Plate XIV, figs. 6, 6 *a*.

Description.—Shell elongate, straight, tapering at the rate of 1 in 12 in the septal part, but becoming almost cylindrical about the body-chamber. Section circular. Siphuncle central. Septa only slightly oblique, deeply concave. Surface bearing numerous, elevated, rounded rings about their own diameter apart; about six rings occupying a space equal to the width of the shell; the whole covered by about thirty strong, raised, thin rays, which do not alternate in the lower part of the shell but have at the upper end a secondary series of much finer intermediary lineations, three times as numerous as the major rays.

Size.—A broken specimen measures 40 mm. in length by 13 in width. Another specimen 78 mm. long, has a diameter of 22 mm.

Locality.—Wolborough. One specimen is in the Battersby Collection in the Torquay Museum, and another is in the Museum of Practical Geology.

Remarks.—I formerly regarded these fossils as specimens of *O. tubicinella*, and was led into some confusion thereby. Taking, however, the specimen in the

1 1851, M'Coy, 'Brit. Assoc. Rep.,' p. 103.

2 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 89, pl. iii, figs. 7, 8, 15.

3 1868, Barrande, 'Sil. Syst. Bohême,' vol. ii, pt. 3, p. 264, pl. cclxxvi, figs. 1—17, Ét. F and G.

4 1849, D'Orbigny, 'Prodrome,' p. 55.

5 1889, Barrois, 'Mém. Soc. Géol. Nord.,' vol. iii, 'Faune Calc. d'Erbray,' p. 228, pl. xvi, figs. 4 *a*—*c*.

Torquay Museum as the type, it will be seen that it differs from that shell in several particulars. The rings are closer, steeper, and half as numerous again (*i. e.* 3 to 2), and the section is circular. Hence, in the opinion of Mr. Foord and myself, it has to be regarded either as a distinct species or variety.

I have coupled the specimen in the Museum of Practical Geology with it with some doubt, as while it presents a great resemblance there are some points of difference. These are probably due, however, to its being in a different state of preservation and belonging to a different part of the shell. It appears to contain part of the body-chamber and the upper portion of the septal chambers. Its rings are less elevated, and in the upper part the tube is cylindrical and the rays more distant, with minor lineations between. This last feature reminds us of the ornamentation in *O. eutrichum*, but its markings are much coarser than those of that species. Towards the lower part of the specimen the characters grow much more like those of the upper part of the Torquay specimen, which is, I imagine, a portion of the tube considerably nearer to the apex; and therefore there seems every reason for presuming that they are specifically identical.

Affinities.—From *O. calamitaceum*, Portlock[1] (not Münster), it differs in the coarseness and closeness of its rays, and in the absence of the finer radiations in its lower part, as well as in its circular section. The section of the Irish shell, which Blake treats as a variety of *O. gracile*, Portlock[2] (not Blumenbach),[3] is very elliptic, but Portlock seems to consider that this might have been due to pressure.

O. Nicholianum, Blake,[4] a still nearer form, differs from our type in having sharp ribs and less prominent and fewer rays, and in the septa being apparently closer.

10. Orthoceras subannulare, *Münster*. Plate XIV, figs. 7, 7 *a*, 8, 8 *a*, 8 *b*.

1840. Orthoceratites subannularis, *Münst.* Beitr., pt. 3, p. 99, pl. xix, fig. 3.
1850. Orthoceras Wissembachii, *F. A. Römer* (not *d'Arch.* and *de Vern.*). Beitr., pt. 1, p. 17, pl. iii, fig. 22.
1868. — discretum, *Barrande.* Syst. Sil. Bohême, vol. ii, p. 276, pl. cclxxix, figs. 38—43, Ét. F.
? 1868. — subannulare, *Barrande.* Syst. Sil. Bohême, vol. ii, pt. 3, p. 343, pl. ccx, figs. 8—10; pl. ccxii, figs. 14—18; pl. ccliii, figs. 11—14; pl. cclxxxiii, figs. 1—19; pl. cccxxiii, figs. 15—19, &c., Ét. E and G.

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[1] 1843, Portlock, 'Rep. Geol. Londonderry,' p. 365, pl. xxv, figs. 1 *a*, *b*.
[2] Ibid., p. 366, pl. xxv, fig. 2.
[3] 1803, Blumenbach, 'Specimen Archæologiæ Telluris,' p. 21, pl. ii, fig. 6.
[4] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 89, pl. iii, figs. 7, 8, 15.

? 1882. ORTHOCERAS SUBANNULARE, *Blake*. Mon. Brit. Foss. Ceph., pt. 1, p. 94, pl. v, figs. 6, 6 *a*.
? 1888. — — *Foord*.[1] Cat. Foss. Ceph. Brit. Mus., vol. i, pp. 59 and 94.

Description.—Shell elongate, slightly conical, tapering in the ratio of about 1 : 16. Section circular. Septa very concave, slightly oblique and arching; very distant, their height being about one-third or two-fifths of their width. Siphuncle central, large. Surface bearing three broad, low, indistinct, rounded rings or bulges on each segment (which appear rather sharper and more distinct on the inner shell); and covered both on the rings and hollows with sharp, distant, prominent, transverse lines, with sloping sides, and somewhat unequal in height, which have the appearance of being slightly imbricated by longitudinal markings, and are about eight times as numerous as the rings.

Size.—The larger specimen in the Museum of Practical Geology, measuring 114 mm. in length, is 18 mm. wide at the upper extremity.

Locality.—There is a small portion of the septal part, consisting of almost three chambers, in my Collection, which I believe to have come from Wolborough; and two other specimens, one of which is very long, in the Museum of Practical Geology from the same locality.

Remarks.—There is, in the opinion of both Mr. Roberts and myself, no reason for hesitating about the identification of these fossils with Münster's species, as they agree in every respect both with his figure and description. Supposing that there is no mixing of species under this name, it appears to be common to both the Silurian and the Devonian of England and the Continent. The ribs in Münster's species are more rounded than in our specimens, but they are described by him as being sometimes sharp: our fossils agree with his in the central position of the siphuncle and in the circular section; but, on the other hand, M'Coy asserts that neither of these points are correct if judged by the fossils of Münster's locality; and Barrande's figures of the species bear him out in this respect. In fact, there is much reason to doubt the identity of Barrande's *O. subannulare*[2] with the present fossil; as it has more distant chambers and unimbricated and oblique ribs and riblets, which do not seem to be so sharp as those in our form.

Foord[3] gives a full description of *O. subannulare* as occurring in the Wenlock Shale and the Bohemian Étage E, which, while generally agreeing, differs from our specimens in the important particular that the depth of the chambers is stated to be two-thirds instead of two-fifths of their width. *O. discretum*, Barrande,[4] has,

[1] For other synonyms of the Silurian species see Foord, *loc. cit.*

[2] 1866, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 343, pl. cclxxxiii, figs. 1—19, &c., Ét. D (colony) and E.

[3] 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' vol. i, p. 53.

[4] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 276, pl. cclxxix, figs. 38—43, Ét. F.

indeed, much more resemblance to the Devonshire shell than has his *O. subannulare*, although its ornamentation is finer and its siphuncle not quite central, and I am much inclined to regard it as a variety. To sum up, while Münster's original description of his Devonian shell agrees exactly, as far as it goes, with our shell, the interpretations of it by M'Coy, Barrande, and Foord, referring chiefly to the form occurring in the Silurian beds, present some points of difficulty which raise a strong doubt as to the identity of the Silurian form with Münster's, and which do not appear to arise in another Devonian species described by the Bohemian author. Lastly, *O. Wissembachii*, d'Arch. and de Vern.,[1] as given by F. A. Römer, appears so similar as to cause a presumption of its identity, its rings being much closer and its size much greater than in d'Archiac's type, and, moreover, bearing secondary striæ. The specimen, however, which Römer figures, is a small fragment showing few specific characters.

Affinities.—Our shell comes very close to *O. annulatum*, Sow.,[2] but its septa and ribs are wider apart, its riblets are closer, more numerous, and less fimbriated and foliaceous, and its longitudinal marks are always almost invisible. These differences are clearly shown in Blake's[3] figures of Sowerby's fossil, its small flounced riblets marking it as specifically distinct.

O. vertebratum, Sandberger,[4] has the rings much more rounded and more distant, so that the distances of the septa, which are half as numerous as the rings, are equal to the width of the shell. *O. solitarium*, Barrande,[5] has a very excentric siphuncle and much narrower chambers.

O. Agassizi, Barrande,[6] has an excentric siphuncle and no longitudinal imbrications.

11. ORTHOCERAS ORYX, n. sp. Pl. XIV, figs. 9, 9 *a*, 9 *b*, 9 *c*.

1841. ORTHOCERAS IBEX, *Phillips* (not *Sow.*). Pal. Foss., p. 111, pl. xliii, fig. 208.
1888. — — *Etheridge*. Foss. Brit., pt. 1, Pal., p. 168.

Description.—Shell elongate, small, not tapering much. Section oval. Septa? Siphuncle central (*fide* Phillips). Surface with numerous prominent arching

[1] 1842, D'Arch. and de Vern., 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 345, pl. xxvii, fig. 3.

[2] 1818, Sow., 'Min. Conch.,' vol. ii, p. 73, pl. cxxxiii; and 1889, Foord, 'Cat. Ceph. Brit. Mus.,' vol. i, p. 53.

[3] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 89, pl. iv, figs. 1—8; and pl. viii, figs. 1, 3.

[4] 1852?, Sandberger, 'Verst. Rhein. Nassau,' p. 170, pl. xx, figs. 3 *a*—*c*.

[5] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 267, pl. cclxxix, figs. 32—37, Ét. E.

[6] 1866, Ibid., p. 299, pl. cclxxxi, figs. 1—18, &c., Ét. E and G.

transverse ridges, about half the width of the intervening concavities. The whole surface covered by very numerous, close, rounded, transverse striæ, about ten or twelve times as numerous as the rings, and similar longitudinal striæ by crossing both rings and hollows, about half as numerous as the transverse striæ, which thus form a fine network over the shell.

Size.—Section with diameters of 10 mm. and 9 mm. respectively.

Locality.—One fragmentary specimen is in my Collection, from Lummaton. Phillips's *O. ibex* came from South Petherwin.

Remarks.—My small specimen, though somewhat worn down by friction in a quarry-boy's pocket, shows the markings very clearly. The outside test was black and papyraceous, and probably, as the markings are clear upon the inner coat, was, when unworn, very sharply ornamented. At first I supposed it to be a specimen of *O. tubicinella*, Phil.; but there are several reasons for separating it from that species, *e. g.* its very oval section, its strong transverse striæ, and its closer longitudinal striæ. To the figure and description given by Phillips of his *O. ibex* it comes very much nearer, being only separated by the presence of the transverse striæ, which are not mentioned by him, though he mentions the others. I imagine, however, that it is the same shell as *O. ibex*, Phillips, as the fact of Phillips's identification would presuppose the existence of these striæ. But from the original *O. ibex*, Sow.,[1] as described by him and by Foord,[2] the presence of longitudinal striæ most clearly distinguishes it. This distinction, moreover, is further borne out by Blake,[3] who distinguishes *O. ibex*, Sow., as having only transverse markings, from *O. tenuiannulatum*, M'Coy,[4] which, as a specimen in the British Museum shows, has fine thread-like striæ quite distinct from the coarse rounded rays of the present form.

Affinities.—*O. Gerolsteinense,* Steininger,[5] seems to be similar in its section, and its septa have the same curvature as have the rings in *O. oryx*, but as it is only a cast it cannot be further compared.

[1] 1839, Sowerby in Murch., 'Sil. Syst.,' p. 613, pl. v, fig. 30.

[2] 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' pt. 1, p. 51.

[3] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 98, pl. v, fig. 9.

[4] 1851, M'Coy, 'Ann. Nat. Hist.,' ser. 2, vol. vii, p. 45; and 1852, M'Coy, 'Brit. Palæozoic Foss.,' p. 320, pl. xi, fig. 31.

[5] 1853, Steininger, 'Geogn. Besch. Eifel.,' p. 39, pl. viii, figs. 3 *a*, *b*, *c*.

12. ORTHOCERAS CHAMPERNOWNI, n. sp. Pl. XV, figs. 11, 11 *a*, 12.

1841. ORTHOCERAS IMBRICATUM, *Phil.* (not *Wahlenberg*). Pal. Foss., p. 111, pl. xlii, fig. 207.
1853. — — *Steininger.* Geogn. Beschr. Eifel., p. 39.
1855. — SOWERBYI, ? *M'Coy.* Brit. Pal. Foss., pt. 3, p. 573.
1878. — sp., *Kayser.* Abhandl. Specialk. Preuss., Band iv, pt. 2, pl. xi, fig. 7.
1888. — IMBRICATUM, *Etheridge.* Foss. Brit., pt. 1, Pal., p. 168.
1889. ACTINOCERAS SOWERBYI, ? *Foord.* Cat. Foss. Ceph. Brit. Mus., pt. 1, p. 191.

Description.—Shell large or of medium size, straight, nearly cylindrical in the body-chamber, rapidly tapering in the septal portion. Rate of tapering 1 : 6. Septa very close, moderately concave, slightly oblique, with arched edges. Distance of septa only one-twelfth of their width. Siphuncle slightly excentric, large, and somewhat beaded by the edges of the septa. Section slightly elliptic, with diameters as 15 : 16. Surface unknown.

Size.—Mr. Champernowne's specimen is 55 mm. long, 23 mm. wide at the oral, and 13 mm. at the apical, extremity.

Locality.—Wolborough. There is a beautiful specimen, sliced and polished, in Mr. Champernowne's Collection; a rather fragmentary specimen which shows the exterior is in Mr. Vicary's Collection, another in the Torquay Museum, and two more in the Museum of Practical Geology.

Remarks.—The specimen figured by Phillips is much larger than any which I have myself seen, but otherwise it accurately corresponds with them. He states the section to be elliptic, with diameters in the ratio of 10 : 12. I am not acquainted with the surface ornamentation, and am not very certain about the identity of the two specimens in the Torquay and Vicary Collections, which I have not lately had the opportunity of examining.

As *O. imbricatum*, Wahl.,[1] is a Silurian species the question arises as to the correctness of Phillips's determination. To Sowerby's figure,[2] given in the 'Silurian System,' it bears a strong resemblance, the differences being that the Silurian species is of a more regular conical form, not so cylindrical on the body-chamber, and tapering more slowly in the septal part, and that its septa are slightly more oblique and rather wider, bearing a relation to the diameter of about 1 to 10. Thus it is most probably distinct. Mr. Foord[3] has dwelt at length upon the various species that have been at various times included under the name *O. imbricatum*, and the result is to leave the present species without an appellation. Thus we find

[1] 1821, Wahlenberg, 'Nova Acta Reg. Soc. Sc. Upsal.,' vol. viii, p. 89.
[2] 1839, Sowerby in Murch., 'Sil. Syst.,' p. 620, pl. ix, fig. 2.
[3] 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' pt. 1, pp. 19, 181, 191.

that;—(1) Wahlenberg's species is slightly described and not figured; but no fossils are now found in Sweden with the slender filiform siphuncle of which he speaks, but only with a broad beaded one; (2) These latter are the fossils identified with it by Hisinger, and they appear to be quite distinct from the Devonshire shell on account of the obliquity of their septa, and the very excentric position of the siphuncle; (3) Under these circumstances Foord, at Lindström's suggestion, sinks Wahlenberg's description and treats the species as *O. imbricatum*, Hisinger,[1] and places it under the genus *Actinoceras* on account of its large siphuncle; (4) In this species he also places *O. pseudo-imbricatum*, Barrande,[2] leaving *O. imbricatum*, Barrande,[3] apparently without a name: (5) *O. imbricatum*, Sow.,[4] in Murch. 'Sil. Syst.,' he places as a synonym of *O. perversum*, Blake.[5] According to his description this species has deeper chambers than ours has. (6) *O. imbricatum*, Blake,[6] he places as a synonym of *O. Marloense*, Phillips.[7] This has also deeper chambers than ours; and, as far as can be judged from the slight descriptions by Foord, neither of them corresponds with it. (7) Finally he places *O. imbricatum*, Phil., 'Pal. Foss.,' with a "?" under *Actinoceras Sowerbyi* (M'Coy)[8] = *O. undulatum*, Sow.,[9] 'Min. Conch.' (not Schlotheim nor Phillips).

This last identification, however, is apparently wrong; for the septa do not appear to form a sinus in Phillips's species, and the siphuncle seems much smaller and nearly if not quite central. It is, however, apparently rather large, so that the shell may possibly prove to belong to the genus *Actinoceras*, although from the evidence at present existing this is most improbable. Unfortunately, Mr. Champernowne's specimen has lost the central part in slicing, and the siphuncle does certainly seem to be slightly on one side along the shorter diameter.

Kayser[10] figures, apparently without any description, a longitudinal section of an *Orthoceras*, which, though larger, closely corresponds with the English fossils in the width of its septa and the contour of its sides. The lowest part of its septal chambers is perhaps rather more central.

In *O. angustiseptatum*, Gümbel,[11] which is the same as *O. gregarium*, Münst.[12] (not

1 1831, Hisinger, 'Anteckn. Physik. Geogn.,' pt. v, p. 112, pl. iv, fig. 4.

2 1866, Barrande, 'Syst. Sil. Bohême,' vol. ii, pt. 3, p. 705, pl. ccxxviii, fig. 1; pl. ccxxxiii, figs. 4—8; and pl. cccexl, figs. 1, 2.

3 Ibid., p. 701, pl. cccexl, figs. 3, 4.

4 1839, Sowerby in Murch., 'Sil. Syst.,' p. 620, pl. ix, fig. 2.

5 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 155, pl. xvi, figs. 1, 2.

6 Ibid., p. 153, pl. xiv, figs. 1, 3—6.

7 1848, Phillips, 'Mem. Geol. Surv.,' vol. ii, pt. 1, p. 353, pl. iii, fig. 1.

8 1855, M'Coy, 'Brit. Pal. Foss.,' pt. 3, p. 573.

9 1814, Sow., 'Min. Conch.,' vol. i, p. 130, pl. lix.

10 1878, Kayser, 'Abhandl. Geol. Specialk. Preussen,' Band iv, pt. 2, pl. vi, fig. 7.

11 1879, Gümbel, 'Geogn. Beschr. König. Bayern,' pt. 3, p. 498.

12 1840, Münster, 'Beitr.,' pt. 3, p. 97, pl. xviii, fig. 1 *b*.

Sow.), and has the narrowest chambers of those species which Münster figures, the septa are decidedly more distant.

Orthoceras cf. *planoseptatum*, Sandberger, is a specimen figured by Beushausen[1] as a cast. It only differs from this form by the somewhat greater depth of its septa, their ratio to the width being only 1 : 8 instead of 1 : 12.

O. Kossvæ, Tschern.,[2] has slightly wider chambers, and a more excentric siphuncle. It is a very large shell with a large body-chamber, but its surface is unseen.

O. excentricum, Sowerby, has, according to Blake,[3] flatter and more distant septa; and, as figured by the same author, *O. imbricatum*, Wahlenberg,[4] has decidedly more distant septa and increases much more slowly, so that it evidently is distinct. *O. perversum*, Blake,[5] comes nearer in the closeness of the septa, but still differs in being almost cylindrical.

13. Orthoceras laterale, *Phillips*. Pl. XV, figs. 1—5.

	Orthocera, sp., *Hennah.*		Lime Rocks of Plymouth, pl. viii, fig. 3.
1841.	Orthoceras laterale, *Phil.*		Pal. Foss., p. 110, pl. xli, figs. 205 *a—e*.
? 1852 ?	—	simplicissimum, *Sandb.*	Verst. Rhein. Nassau, p. 172, pl. xx figs. 7 *a*, *b*.
? 1852.	—	multiseptatum, *F. A. Röm.*	Beitr., pt. 2, p. 80, pl. xii, figs. 21 *a*, *b*.
1855.	—	— —	Ibid., pt. 3, p. 36, pl. vii, fig. 10.
1867.	—	Grundense, *Trenkn.*	Paläont. Nov., pt. 2, p. 21, pl. vii, fig. 11.
1884.	—	Grundense, *Clarke.*	Neues Jahrb. f. Min., &c., p. 334, pl. iv, figs. 7—9.
1888.	—	laterale, *Etheridge.*	Brit. Foss., pt. 1, Pal., p. 168.
1888.	—	— ? *Foord.*	Cat. Foss. Ceph. Brit. Mus., vol. i, p. 86.

Description.—Shell elongate, tapering, sometimes very large; very slightly arched, so that the ventral side is very slightly convex, and the dorsal slightly concave; upper part slightly expanding. Rate of tapering, 1 in 7 or 1 in 8. Apex very small, possibly acuminate. Section slightly elliptic. Siphuncle central, small. Chambers very concave, rather narrow, about five or six times as wide as

[1] 1884, Beushausen, 'Abhandl. Geol. Specialk. Preussen,' Band vi, pt. 1, p. 41, pl. vi, fig. 14.

[2] 1887, Tschernyschew, 'Mém. Com. Géol.,' vol. iii, pt. 3, pl. clxix, t. 3, figs. 1 *a—c*.

[3] 1882, Blake, 'Mon. Brit. Foss. Ceph.,' pt. 1, p. 152, pl. xii, fig. 2.

[4] Ibid., p. 153, pl. xiv, figs. 1, 3—6.

[5] Ibid., p. 155, pl. xvi, figs. 1, 2.

they are high. Septa slightly oblique and arching. Surface apparently smooth, or possibly very finely reticulate.

Size.—One of Mr. Vicary's specimens is $7\frac{1}{2}$ inches high, by $1\frac{1}{2}$ inches in greatest diameter. A specimen in my Collection is $1\frac{1}{2}$ inches wide, although its body-chamber is absent. A small specimen has a diameter of only 2 mm. at its broken apical end.

Locality.—This is the commonest *Orthoceras* at Wolborough. There are fourteen specimens in Mr. Vicary's Collection, eleven in the Museum of Practical Geology, one in the Battersby Collection of the Torquay Museum, four or five in the British Museum, and one in my Collection.

Remarks.—Almost without exception the surfaces of these specimens have been roughened and partially destroyed by fossilization, and there is no indication that they bore any ornament, except that in one of Mr. Vicary's specimens a fine reticulation is just discernible under the lens. It is doubtful whether this may not have been caused by weathering, but on the whole it looks too regular to be due to such an accidental cause, and therefore it is probable that the external shell was minutely reticulate. The shells are characterised by their peculiar contour, slightly unsymmetrical rather than actually curved, and expanding (as mentioned by Phillips) in the upper regions. It would appear that in the young state its shape was rather more slowly tapering than in the aged shell.

I had for some time a doubt whether the specimen which Phillips figured as 205 *a* is really the same as the rest of his specimens of this species, and this doubt seems to be shared by Mr. Foord, but an examination of Mr. Vicary's large series of specimens appears to set the question at rest.

Though Phillips evidently is dealing in his 'Palæozoic Fossils' with the species to which these Newton specimens belong, his description presents some divergences from them. The chambers are said to be one-third or one-fourth their diameter in height, instead of one-sixth, the siphuncle is said to be excentric, and the section elliptic in the ratio of 10 : 12. It is possible that the state of preservation of the specimens, or their age, or the confusion with Sowerby's *O. undulatum*, may account for these slight discrepancies. On the other hand, the fusiform shape near the mouth, mentioned by Phillips, is well marked in our specimens, and they agree perfectly with his figures 205 *a*, *b*, *c*, *d*, both in shape and in the height of their chambers. I have not had the opportunity of comparing the Newton fossils with any South-Petherwin specimens. Possibly the figures 205 *a* and *b* refer to them; but 205 *c* and *d* are evidently taken from Wolborough fossils.

The nomenclature of the species presents much difficulty. Sowerby[1] described a Carboniferous species, calling it *O. undulatum*, in 1814. In 1822 Schlotheim[2]

[1] 1814, Sowerby, 'Min. Conch.,' vol. i, p. 130, pl. lix.

[2] 1822, Schlotheim, 'Petref.,' vol. i, p. 55, pl. xi, fig. 1.

described a totally different species under the same name. In 1837 Phillips,[1] in the 'Geology of Yorkshire,' described a fossil under the name *O. undulatum*, Sowerby, which, however, Mr. Foord identifies with *O. striatum*, Sowerby.[2] In the naming of his plates Phillips substituted the name of *O. laterale* for Sowerby's name without explanation. However, in 1841 he described and figured the present species under the name *O. laterale*,[3] identifying it with the Yorkshire shell, and stating that he discarded Sowerby's name because it was "given by foreign authors to a different and well-known species." Portlock tries, not very successfully, to remove the confusion; pointing out that the siphuncle in Sowerby's shell is marginal, he leaves Phillips's name for that, and gives a new name, *O. subimbricatum*,[4] to another Carboniferous specimen, which he supposes to be the same as Phillips's.[0] This, however, differs from the Devonian form by having "undulating lines parallel to the septa," and hence Portlock's name cannot, under any circumstances, be retained for it. There can be no doubt that Phillips's name should properly be applied to his own specimens, and not to Sowerby's, which, indeed, have received a new designation, *Actinoceras Sowerbyi*, from M'Coy.[5] It appears, however, that Sowerby's name has the priority over Schlotheim's, and therefore ought to be retained for his species, *A. undulatum*. Again, as Phillips's Yorkshire shell is the same as another of Sowerby's species, his names for that must be replaced by its original name, *A. striatum*, Sowerby, sp.[6] But we have seen that the name *O. laterale* was only vaguely attached to the figure of the Yorkshire shell, and that the first time a species was definitely described under it was in the case of the Devonshire fossil. To this species it has generallly been regarded as belonging by succeeding authors, *e. g.* Bronn,[7] Foord. Under these circumstances it seems best to regard the description in the 'Palæozoic Fossils' as its authoritative definition, and to retain Phillips's name, *O. laterale*, only for the Devonian shell, especially as it will be seen that there are not very decisive grounds for deciding the identity of the foreign species which appear to correspond with it.

It may be observed that it is clearly distinguished from the two abovementioned species, *A. striatum*, Sow., sp. (= *O undulatum*, Phil.), and *A. undulatum*, Sow., sp. (= *A. Sowerbyi*, M'Coy), by the small size and the central position of its siphuncle.

O. Grundense, Trenk., as figured by Clarke[8] may well be the same species,

[1] 1837, Phillips, 'Geol. Yorkshire,' vol. ii, p. 251, pl. xi, fig. 1.
[2] 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' vol. i, p. 190.
[3] 1841, Phillips, 'Pal. Foss.,' p. 110, pl. xli, figs. 205 *a—e*.
[4] 1843, Portlock, 'Rept. Geol. Londonderry,' p. 391.
[5] 1855, M'Coy, 'Brit. Pal. Foss.,' pt. 3, p. 573.
[6] 1814, Sowerby, 'Min. Conch.,' vol. i, p. 129, pl. lviii.
[7] 1848, Bronn, 'Index Pal.,' vol. iii, p. 865.
[8] 1884, Clarke, 'Neues Jahrb. für Min.,' Beil.-Band iii, p. 334, pl. vi, figs. 7—9.

although the small fragment given is hardly enough for identification. He moreover states the shell to be smooth, which apparently *O. multiseptatum*, F. A. Römer, is not.

The shell described by Sandberger[1] as *O. simplicissimum* comes very close to our shells. It appears only to differ from them in its rate of tapering being less (1 in 8, instead of 1 in 6), in the section being quite circular, and in the septa not being apparently arched obliquely. One of Mr. Vicary's specimens, however, seems to show that the section *is* circular when the shell is young, and only becomes elliptic with age; and if Sandberger's figure is a front view the arching of the septa would not be seen. Thus it is very possible that it may represent the same shell.

O. multiseptatum, F. A. Römer,[2] as far as the fragmentary cast which he figures will admit of comparison, seems chiefly to differ in having straight, horizontal septa, and a perfectly circular section. However, under the same name he gives another fossil[3] from the Iberger Kalk, which has deflected septa and an elliptic section, so that if his two fossils belong to the same species, it would be difficult to separate it from the present form. The septa seem, however, much less deflected than in Phillips's figure.

Affinities.—*O. conoideum*, Münster,[4] comes so close to Phillips's species that I was at one time much inclined to suppose them to be identical. It is, however, a shorter shell, the rate of tapering being about 1 in 5; and it wants the peculiar unsymmetrical contour of *O. laterale*. Its septa seem rather farther apart. In Münster's plate they are between one-third and one-fourth their height apart, while Foord[5] states that they are two-sevenths in the specimens of that shell in the British Museum. As in some of the Devonshire specimens where they are shown they are only one-fifth their width apart, it would appear that the two species are distinct.

O. laterale may also be compared with *O. angustiseptatum*, Gümbel,[6] which is the same as *O. gregarium*, Münster[7] (not Sowerby). Here the septa seem about equally distant; but while those of the present species are obliquely arched there is nothing in Münster's figure to show that the German fossils were so. Foord's notice of this species[8] leads to the supposition that the septa are close.

O. regulare, Schlot., as given by F. A. Römer,[9] appears very similar; it seems

1 1852 ? Sandb., 'Verst. Rhein. Nassau,' p. 172, pl. xx, figs. 7 *a*, *b*.

2 1852, F. A. Römer, 'Beiträge,' pt. 2, p. 80, pl. xii, figs. 21 *a*, *b*.

3 1855, ibid., pt. 3, p. 36, pl. vii, fig. 10.

4 1840, Münster, 'Beitr.,' pt. 3, p. 96, pl. xviii, figs. 4, 5.

5 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' vol. i, p. 94.

6 1879, Gümbel, 'Geogn. Besch. Fichtelgeb. König. Bayern,' pt. 3, p. 498.

7 1840, Münster, 'Beitr.,' pt. 3, p. 97, pl. xviii, fig. 1 *b* (not 1 *a*).

8 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' vol. i, p. 96.

9 1843, F. A. Römer, 'Verst. Harz.,' p. 35, pl. x, figs. 4, 5, 8, 9.

to have, however, more distant septa (fig. 4), and, unless Römer has placed two species under one name, differs also in having annular depressions towards the apical end. Clarke[1] further describes this shell, saying that it is the common *Orthoceras* of the Iberger Kalk, and from his description it is clear that it and its ally, *O. multiseptatum,* are distinct from ours. Clarke[2] also distinguishes *O. laterale* from *O. compressum,* F. A. Römer, with which Trenkner had identified it.

O. Ausavense, Steininger,[3] is a very small species, differing from the present by the marginal position of its siphuncle, and probably by other features. This species Wahlsmidt[4] refers, no doubt correctly, to the genus *Bactrites.* *O. affine,* Portlock,[5] seems more elliptic in section, and more conical. *O. Helmerseni,* Pacht,[6] has a dilate section, an excentric siphuncle, and slightly angulated septa. *O. curvescens,* Barrande,[7] has close, microscopical radiations, and *O. Morrisii,* Barrande,[8] has a constricted aperture and presents less asymmetry.

14. Orthoceras cf. O. tæniale, *Barr.* Pl. XV, fig. 6, 6 *a.*

1888. Orthoceras sp. cf. O. simplicissimum, *Foord.* Cat. Foss. Ceph. Brit. Mus., vol. i, p. 87.

Description—Shell straight, rapidly tapering, with contour of sides somewhat unequal, slightly expanding above. Septa convex, slightly oblique. Siphuncle central. Section circular. Ratio of tapering about 1 in 6.

Size.—A portion of the shell measures 60 mm. in length, and 19 mm. in greatest, 16 mm. in least, diameter.

Locality.—Wolborough. A specimen is in Mr. Vicary's Collection, and another is in the British Museum.

Remarks.—No signs of the external markings are visible upon either of the specimens, and there is therefore insufficient data for defining the species with any certainty. I at first regarded it as an example of *O. laterale,* Phillips, to which it evidently is very closely allied; but afterwards Mr. Foord, Mr. Crick, and

[1] 1884, Clarke, 'Neues Jahrb. für Min.,' Beil.-Band 3, p. 334.

[2] Ibid., p. 335.

[3] 1853, Steininger, 'Geogn. Beschr. Eifel.,' p. 40, pl. i, fig. 11.

[4] 1885, Wahlsmidt, 'Über Devon. Schicht. Gegend. Wildungen,' p. 921, pl. xxxix, figs. 4 *a*, *b*.

[5] 1843, Portlock, 'Rept. Geol. Londonderry,' p. 3 7, pl. xxvii, fig. 9.

[6] 1858, Baer and Pacht, 'Beiträge Russ. Reiches,' p. 88, pl. iii, figs. 2, 3; and 1863, Semenow and Müller, 'Mel. Phys. et Chim.,' 'Devon. Sch. Mittel Russland,' vol. v, p. 673, pl. i, figs. 13 *a*, *b*.

[7] 1868, Barrande, 'Syst. Sil. Bohème,' vol. ii, pt. 3, p. 183, pl. cclvi, figs. 1—8, Ét. E.

[8] Ibid., p. 526, pl. cccl, figs. 9—19; and pl. ccccxlii, figs. 29, 30, Ét. D (colony) and E.

myself, on comparing it with examples in the British Museum, came to the conclusion that it could not belong to that species on account of the decidedly greater proximity of its septa; and this difference is certainly borne out by other specimens of the latter shell which I have elsewhere examined. It appears to come midway between the two species described by Phillips as *O. laterale* and *O. imbricatum*.

As far as the specimen goes, I can see no difference between it and *O. tæniale*, Barrande.[1] In the latter shell the external ornament consists in fine regular upward imbrications, which are rather closer than the septa, but become still closer at the upper end, a style of ornament which I do not know among Devonshire specimens.

O. timidum, Barr.,[2] is a smaller and more elongate form.

The specimen in the British Museum is labelled *O.* cf. *simplicissimum*, Sandberger, which is a shell nearly resembling the last species, under the heading of which I have noted it. In some points, as, for instance, the circular section and the size of the siphuncle, Sandberger's species comes nearer still to the present shell; but, as it is much more elongate and its septa are decidedly wider, I do not think it can belong to the same species.

15. Orthoceras speciosum, *Münster*. Pl. XV, figs. 7 ?, 8—10.

1840. Orthoceratites speciosus, *Münster*. Beitr., pt. 3, p. 96, pl. xviii, figs. 1 *a* and 3.
1841. Orthoceras cinctum, *Phillips* (not *Sow.*, Min. Conch.). Pal. Foss., p. 108, pl. xli, fig. 204.
1849. — Oceani, *d'Orbigny*. Prod., p. 54.
1879. — speciosum, *Gümbel*. Geogn. Beschr. Fichtelgebirges, pt. 3, p. 498.
1888. — cinctum, *Etheridge*. Foss. Brit., pt. 1, Pal., p. 168.
1888. — speciosum, *Foord*. Cat. Foss. Ceph. Brit. Mus., vol. i, p. 94.

Description.—Shell medium-sized, straight, elongate, slightly tapering. Rate of tapering, 1 : 6 or 1 : 7. Section elliptic, with diameters as 13 : 11. Septa very concave, slightly arching, very distant. Height of chambers about one-third their length. Siphuncle large, rather beaded between the septa, central or somewhat excentric. Surface smooth.

[1] 1868, Barrande, 'Syst. Sil. Bohème,' vol. i, pt. 3, p. 387, pl. ccxxiv, figs. 24—26; and pl. cccxiv, figs. 1—23, Ét. E and F.

[2] Ibid., p. 388, pl. ccxvii, figs. 6, 7; pl. cccxxvii, figs. 19, 20; and pl. ccccxxiv, fig. 30—32, Ét. D (colony) and E. (Barrande afterwards changes the name of pl. cccxv, figs. 20—32, pl. cccxcvi, figs. 21—28, to *O. spiculum*).

Size.—A specimen in the Torquay Museum, measuring 75 mm. in length, is 17 mm. in width at the lower, and 25 mm. at the upper end.

Locality.—Wolborough. One of Phillips's figured types is in the Museum of Practical Geology. There are also four specimens in Mr. Vicary's Collection, and one in the Torquay Museum.

Remarks.—The smoothness of the species is certain, as a small fragment of the external shell, exposed in Phillips's type-specimen after it was drawn, remains and shows absolutely no markings. Hence it differs from Sowerby's *O. cinctum*,[1] which he described in 1829 and stated to be covered with "fine, undulating, raised lines," and which, according to Foord,[2] is also the *O. cinctum* of Münster,[3] as well as the *O. cinctum* of Phillips's 'Geology of Yorkshire.'[4] The type specimen of the latter shell is in the British Museum, and shows clearly the regular undulating ornamentation. On the other hand, *O. speciosum*, Münster, is evidently very similar to the English fossils. The septa of Münster's shell are perhaps slightly closer in one of his figures; Mr. Foord states them to be from one half to one quarter of their height. This, however, would include the measures of the present species, and its rate of tapering also seems, upon the whole, to agree, although in some individuals it is considerably greater than in the German shell, which, like the British form, is smooth. There are two specimens of that shell, labelled by Münster himself, in the British Museum. One of these almost exactly agrees with Phillips's type specimen in every respect. The other seems rather more circular, and its siphuncle appears somewhat more central than that in our fig. 10. On the whole there does not appear any reason for distinguishing the English specimens, which, as will be seen below, are rather variable, from these two shells. Thus, as far as the present evidence goes, they must be regarded as identical, and therefore the species must bear Münster's name.

D'Orbigny separated the *O. cinctum* of Münster from that of Sowerby, calling the former *O. cypris*, d'Orb. He also separated Phillips's South-Petherwin shell from Münster's species under the name of *O. Oceani*, d'Orb., though he gave no reason for doing so, incorrectly retaining, however, the Newton specimens under Münster's name. Thus, if further knowledge of the English species should lead to the necessity of separating them from *O. speciosum*, they ought then to be known as *O. Oceani*, d'Orb.

One of Mr. Vicary's fossils gave me some perplexity on account of its apparently very cylindrical shape. I find, however, that this is due partly to the upper part having been worn away, partly to the lower part being rather expanded by a

[1] 1829, Sowerby, 'Min. Conch.,' vol. vi, p. 168, pl. cccclxxxviii, fig. 3.

[2] 1888, Foord, 'Cat. Foss. Ceph. Brit. Mus.,' vol. i, p. 106.

[3] 1840, Münster, 'Beitr.,' pt. 3, p. 99, pl. xix, figs. 4 *a*, *b*.

[4] 1836, Phillips, 'Geol. Yorks.,' pt. 2, p. 237, pl. xxi, fig. 1.

fracture. The rate of tapering seems greater in this species along the major than along the minor diameter. This specimen also retains an interesting segment of the siphuncle, free from matrix, and showing its beaded shape.

Another of Mr. Vicary's specimens, which has lost its shell, has a low rounded carina running longitudinally across the segments. A similar carina is seen in the figures of *O. serratulum*, Barrande,[1] and of *O. Marcellense*, Hall.[2]

A third fossil in the same collection I have referred with some doubt to this species. It is a cast of a much smaller shell. In it the septa are decidedly closer, but their ratio to the diameter remains about the same. They are also very oblique to the axis of the shell, as will be seen by reference to its figure (Plate XV, fig. 7); but this appearance is perhaps due to the particular side which is exposed, and which cannot be so well seen in Phillips's typical specimen (fig. 8). Its rate of tapering seems to be about the same. It appears, therefore, that, though there are no data at present for removing it from the present species, there is a possibility that a more perfect example, if found, might prove it to belong to some other form.

Affinities.—In *O. lineare*, Münster,[3] a fine microscopical striation is present; *O. regulare*, Schlotheim, has, according to Münster,[4] more distant septa, which are almost as much as their width apart; while *O. venustum*, Münster,[5] also differs in the great excentricity of its siphuncle.

F. A. Römer[6] appears to identify *O. regulare*, Schlotheim, with a shell different from the one which Münster has referred to it; and possibly he may have allocated more than one species under that name. He states his shell to be smooth, but the septa are narrower than those of Phillips's *O. cinctum*, and it approaches *O. laterale*, Phillips, more nearly than the present form. *O. virgatum*, Sowerby,[7] as given by F. A. Römer,[8] seems very similar, but differs in having more distant septa, and in being ornamented with longitudinal striæ. A reference to Sowerby's original species shows that whether it be the same as Römer's version of it or not, it is quite distinct from the shell under consideration, and that it has these striæ very large and coarse. *O. subconicum*, F. A. Römer,[9] tapers much more rapidly, and has more distant septa. *O. inæquale*, F. A.

[1] 1868, Barrande, 'Syst. Sil. Bohême,' vol. ii, pt. 3, p. 550, pl. ccxcviii, figs. 6—13, Ét. E.

[2] 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 278, pl. xxxviii, figs. 4—9; pl. lxxxiii, figs. 1—12; and pl. cxiii, fig. 18.

[3] 1840, Münster, 'Beitr.,' pt. 3, p. 99, pl. xix, fig. 1.

[4] Ibid., p. 95, pl. xix, figs. 3, 4.

[5] Ibid., p. 98, pl. xviii, fig. 6.

[6] 1843, F. A. Römer, 'Verst. Harz.,' p. 35, pl. x, figs. 4, 5, 8, 9.

[7] 1839, Sow. in Murch., 'Sil. Syst.,' p. 620, pl. ix, fig. 4.

[8] 1843, F. A. Römer, 'Verst. Harz.,' p. 36, pl. xii, fig. 37.

[9] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 17, pl. iii, fig. 20.

Römer,[1] has a very elliptic section, and its siphuncle is situated very near its ventral side.

There is no reason for following Portlock[2] in supposing that Phillips's shell may be the same as *O. sub-flexuosum*, Münster. *O. vagans*, Salter,[3] is distinguished by having very distant unequal septa, varying in height from half to twice the diameter of the shell. *O. gregarium*, Sowerby,[4] has horizontal septa.

O. aff. *Marcellense*, Vanux., is a species figured by Tschernyschew,[5] which differs from the present shell by having very much narrower, straighter chambers, and a less central siphuncle.

16. Orthoceras, cf. O. acuminatum, *Eichwald*. Pl. XII, figs. 5—7.

?? 1841 Orthoceras Ludense, *Phil.* (not *Sowerby*). Pal. Foss., p. 110, pl. xlii, figs. 206 *a*, *b*, *c*.
? 1860. — acuminatum, *Eichwald*. Leth. Rossica, vol. i, p. 1215, pl. xlix, fig. 6.

Description.—Shell large, rather rapidly tapering. Septa deeply but unequally concave, oblique, and arching, rather narrow. Ratio of tapering 1 in 9. Section elliptic, in the ratio of 10 : 12. Siphuncle somewhat excentric on the smaller diameter. Surface nearly smooth, only marked by some indistinct, transverse, coarse inequalities. Structure massive.

Size.—48 mm. in width.

Locality.—Lummaton. Two fragmentary specimens of the body-chamber in my Collection, and a third in the Woodwardian Museum.

Remarks.—This species presents some points of agreement with that described by Phillips, from Marwood and South-Petherwin, as *O. Ludense*, Sowerby. It approaches it in size, and the convexity of its septa is the same; but its siphuncle is much smaller, its section is less elliptic, and its shape is decidedly less conical, as in that shell the rate of tapering amounts to 1 : 5. There are also other points in which there are indications that more perfect specimens would show divergencies from Phillips's description, and therefore it seems very unlikely that it belongs to that species. The specimens, however, that I know of it are too fragmentary to allow a positive identification, and indeed it is not certain that

[1] 1850, F. A. Römer, 'Beitr.,' pt. 1, p. 50, pl. viii, figs. 8 *a*, *b*.
[2] 1843, Portlock, 'Rept. Geol. Londonderry,' p. 372, pl. xxviii, fig. 3.
[3] 1848, Salter, 'Quart. Journ. Geol. Soc.,' vol. v, p. 153, pl. vi, fig. 6.
[4] 1839, Sowerby in Murch., 'Sil. Syst.,' p. 619, pl. viii, fig. 16.
[5] 1887, Tschernyschew, 'Mém. Com. Géol.,' vol. iii, pt. 3, p. 163, pl. iii, figs. 2 *a*—*c*.

they all belong to the same species; but they do not seem to agree with any of the other species from the localities under notice. In only one of these specimens can the width of a chamber be seen, and this is very narrow; but it is often the case, as noted by Mr. Bather in the 'Geological Magazine' for October, 1887, p. 449, that the first chamber of a Cephalopod is narrower than the rest; and therefore no deduction of their general width can in this case be made. They are not easily comparable with the fossils which above I have united to Phillips's last-mentioned species, under the name of *Actinoceras devonicans*, n. sp.,[1] as they belong for the most part to a different portion of the shell. They seem, however, to differ from them generically, as well as specifically, on account of the small size of their siphuncle, and of their section being decidedly more circular.

On the other hand, the present species appears to agree, as far as can be judged from our defective specimens, with *O. acuminatum*, Eichwald,[2] but here again we have not sufficient data to form a decided opinion. As so few species have hitherto been proved to be common to the Devonian Formations of England and Russia, the presumption is, on general grounds, against their identity, when it is remembered that there are many features, not observable in our fossils, in which there is room for specific divergency between the two forms.

Affinities.—From *O. Ludense*, Sowerby[3] (not Phillips), it is distinctly different, not being, for instance, circular in section.

O. crassum, F. A. Römer,[4] as figured by Tietze,[5] is distinguished by being widely oval instead of moderately elliptic in section; but, as given by Sandberger,[6] it differs in being quite circular instead of elliptic, and in having the margins of the septa straight instead of oblique.

From *O. Robertsii* it differs in not having a circular section, and in its surface being in all probability smooth.

NOTE.

As the localities, with which we are now dealing, have proved to be so prolific in Cephalopods, it may be interesting at the present point to review the species of this class which have been elsewhere recorded from the South of England.

In 1840 Sowerby described seven species by name, viz. *Orthoceras cylindraceum*,[7]

[1] See above, p. 120.

[2] 1860, Eichwald, 'Lethæa Rossica,' vol. i, p. 1215, pl. xlix, fig. 6.

[3] 1839, Sowerby in Murch. 'Sil. Syst.,' p. 619, pl. ix, fig. 1.

[4] 1843, F. A. Römer, 'Verst. Harz.,' p. 35, pl. x, fig. 6.

[5] 1870, Tietze, 'Über Devon. Schicht. Ebersdorf,' p. 36, pl. i, fig. 17.

[6] 1852 ?, Sandberger, 'Verst Rhein. Nassau,' p. 162, pl. xix, figs. 1, 1 *a*.

[7] 1840, Sow., 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. lii, figs. 6 and 7, and pl. lvii, fig. 28. The last of these figures, which is from a Newton specimen, is evidently different from the rest, and

O. striatulum, O. tubicinella, Goniatites carbonarius, G. vinctus, and two *Clymeniæ;* of these, two were from the Culm, three from the Clymenia-beds, and two from the Limestones.

Of the forty-three species given in Phillips's 'Palæozoic Fossils,' we have seen that twenty-two (counting synonyms) are to be included in our present list. Seventeen species come from South Petherwyn, viz. seven *Clymeniæ, Goniatites bifer,* Phill., *G. linearis,* Münst., *G. insignis,* Phill., *Nautilus megalosipho,* Phill., *Cyrtoceras ? rusticum,* Phill., *O. cinctum,* Sow., *Orthoceras laterale,* Phill., *O. ibex,* Sow.,[1] and *O. ludense,* Sow.; and of these only four occur at Lummaton or Wolborough. He also gives four from the Upper Devonian of North Devon, viz. *O. ? tentaculare,* Phill., *O. lineolatum,* Phill., *O. ludense,* Sow., and *O. imbricatum,* Wahl., of which the last two are common to the Wolborough beds. Another species, *Cyrtoceras bdellalites,* Phill., is from Mudstone Bay; and five more, *Orthoceras cylindraceum,* Sow., *Goniatites spiralis,* Phillips, *G. crenistria,* Phill., *G. mixilobus,* Phill., and *G. spirorbis,* Phill., belong to the Culm.

M'Coy, in the 'British Palæozoic Fossils,' describes *Aganides vinctus,* Sow., sp. (= *Goniatites insignis,* Phill.), *Cyrtoceras bdellalites,* Phill., *C. reticulatum,* Phill., *C. subornatum,* M'Coy, *O. striatum,* Sow., *Cycloceras striatulum,* Sow., sp., *C. tubicinella,* Sow., sp., and six *Clymeniæ,* of which two are new species.

In 1877 Mr. Lee drew attention to the occurrence at Saltern Cove, near Paignton, of the following Cephalopods belonging to the Upper Devonian Fauna of Büdesheim: *Goniatites auris,* Quenst., *G. retrorsus,* Quenst., *G. Ausavensis,* Stein., *G. Gerolsteinus,* Stein., *G. primordialis,* Quenst., *G. Prumiensis,* Stein., and *Orthoceras* (= *Bactrites*) *Schlotheimi,* Quenst. This locality is of great interest, for, while it distinctly contains an Upper Devonian Fauna, it is most difficult to separate it stratigraphically from adjacent beds containing *Pleurodictyum problematicum* and other Lower Devonian types. Most likely Barrande would have regarded it as a "colony;" but, in view of the extraordinary local variability in thickness of the Middle Devonian Limestones, it seems possible to recognise in this spot a point of rest during Middle Devonian times, where, consequently, the *Intumescens*-stage was immediately superjacent on and undistinguishable from the Lower Series.

Another interesting locality, brought into prominent notice by Mr. Lee, is

probably belongs to the species described above as *O. Robertsii,* under the heading of which it should be added as a synonym.

[1] It appears that D'Orbigny in his 'Prodrome,' p. 54, has separated the *Orthoceras ibex* of Phillips from that of Sowerby without assigning a reason for doing so. Both names, *O. ibex,* Phill., and *O. Phillipsii,* D'Orb., have been kept side by side in Etheridge's Catalogue; but this is evidently an oversight. It would seem, therefore, that D'Orbigny's name must supersede the name *O. oryx* which I have proposed in the text, unless my specimen should prove different from Phillips's, which I do not at all expect will be the case.

PLATE V.

GONIATITES OBLIQUUS, *Whidborne*. (Page 56.)

FIG.

1. Largest known specimen. Wolborough. Torquay Museum. 1 *a*, portion of keel seen from behind.
2. Suture-line of another specimen. Wolborough. British Museum.
3. Specimen showing traces of surface-markings; 3 *a*, front view. Wolborough. Museum of Practical Geology.

GONIATITES FULGURALIS, n. sp. (Page 59.)

4. Specimen showing surface ornamentation (the lateral lobe is really rather nearer the inner edge than is represented); 4 *a*, front view. Lummaton. My Collection.

GONIATITES INCONSTANS, *Phillips*. (Page 63.)

5. Specimen much worn and fractured. Wolborough. 5 *a*, front view. Museum of Practical Geology.
6. Specimen preserving exterior ornamentation; 6 *a*, front view; 6 *b*, nucleus enlarged. Wolborough. Vicary Collection.

GONIATITES TRANSITORIUS, *Phillips*. (Page 61.)

7. Specimen showing external surface-markings and approaching *G. obliquus*. Wolborough. British Museum.
8. Front view of another specimen. Wolborough. British Museum.
9. Specimen preserving outer shell. Wolborough. Vicary Collection.
10. Phillips' original figured specimen, wanting shell; 10 *a*, suture-line. Wolborough. Museum of Practical Geology.

GONIATITES MOLARIUS, n. sp. (Page 64.)

11. Specimen retaining outer shell; 11 *a*, front view, restored on one edge. Wolborough. Torquay Museum.

GONIATITES GLOBOSUS, *Münster?* (Page 67.)

12. Medium-sized specimen showing marginal suture-line; 12 *a*, front view (body-chamber absent); 12 *b*, suture-line. Wolborough. Museum of Practical Geology.

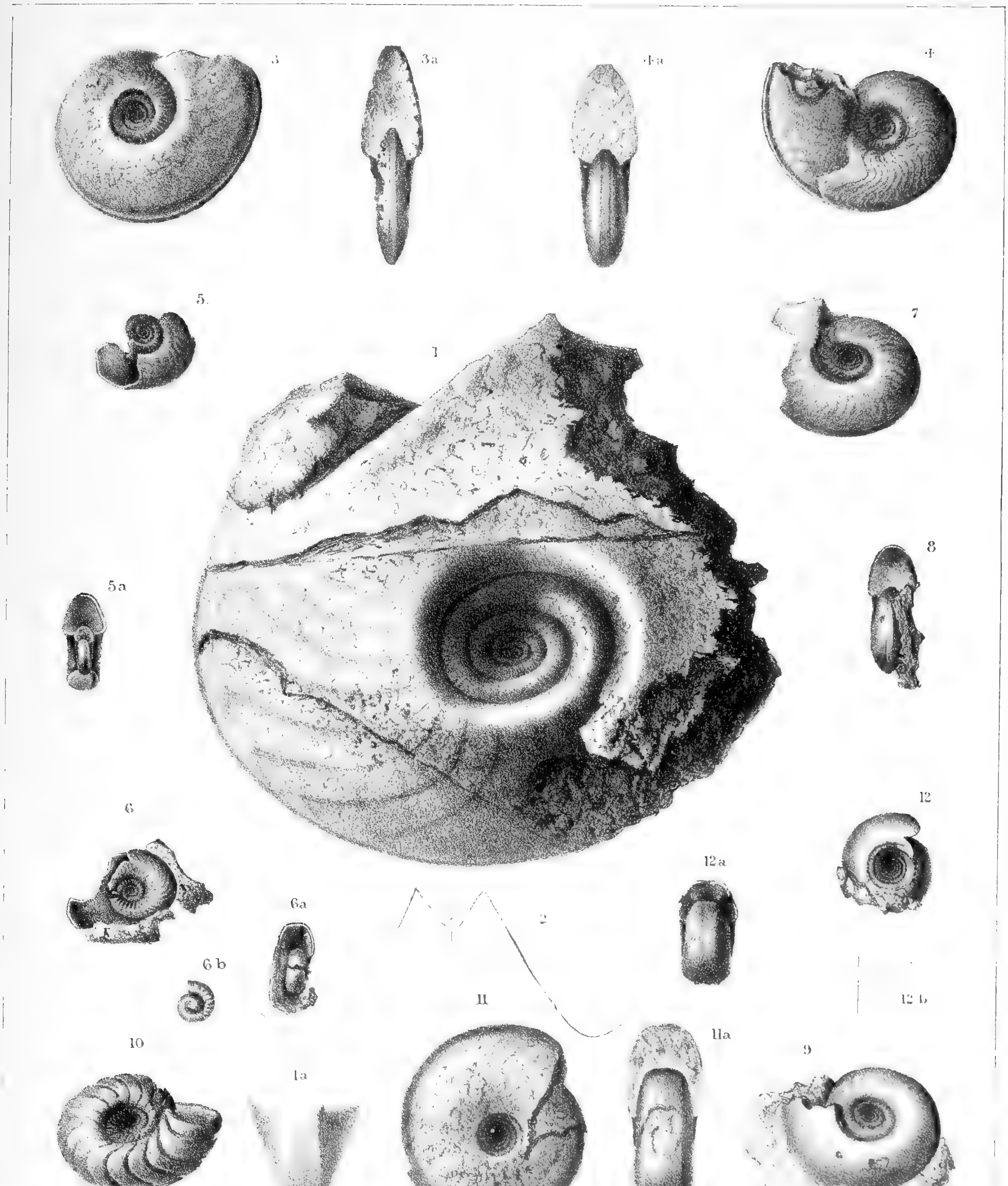
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PLATE VI.

Goniatites Hughesii, *Whidborne.* (Page 69.)

Fig.

1. The largest specimen known; 1 *a*, front view. Lummaton. My Collection.
2. Specimen showing suture-lines under the external shell; 2 *a*, suture-line. Lummaton. Lee Collection, British Museum.
3. Rear view of another specimen; 3 *a*, portion of surface magnified. Lummaton. Lee Collection, British Museum.

Goniatites molarius, n. sp. (Page 64.)

4. Specimen showing suture-lines; 4 *a*, suture-line. Wolborough. British Museum.
6. Young specimen; 6 *a*, front view. Wolborough. Torquay Museum.

Goniatites globosus, *Münster ?* (Page 67.)

5. Specimen with small umbilicus; 5 *a*, front view. Wolborough. Torquay Museum.

Goniatites nuciformis, *Whidborne.* (Page 77.)

7. The largest specimen known, wanting body-chamber; 7 *a*, front view; 7 *b*, suture-line. Wolborough. Vicary Collection.

Goniatites transitorius, *Phillips.* (Page 61.)

8. Specimen wanting body-chamber; 8 *a*, front view. Wolborough. Museum of Practical Geology.

Goniatites psittacinus, *Whidborne.* (Page 72.)

9. Specimen without external shell; 9 *a*, suture-line. Wolborough. Vicary Collection.
10. Largest specimen known, retaining shell; 10 *a*, front view. Wolborough. Vicary Collection.
11. Specimen retaining external shell. Wolborough. Vicary Collection.

12, 13. Specimens showing various positions of the aperture and proving the umbilicus to be closed only by the external shell; 12 *a* (printed 12 on the Plate in error), 13 *a*, front views showing suture-lines; 12 *b*, 13 *b*, suture-lines. Wolborough. Vicary Collection.

Goniatites, sp. (Page 75.)

14. Specimen wanting body-chamber; 14 *a*, line of the lower part of the chamber-wall; 14 *b*, suture-line. Wolborough. Museum of Practical Geology.

Goniatites, sp. (Page 76.)

15. Specimen wanting body-chamber; 15 *a*, probable contour of suture-line. Wolborough. Museum of Practical Geology.

Goniatites aratus, *Whidborne.* (Page 66.)

16. Specimen showing falcated sulci; 16 *a*, front view. Lummaton. Lee Collection, British Museum.

Goniatites circumflexifer ? *Sandberger.* (Page 71.)

17. Specimen showing depressed centre. Barton. British Museum.

PLATE V

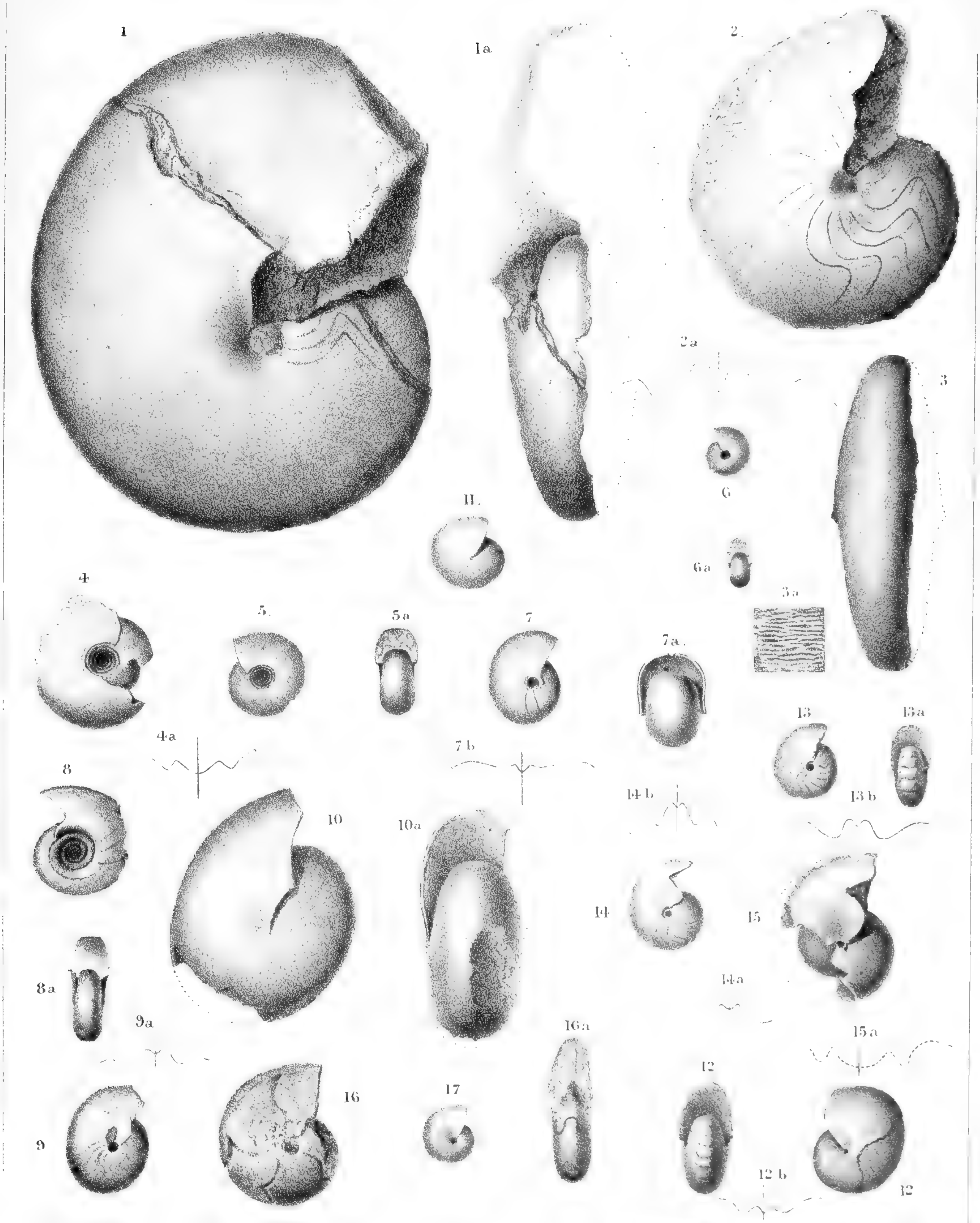

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PLATE VII.

GONIATITES NUCIFORMIS, *Whidborne*. (Page 77.)

FIG.

1. Front view of a middle-sized specimen with a very dilate mouth; 1 *a*, side view. Wolborough. Vicary Collection.

GONIATITES PENTANGULARIS, *Whidborne*. (Page 79.)

2. Fragmentary specimen showing the ornamentation on the outer and inner whorls (enlarged two diameters); 2 *a*, front view. Barton. Lee Collection. Twice natural size.

TEMNOCHEILUS INORNATUS, *Whidborne*. (Page 80.)

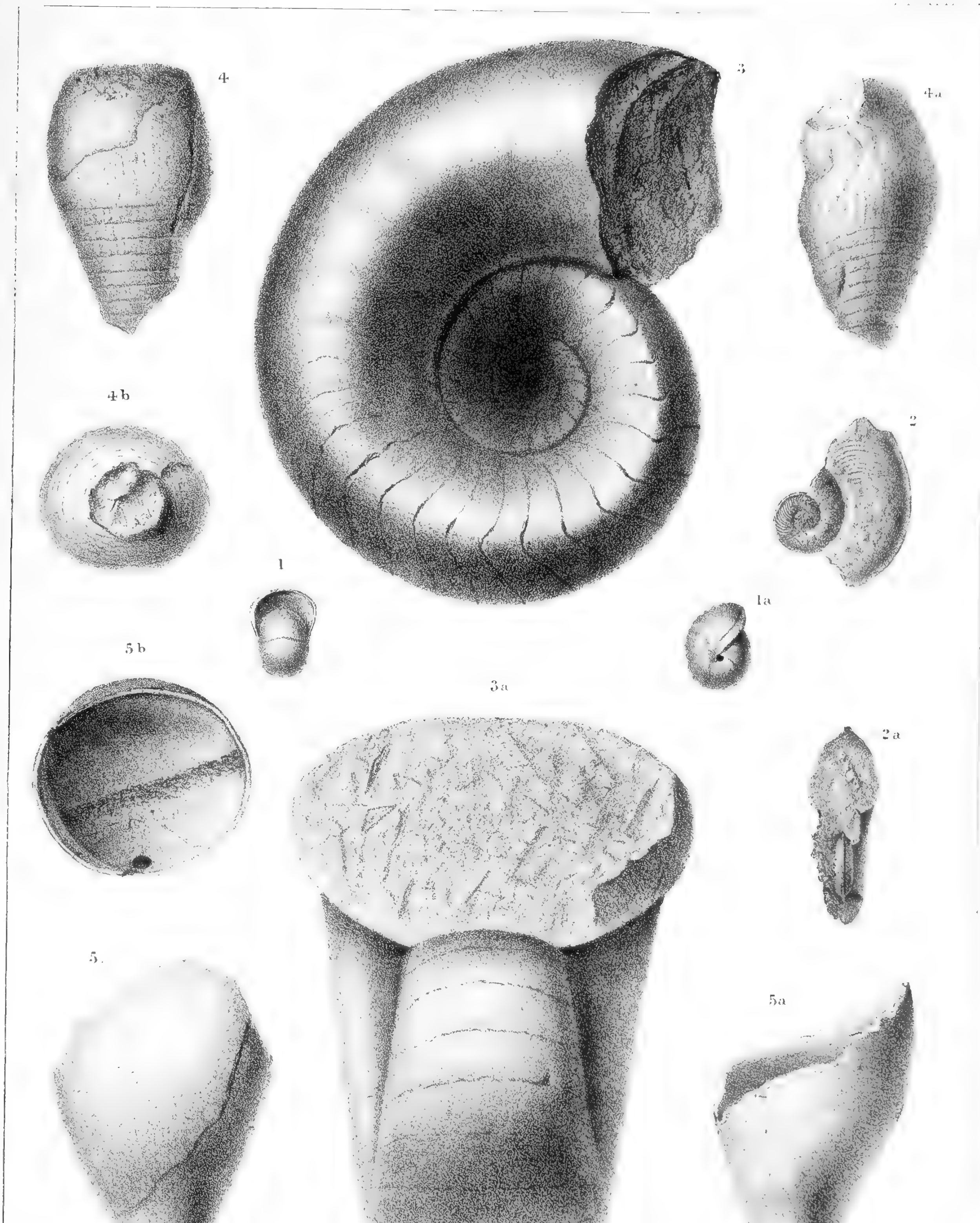
3. Specimen wanting the external shell and showing the septa; 3 *a*, front view. Wolborough. Museum of Practical Geology.

POTERIOCERAS MARRI, *Whidborne*. (Page 114.)

4. Ventral view of a nearly perfect shell wanting external test, and showing septa and longitudinal markings; 4 *a*, lateral view; 4 *b*, apical view. Wolborough. Vicary Collection.

POTERIOCERAS VASIFORME, *Whidborne*. (Page 113.)

5. Dorsal view of specimen retaining external shell; 5 *a*, lateral view, showing the fragment of a broken chamber below, proving their extreme narrowness; 5 *b*, upper view. Wolborough. Torquay Museum.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4a
4b
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1a
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3a
2a
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5a

PLATE VIII.

GYROCERAS PRÆCLARUM, *Whidborne.* (Page 91.)

FIG.

1. Almost perfect specimen, wanting the outer layer of shell and having two specimens of *Davidsonia Verneuilii*, Bouchard, attached to the body-whorl; 1 *a*, front view. Wolborough. Vicary Collection.
2. Almost perfect specimen of a younger shell, retaining the external ornament and showing the nucleus; 2 *a*, front view (with another fossil projecting from it). Wolborough. Museum of Practical Geology.
3. Side view of Phillips' original specimen of *C. ornatum*, Phil. (not Goldf.), showing the character of the nodes surmounted by the external surface-marks, which are slightly worn. It will be seen by comparison with fig. 2 that its ornamentation has become much more rugged with age but not nearly to the extent represented in Phillips' figure. Wolborough. Museum of Practical Geology.

GYROCERAS ASYMMETRICUM, n. sp. (Page 93.)

4. Side view of a portion of a whorl, showing the great asymmetry, the rounded ornamentation, and the absence of the longitudinal ridge on the elbow of the shell; 4 *a*, front view of the same shell showing the great obliquity of the transverse ridges. Wolborough. Vicary Collection.

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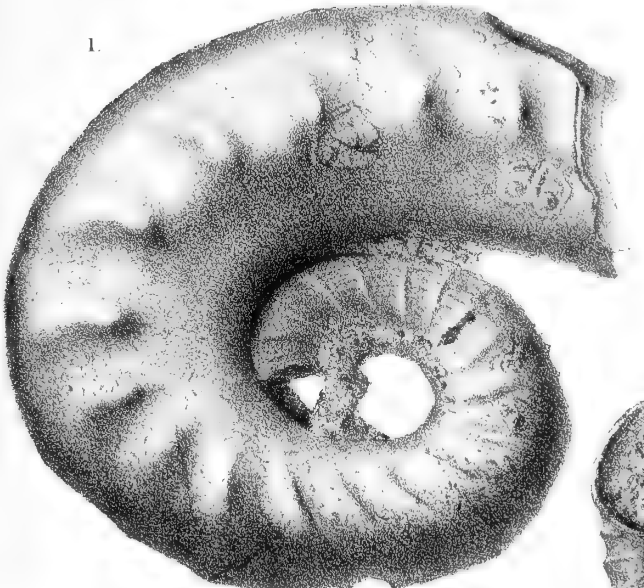
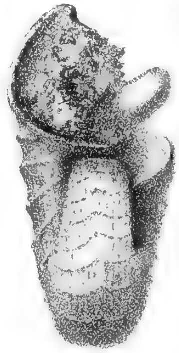


1a

2a



2.

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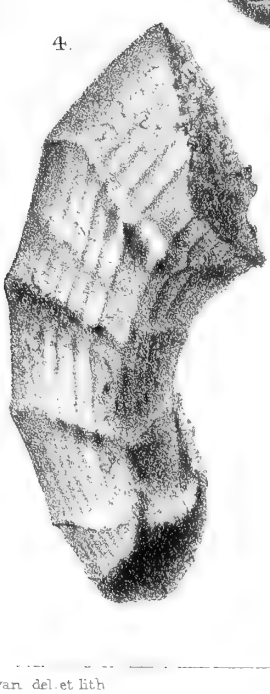

4a.

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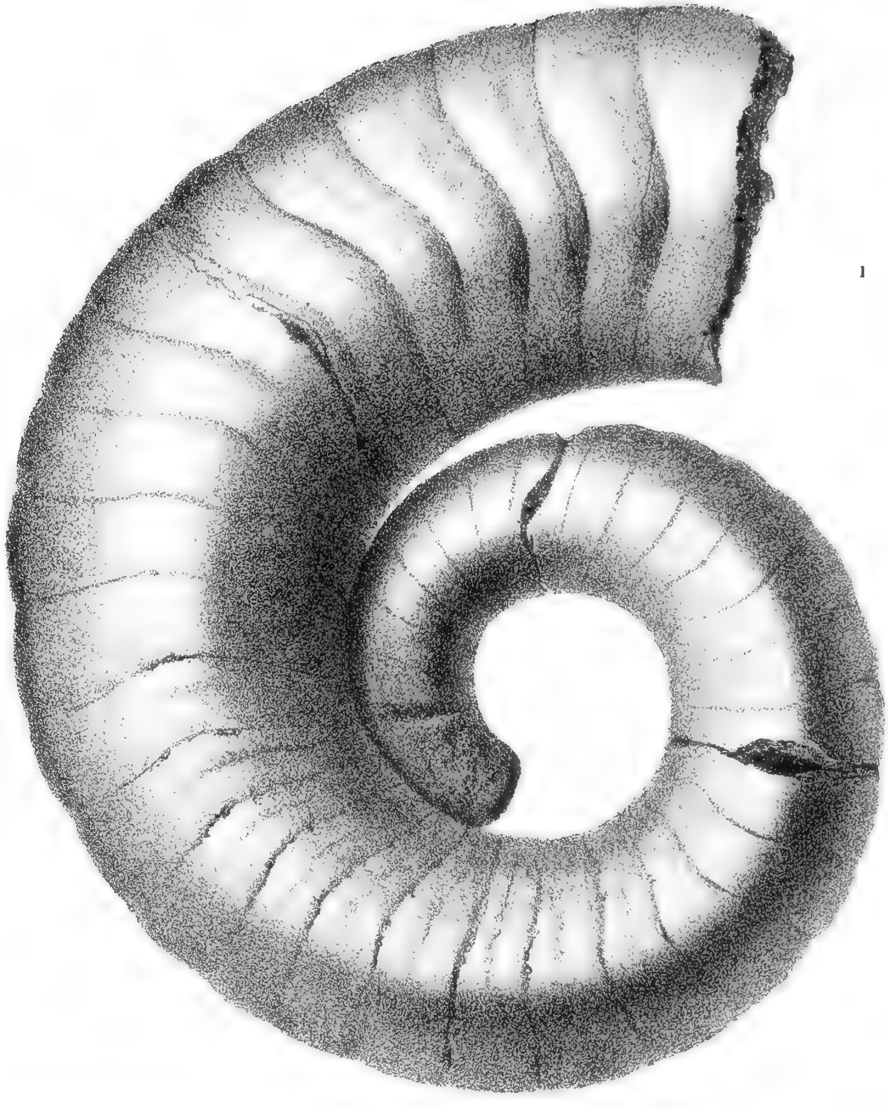
PLATE VIII A.

GYROCERAS ORNATUM, *Goldfuss*, sp., MS. (Page 94.)

FIG.

1. Cast of a large specimen consisting of 44 chambers, but wanting the apex and the body-chamber; 1 *a*, front view of the same specimen showing the shape of the section of the whorl and the siphuncle. Apparently a German specimen. Museum of Practical Geology.

PLATE



1

1a.

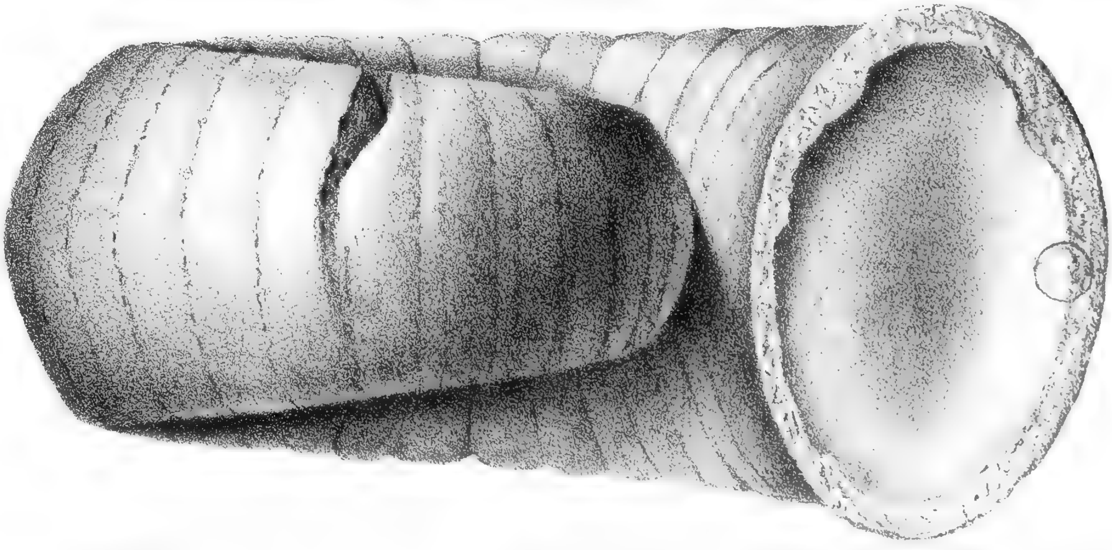


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PLATE IX.

Trochoceras Vicarii, *Whidborne.* (Page 85.)

Fig.

1. Lateral view of an almost perfect specimen, retaining signs of the surface ornament although partially obliterated by fossilisation; 1 *a*, front view; 1 *b*, portion of the ornamentation (enlarged). Wolborough. Vicary Collection.

Trochoceras pulcherrimum, *Whidborne.* (Page 86.)

2. Lateral view of a specimen retaining the shell, partially embedded in matrix. Lummaton. Torquay Museum.
3. Lateral view of a portion of a similar shell, the rest of which was embedded in matrix; 3 *a*, portion of the ventral surface enlarged. Lummaton. My Collection.
4. Lateral view of another fragment; 4 *a*, ventral view with part of the shell removed, showing the wall of the uppermost chamber; 4 *b*, portion of lateral surface, much enlarged. Wolborough. Vicary Collection.

Trochoceras obliquatum, *Phillips*, sp. (Page 86.)

5. Lateral view of Phillips' original specimen; 5 *a*, dorsal view, showing the asymmetry, and the position of the siphuncle; 5 *b*, portion of surface enlarged. Wolborough. Museum of Practical Geology.
6. Lateral view of young? specimen; 6 *a*, ventral view. Wolborough. Museum of Practical Geology.

Trochoceras reticulatum, *Phillips*, sp. (Page 89.)

7. Lateral view of Phillips' original specimen; 8 *a*, ventral view; 8 *b*, portion of surface enlarged. Wolborough. Museum of Practical Geology.

Trochoceras, sp. (Page 89.)

8. Lateral view of the cast of a fragment, showing the septa, and also the nodes which are rather fewer than the chambers; 8 *a*, end view, showing the wall of a chamber and the position of the siphuncle. Wolborough. Vicary Collection.

Trochoceras Foordianum, n. sp. (Page 83.)

9. Lateral view of the only specimen known; 9 *a*, front view. Wolborough. Vicary Collection.

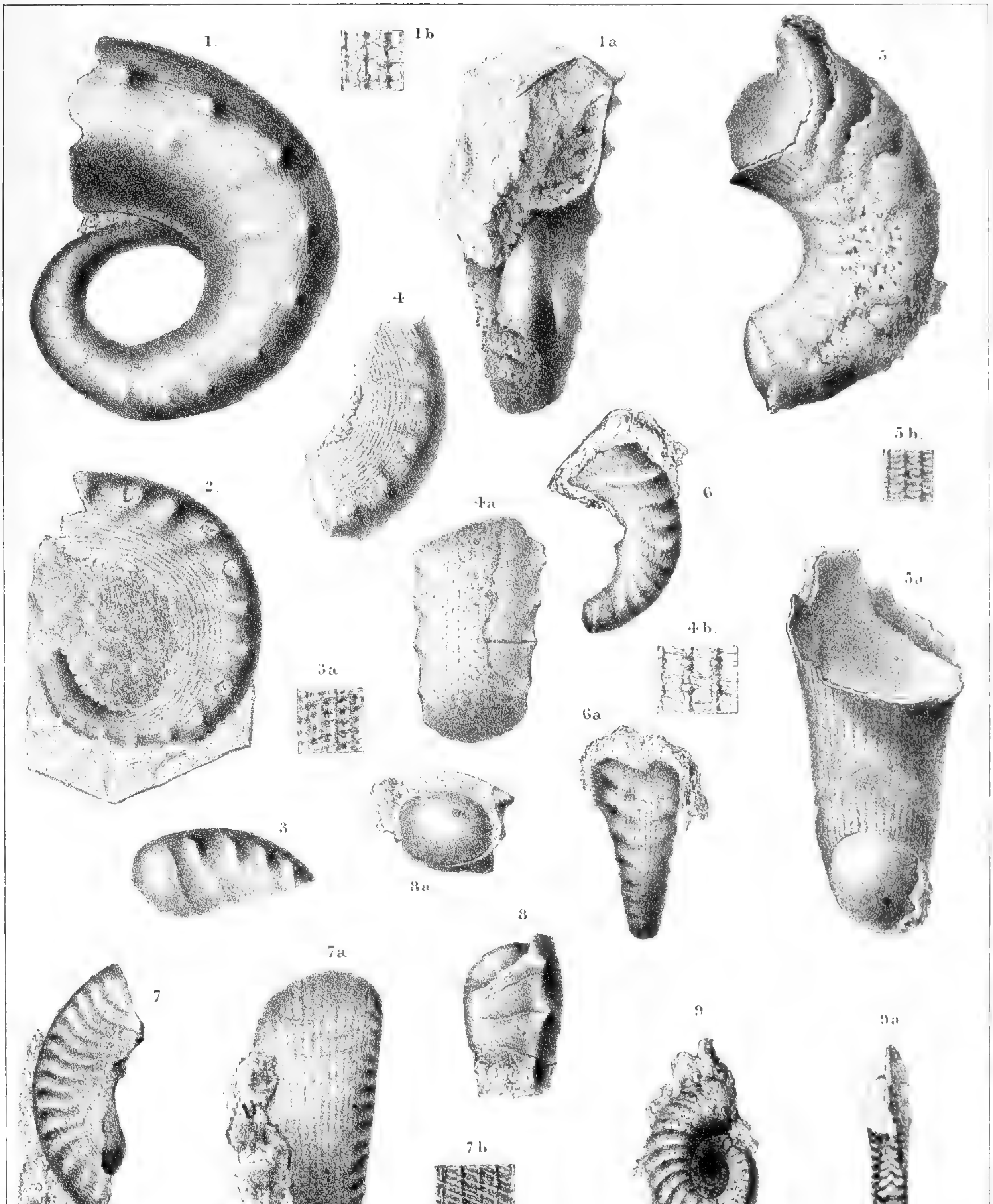

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PLATE X.

CYRTOCERAS QUINDECIMALE, *Phillips*. (Page 102.)

FIG.

1. Ventral view of a specimen showing the longitudinal and transverse ornamentation and the ventral sinus; 1 *a*, lateral view; 1 *b*, diagram of section. Wolborough? Torquay Museum.
2. Oblique view of a specimen supposed to be one of Phillips' type fossils, in which the ornamentation is of a rather finer character. Wolborough. Museum of Practical Geology.

CYRTOCERAS FIMBRIATUM, *Phillips*. (Page 104.)

3. Lateral view of a worn and doubtful specimen showing the asymmetry and the septa at the apical end; 3 *a*, diagram of section showing the position of the siphuncle. Wolborough. Museum of Practical Geology.
4. Ventral view of a specimen showing the longitudinal and transverse ornamentation and the ventral sinus; 4 *a*, diagram of section showing the position of the siphuncle. Wolborough. Torquay Museum.

GYROCERAS TREDECIMALE, *Phillips*, sp. (Page 96.)

5. Ventral view of Phillips' original specimen; 5 *a*, lateral view; 5 *b*, diagram of section. Wolborough. Museum of Practical Geology.
6. Ventral view of the oral portion of a very large specimen. Lummaton. Torquay Museum.
7. Apical portion of another specimen. Lummaton. My Collection.

GYROCERAS EIFELENSE, *D'Arch*. and *de Vern*., sp. (Page 97.)

8. Ventral view of a fragmentary specimen. Wolborough. Museum of Practical Geology.
9. Lateral view of another specimen; 9 *a*, dorsal view showing the numerous longitudinal ribs; 9 *b*, diagram of section showing the position of the siphuncle. Wolborough. Torquay Museum.

CYRTOCERAS CRICKII, n. sp. (Page 99.)

10. Ventral view of a specimen showing the longitudinal ribs and the frequent and regular transverse fimbriæ. Wolborough. Museum of Practical Geology.

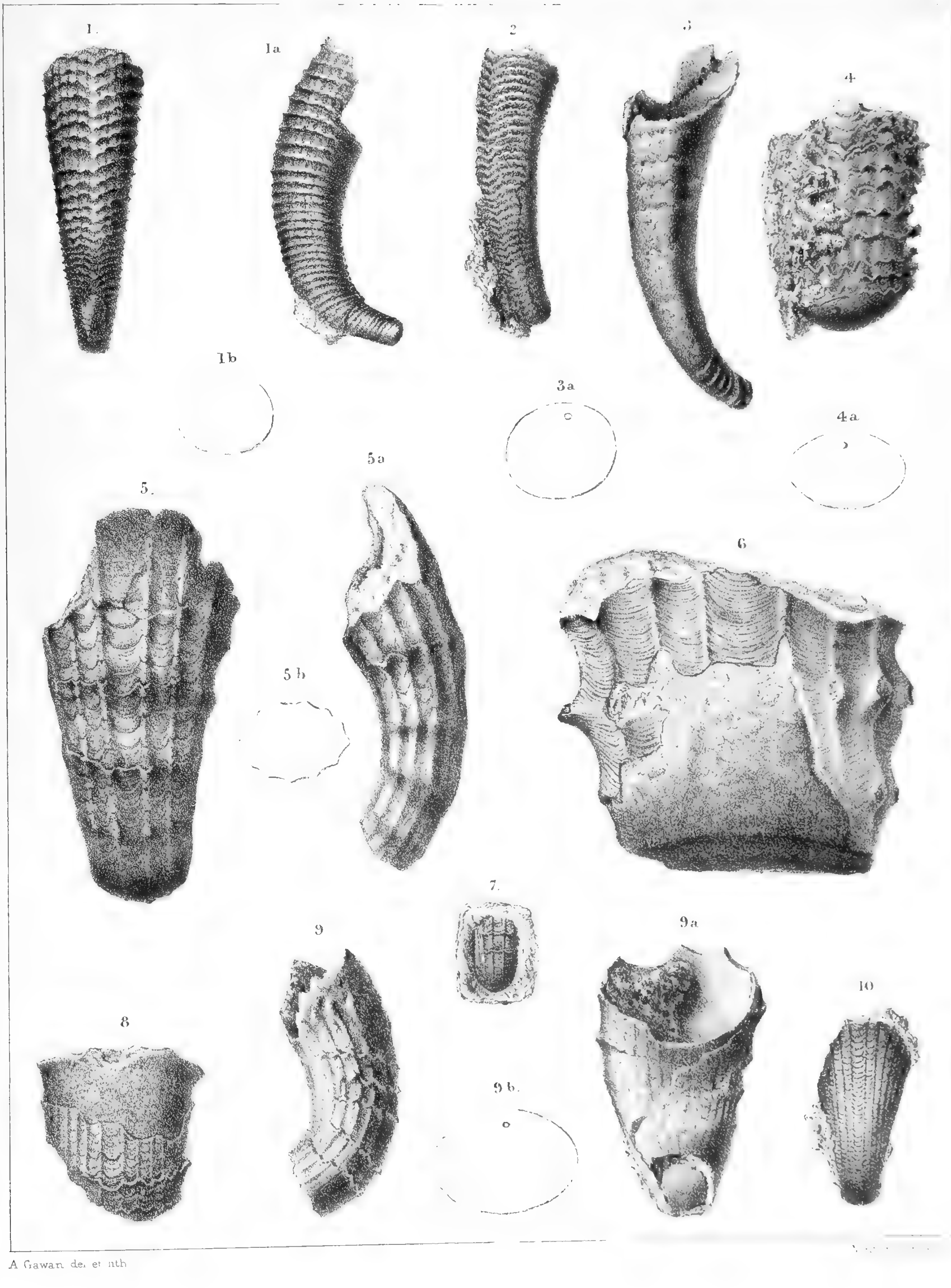

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PLATE XI.

Poterioceras ellipsoideum, *Phillips*, sp. (Page 115.)

Fig.

1. Ventral view of a specimen containing body-whorl and several chambers; 1 *a*, lateral view; 1 *b*, diagram of section of apical end. Wolborough. Museum of Practical Geology.

Gomphoceras poculum, n. sp. (Page 117.)

2. Lateral view of a specimen retaining shell but having no signs of surface ornament. The line of the uppermost chamber is perhaps rather too distinctly shown in this drawing, and some crushed shell in the matrix above the upper margin is omitted; 2 *a*, front view. Lummaton. My Collection.
3. Lateral view of another specimen; 3 *a*, diagram of section showing position of siphuncle. Lummaton. My Collection.

Gomphoceras, sp. (Page 118.)

4. Ventral view of a specimen in which the septal part is almost perfect and the upper part is broken away and shows the interior of the body-chamber; 4 *a*, diagram of section showing position of siphuncle. Wolborough. Vicary Collection.

Phragmoceras? ungulatum, *Whidborne*. (Page 111.)

5. Lateral view of a nearly perfect specimen retaining shell; 5 *a* (lower figure), ventral view; 5 *a* (upper figure), surface enlarged. Wolborough. Museum of Practical Geology.
6. Lateral view of a fragment of the dorsal part of another specimen; 6 *a*, surface enlarged showing the sinus. Wolborough. Museum of Practical Geology.
7. Lateral view of another specimen, defective ventrally. Wolborough. Museum of Practical Geology.
8. Ventral view of a specimen. Wolborough. Museum of Practical Geology.

Cyrtoceras Robertsii, n. sp. (Page 109.)

9. Ventral view of a specimen retaining shell and showing asymmetry; 9 *a*, lateral view; 9 *b*, diagram of section showing probable position of the siphuncle; 9 *c*, portion of surface enlarged showing the character of the ornament and the ventral sinus. Lummaton. My Collection.

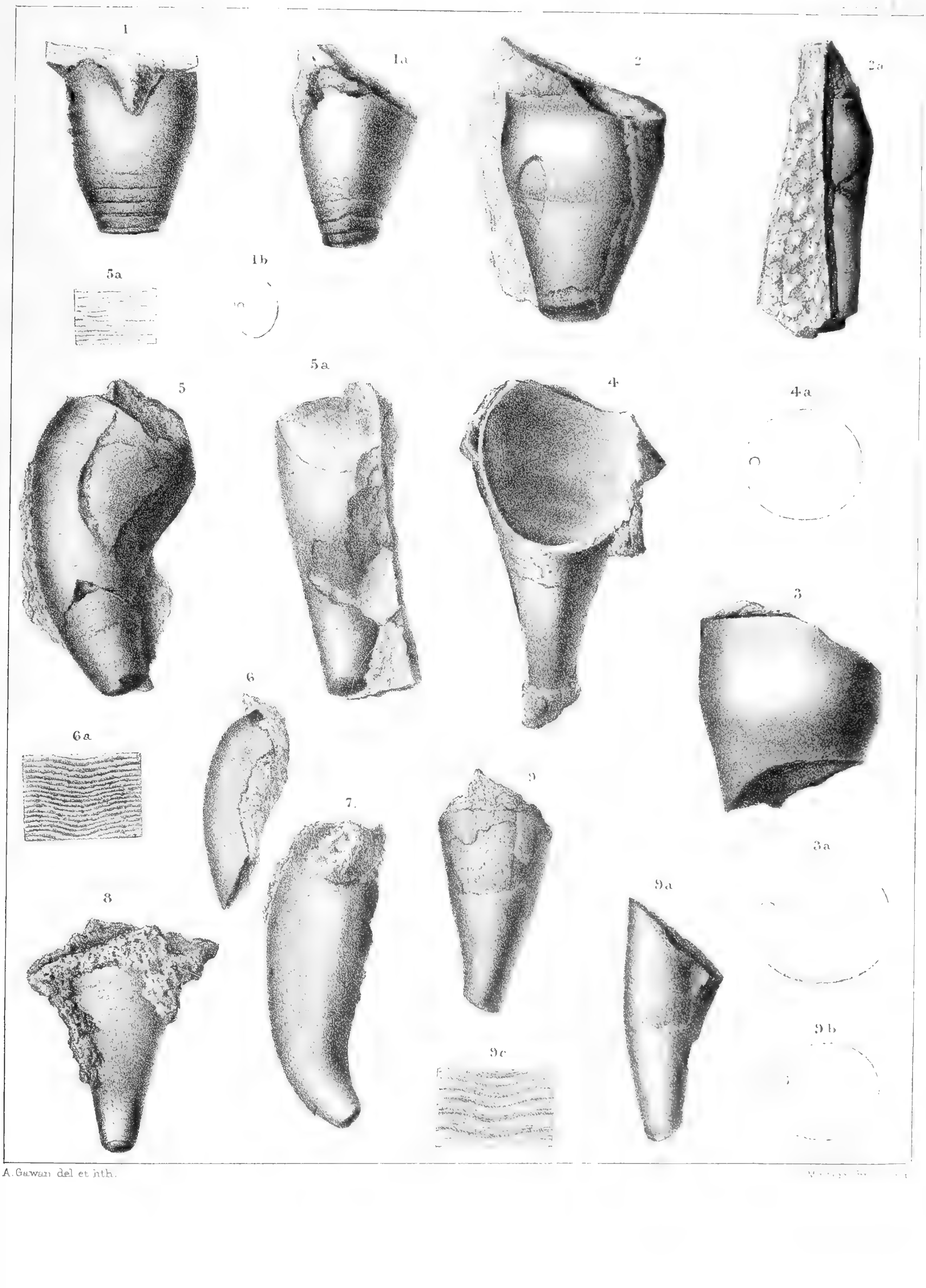

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PLATE XII.

GYROCERAS ARMATUM, *Phillips*, sp. (Page 99.)

FIG.

1. Side view of Phillips' original specimen; 1 *a*, ventral view showing the remains of two specimens of *Davidsonia Verneuilii*, Bouchard, upon its surface. Wolborough. Museum of Practical Geology.

GYROCERAS LEEI, *Whidborne*. (Page 101.)

2. Large specimen showing the external ornamentation and foliaceous appendages upon the higher part but only the outline of an oblique section of the shell below; 2 *a*, outline of an oblique section of the shell as seen upon the other side of the slab which is polished. Lummaton. British Museum.

CYRTOCERAS DIFFICILE, n. sp. (Page 106.)

3. Side view of a specimen retaining the external ornament; 3 *a*, ventral view. Wolborough. Vicary Collection.

CYRTOCERAS, n. sp. (Page 107.)

4. Side view of a specimen retaining shell but showing no signs of ornament. Wolborough. Museum of Practical Geology.

ORTHOCERAS cf. O. ACUMINATUM, *Eichwald*. (Page 152.)

5. Large specimen of a portion of the body-chamber retaining some portions of the shell but showing no signs of ornament. Lummaton. My Collection.
6. Lateral view of another specimen, consisting of part of the body-chamber and of the uppermost septal chamber and showing the obliquity of the septa. Lummaton. My Collection.
7. Diagram of section of another specimen showing the siphuncle. Lummaton. Woodwardian Museum.

ACTINOCERAS DEVONICANS, n. sp. (Page 120.)

8. Specimen seen from below showing the siphuncle and the casts of the organic depositions of the mantle; 8 *a*, lateral view showing the rotundity and obliquity of the septa.

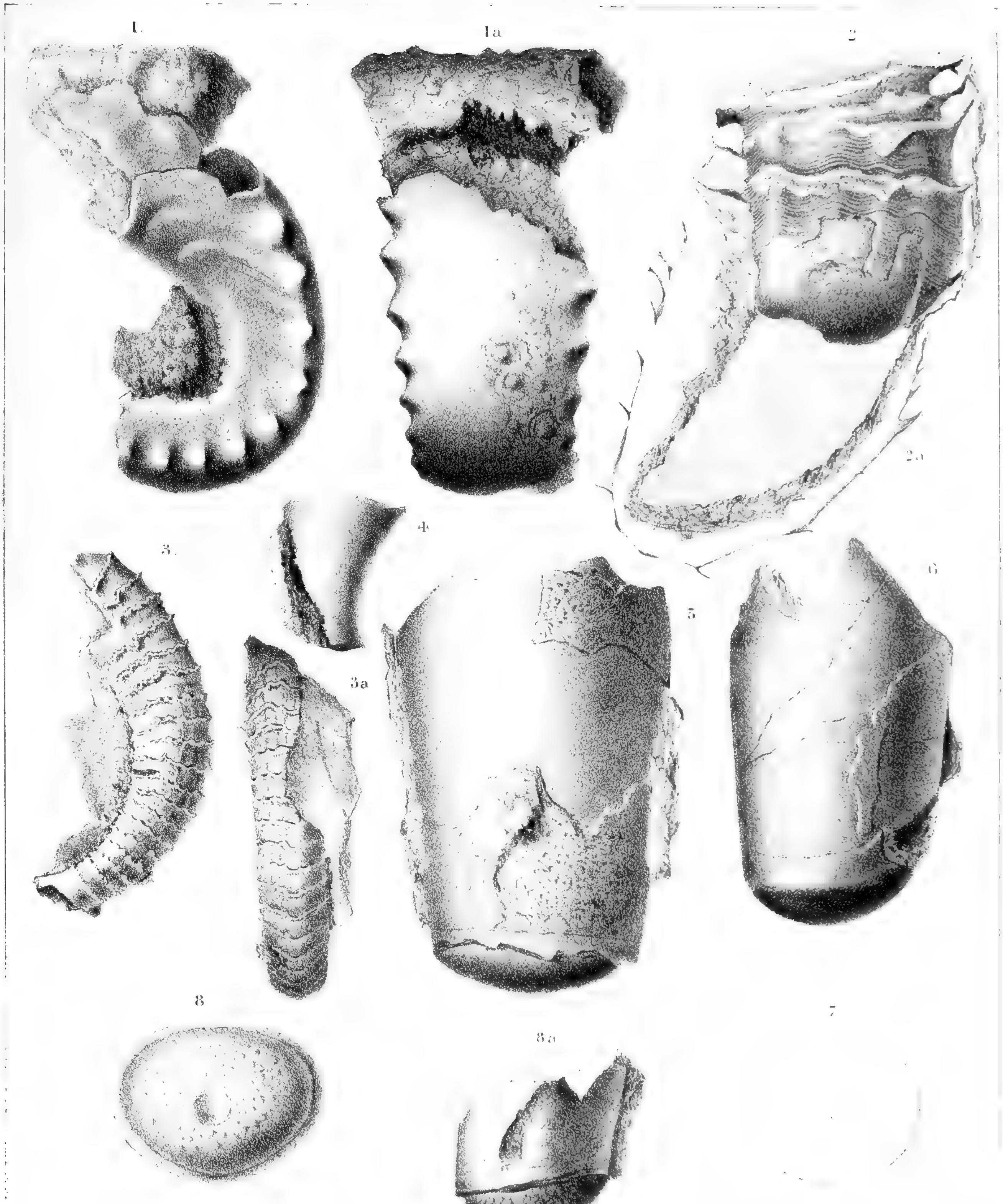
1
1a
2
2a
3
3a
4
5
6
7
8
8a

PLATE XIII.

ORTHOCERAS EUTRICHUM, *Whidborne*. (Page 122.)

FIG.

1. Specimen of the upper part of the shell containing the body-chamber; somewhat compressed, but preserving the outer surface of the shell; 1 *a*, portion of the surface enlarged. Lummaton. Champernowne Collection.

ORTHOCERAS TENUISTRIATUM, *Münster*. (Page 124.)

2. Specimen retaining the test, though considerably weathered; 2 *a*, portion of surface enlarged; 2 *b*, diagram of section. Wolborough? Torquay Museum.

ORTHOCERAS VICARII, *Whidborne*. (Page 129.)

3. A specimen retaining for the most part the external shell, though rather worn, but defective on the ventral side, where septa are exposed, and show that the rings are three times as numerous as the chambers. The downward convexity of the lowest septum, and the position of the siphuncle are also seen. Wolborough. Museum of Practical Geology.
4. A very large specimen retaining the external shell; 4 *a*, portion of surface enlarged. Wolborough. Vicary Collection.
5. Another medium-sized specimen, seen from the side, showing an obliquity of the rings. Lummaton. Lee Collection.

6, 7. Portions of two small specimens; 7 *a*, diagram of section. Lummaton. My Collection.

ORTHOCERAS VICARII, *Whidborne*, var. EDUCTUM. (Page 132.)

8. Small specimen showing the increasing distance of the rings. Lummaton. My Collection.

ORTHOCERAS VICARII (*Whidborne*)? (Page 129.)

9. Ventral view of a specimen; 9 *a*, lateral view, showing a great obliquity of the rings; 9 *b*, diagram of section. Wolborough. Vicary Collection.

ORTHOCERAS ROBERTSII, n. sp. (Page 126.)

10. Large specimen retaining the external shell, obliquely cut below to show the position of the siphuncle; 10 *a*, portion of surface enlarged; 10 *b*, nearly longitudinal section of the lower part of the same specimen showing the chambers and the siphuncle. It is to be noticed that the walls of the chambers constrict the siphuncle, the apparent diminution of which, upwards, is due to the obliquity of the section. Wolborough? Torquay Museum.
11. Another specimen with slightly elliptic section. Wolborough. Museum of Practical Geology.
12. Another specimen, partially retaining outer shell; 12 *a*, portion of surface enlarged; 12 *b*, diagram of section. Lummaton. My Collection.
13. Another large specimen, somewhat weathered, showing the downward convexity of the septum; 13 *a*, portion of surface enlarged. Wolborough. Vicary Collection.

ORTHOCERAS RAPIFORME, *Sandberger*. (Page 121.)

14. Large and nearly perfect specimen which has no trace of any surface ornamentation; 14 *a*, diagram of section. Lummaton. Torquay Museum.
15. Another specimen much worn, but retaining at one point indications of the external ornamentation; 15 *a*, portion of the surface at this point, enlarged. Wolborough. Museum of Practical Geology.

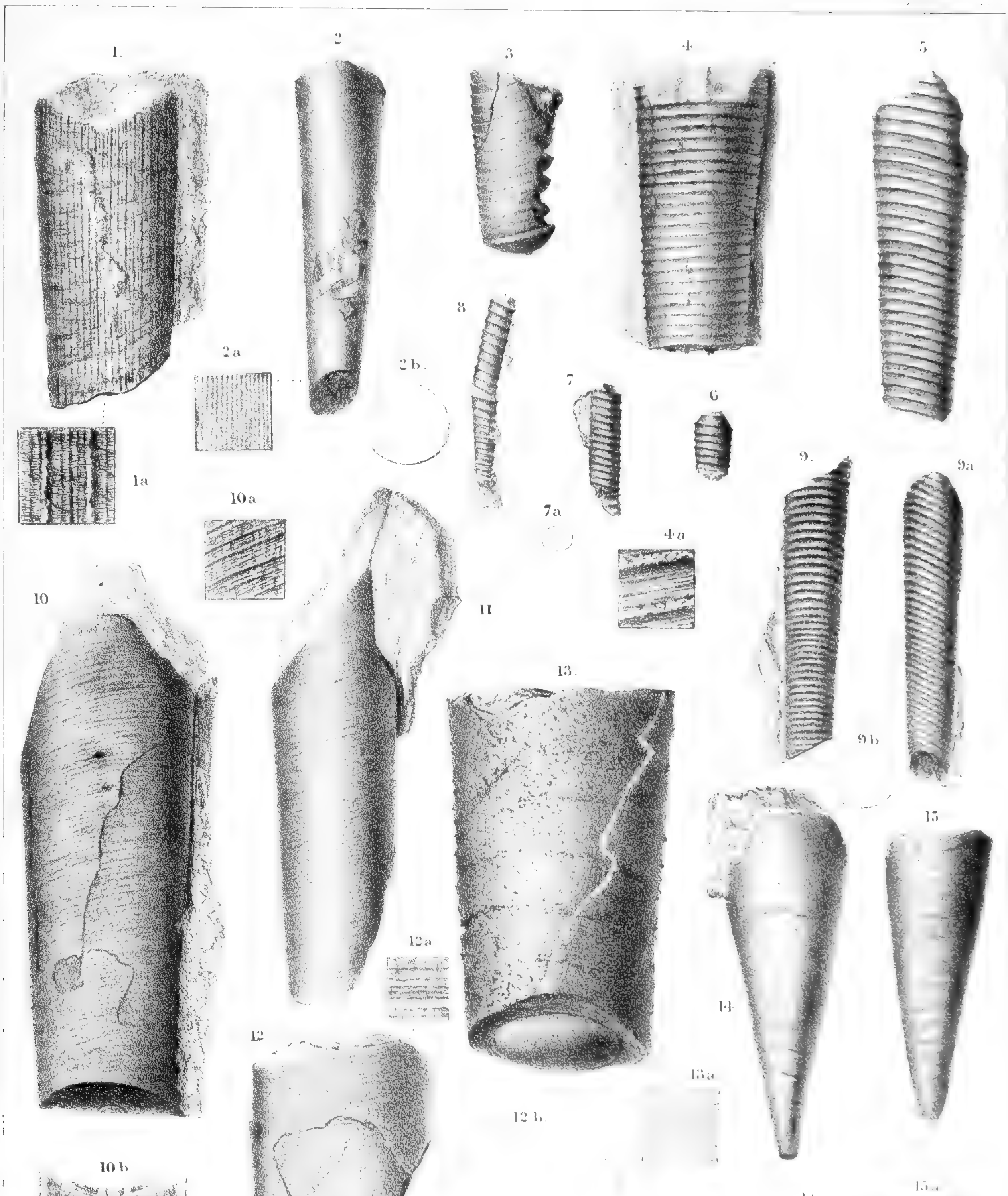

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PLATE XIV.

ORTHOCERAS DOLATUM, *Whidborne*. (Page 132.)

FIG.

1. Large specimen of the septal part of an aged shell showing the ornamentation, although much weathered, above, and the septa and position of the siphuncle below; 1 *a*, diagram of section. Wolborough. Vicary Collection.
2. Another very finely preserved specimen of the septal part; 2 *a*, portion of the surface enlarged; 2 *b*, longitudinal section polished. Wolborough. Torquay Museum.
3. Fragment of the septal part of a specimen belonging probably to the same species. Wolborough. Museum of Practical Geology.

ORTHOCERAS TUBICINELLA, *Sowerby*. (Page 134.)

4. Typical specimen retaining the external coat in a beautiful state of preservation; 4 *a*, diagram of section. Wolborough. Museum of Practical Geology.
5. Specimen of a young shell; 5 *a*, diagram of section. Wolborough. Vicary Collection.

ORTHOCERAS SUB-TUBICINELLA, n. sp. (Page 137.)

6. Finely preserved specimen of the septal portion of the shell. 6 *a*, pattern enlarged. Wolborough. Torquay Museum.

ORTHOCERAS SUBANNULARE, *Münster*. (Page 138.)

7. Very large and fine specimen; 7 *a*, portion of surface enlarged. Wolborough. Museum of Practical Geology.
8. A fragment showing the septa on one side, and on the other a portion of the outer shell, displaced in position, but in a good though rather peculiar state of preservation. The downward convexity of the septa and the position of the siphuncle are seen below; 8 *a*, portion of outer surface enlarged; 8 *b*, diagram of section. Wolborough? My Collection.

ORTHOCERAS ORYX, n. sp. (Page 140.)

9. Small and worn fragment showing the obliquely arching rings; 9 *a*, diagram of section; 9 *b*, portion of surface enlarged; 9 *c*, the same still more enlarged showing the relation of the major and minor transverse ornamentation.

ORTHOCERAS EUTRICHUM, *Whidborne*? (Page 122.)

10. Portion of the body-chamber of a specimen which has lost its external shell; and which is doubtfully referred to this species. Lummaton. My Collection.

Pl.

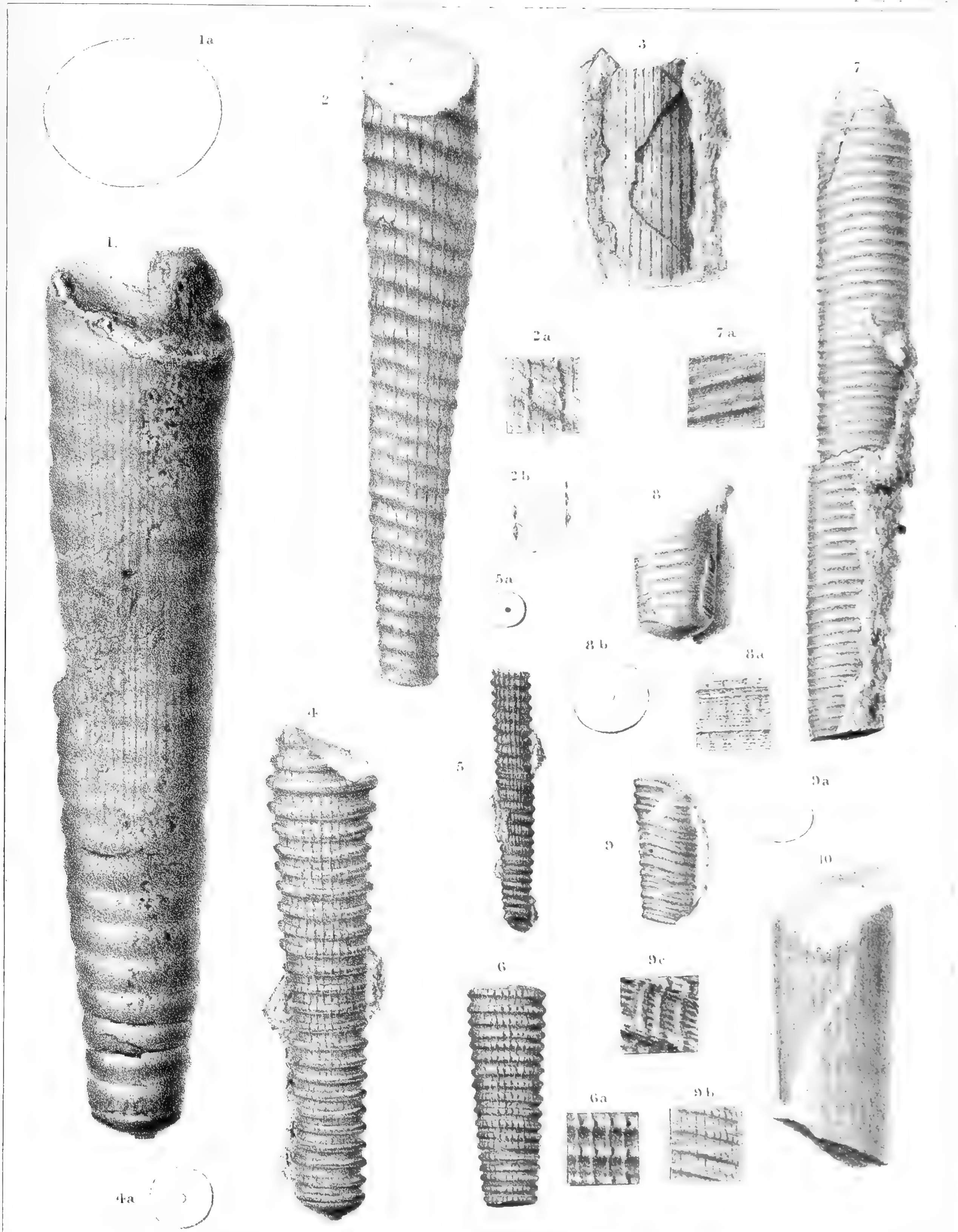

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PLATE XV.

Orthoceras laterale, *Phillips*. (Page 144.)

Fig.

1. The largest specimen known. Wolborough. Vicary Collection.
2. Small specimen showing the acuminate apex, which is not quite perfect; 2 *a*, diagram of section; 2 *b*, portion of surface enlarged and partially restored. Wolborough. Vicary Collection.
3. Another specimen showing the septa and the wall of a chamber. Wolborough. Museum of Practical Geology.
4. Diagram of section of another specimen showing position of siphuncle. Wolborough. Museum of Practical Geology.
5. Another specimen showing the septa. Wolborough. Museum of Practical Geology.

Orthoceras *cf.* O. tœniale, *Barr.* (Page 148.)

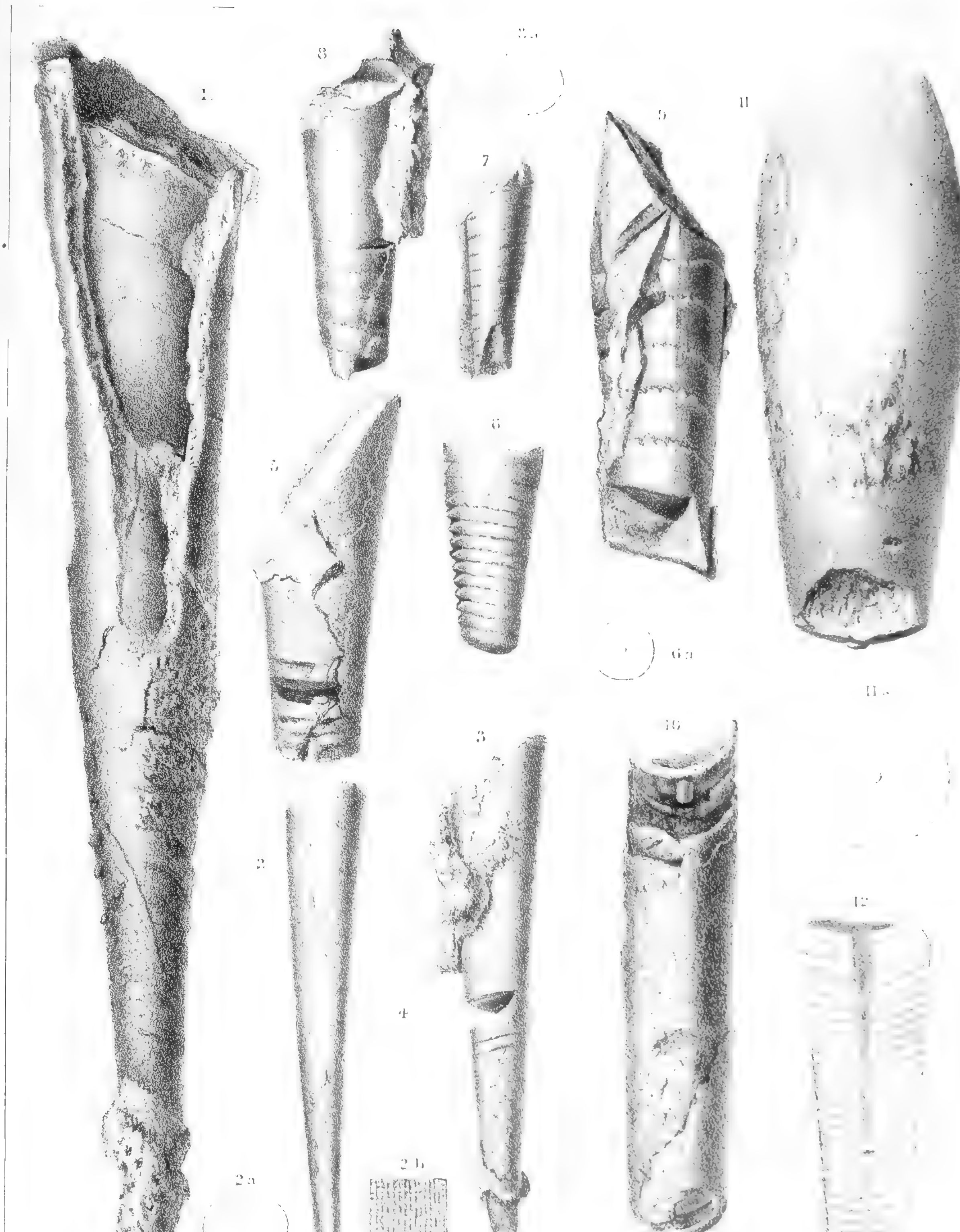
6. Specimen wanting external shell, showing the septa. 6 *a*, diagram of section showing the siphuncle. Wolborough. Vicary Collection.

Orthoceras speciosum, *Münster*. (Page 149.)

7. Rather doubtful specimen with very oblique septa. Wolborough. Vicary Collection.
8. Phillips' original specimen (204 *a*); 8 *a*, diagram of section. Wolborough. Museum of Practical Geology.
9. Large specimen with rather deep chambers, wanting the shell, and showing a carina upon its surface. Wolborough. Vicary Collection.
10. Specimen partially retaining the external shell, though much worn. The septa, and the shape of the siphuncle are seen at the top. The cylindrical appearance is accidental, being caused by the wearing away of the walls above, and by a breakage below. Wolborough. Vicary Collection.

Orthoceras Champernowni, n. sp. (Page 142.)

11. Large specimen of the body-portion of the shell retaining the surface, but with no remains of ornament. 11 *a*, diagram of section showing siphuncle. Wolborough. Museum of Practical Geology.
12. Polished longitudinal section, showing the very narrow septa, and the position and beaded character of the siphuncle. Lummaton. Champernowne Collection.



A. Swan del. et lith.