

PLATE XVII.

(The species figured in this plate have all been obtained from *Holwell*.)

- Fig. 1. *Trochus Holwellensis*, spec. nov.: back view.
2. ———: base, enlarged.
3. *Neritopsis laevis*, Stol.: front view.
4. ———: top view.
5. *Trochus gradatus*, spec. nov.: enlarged.
6. *Phasianella turbinata*, Stol.: back view.
7. *Amberleya alpina*, Stol.: front view.
8. *Delphinula reflexilabrum*, Horne: front view.
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10. ——— *nuda*, spec. nov.: back view.
11. *Trochus latilabrus*?, Stol.: back view.
12. *Nerinea Horneri*, spec. nov.: front view.
13. *Pleurotomaria Buchi*, Desl.: front view.
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22. ——— *scrobiculata*, Stol.
23. ——— *densicostata*, Quenst.
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25. *Pecten Rollei*, Stol.
26. ——— *verticillus*, Stol.
27. ——— *palosus*, Stol.

2. On the PHYSICAL STRUCTURE of WEST SOMERSET and NORTH DEVON,
and on the PALÆONTOLOGICAL VALUE of the DEVONIAN FOSSILS. By
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I. INTRODUCTION.

It seems almost superfluous that another paper should be written upon the structure and succession of the Rocks of "West Somerset and North Devon;" but of late their position or place in the geological series has been questioned in an able paper by Professor Jukes*, in which he endeavoured to prove that the entire series of slates, sandstones, and limestones of the North Devon and West Somerset area belong partly to the Old Red Sandstone and partly to the Carboniferous rocks, rather than to the so-called Devonian Group, to which they have hitherto been considered to belong. In other words, Professor Jukes has propounded views as to the relative succession and physical structure of North Devon diametrically opposed to those held by most geologists, and based upon the investigations of Sir Roderick Murchison and Professor Sedgwick, Professor John Phillips, De La Beche, Weaver, and others; and he distinctly states that they have "all misunderstood the structure of the country," and this arising chiefly from their having been previously unacquainted with the structure and succession of the lower members of the Carboniferous group of rocks, and with the upper series of the Old Red Sandstone, as shown in the South of Ireland (*the Irish Old Red Sandstone*).

Professor Jukes also disputes the *reality* of the "time" succession (not the apparent) of the rock-groups of North Devon, *i. e.* those grits, slates, and sandstones which occur (in the Lynton area) from Lynton or the Foreland, on the north, to the base of the Pickwell Down or Morte sandstones, on the south, or more extendedly to Barnstaple, which is the extreme southern part of the North Devon

* Quart. Journ. Geol. Soc. vol. xxii. p. 321. August 1866.

group under examination. This area is occupied by varied rock masses (three well-defined groups), consisting at the base of red sandstone and slates with gritty and subcalcareous bands, which form the Lynton or Lower Devonian series; succeeding these are red sandstones and slates, well-defined calcareous masses, and bands of limestone, which constitute the Middle Devonian or Ilfracombe group; these are surmounted by a thick zone of red sandstones (the Upper Old Red), which are again overlain by a great series of slaty subcrystalline arenaceous limestones and shales, brown sandstones and grits, which constitute (with the red sandstones below) the Upper Old Red Sandstone or Upper Devonian Series, partly the equivalents of those beds which occur in the Cork district, and termed by the Irish geologists Carboniferous Slate, Coomhola Grits, and *Old Red Sandstone*. It will be my object to endeavour to show that this succession in North Devon and West Somerset is one unbroken and continuous series, existing in both districts, and proved by physical as well as palæontological data. It will also be my endeavour to prove that the hypothetical fault which Professor Jukes has stated to range from Morte Bay on the west to Wiveliscombe and the Quantock Hills on the east has no existence through the centre of North Devon,—and also to show that there is no evidence of a concealed anticlinal (of the nature demanded) with a northern inversion, through the agency of which, and the concealed fault with a supposed northerly downthrow of some 4000 or 5000 feet, we are asked to believe that the Lynton sandstones, grits, and slates, and the Middle or Ilfracombe Series in the north part of the county, are upon the same general horizon as those (similar, not identical) rock-masses comprising the structure of Baggy Point, Marwood, Sloly, Croyde, Braunton, Pilton, &c., on the south, and *above* the Pickwell Sandstones. From these views I entirely dissent on the grounds above stated; and a careful examination of the West Somerset and North Devon areas during the past autumn (1866) now enables me to lay before the Society the results of that investigation.

II. HISTORY AND LITERATURE.

It is necessary to my purpose that a condensed history of the literature of the Devonian Rocks, with their groupings &c., should be understood, and that our British series, with their continental equivalents and their correlation generally, should be paralleled; we shall thus be enabled to trace the history of the question, and aided in coordinating the views held by those geologists and palæontologists who have, both in this country and on the Continent, since the year 1837, adopted the nomenclature proposed by Murchison and Sedgwick in their elaborate memoir upon “the Physical Structure of North Devon and the Rhenish Provinces”*, in which they endeavoured to assign a position and sequence to those slates, sandstones, and limestones which are so conspicuously and extensively developed in North and South Devon and Cornwall. Their views

* Geol. Trans. vol. v. 1840; and Proceedings, vol. iii. 1839.

were ably substantiated by Mr. Lonsdale, by his careful investigation of the fossils, to which he assigned an intermediate and distinct position (to the corals, &c.), showing, with the authors of that memoir, that the stratified rock-masses of that extensive area and their fossil contents hold a position, physically and palæontologically, between the great mass of the Silurian deposits, already definitely determined, and those of the Carboniferous series succeeding them, which are developed on a grand and extensive scale in the culm-trough that occupies the region between Barnstaple, in North Devon, on the north, and Brocastle and Petherwin, in North Cornwall, on the south.

1836. *Sedgwick and Murchison*.—These authors, in a communication to the British Association*, were the first to accurately determine the place of the carbonaceous deposits of North and Central Devon, which had previously been classed with the lowest portions of the Grauwacke; they described the structure of the county in ascending order, and divided the whole series into five groups; they, however, then misunderstood the group of rocks that repose upon the Morte slates and sandstones in North Devon, referring the Upper Devonian or Barnstaple series to the Silurian system, and placing the Carboniferous upon them, which in stratigraphical succession was correct, the *underlying* group being referred to a *wrong* age. In 1839 this error was corrected†.

1837. *Williams, Rev. D., F.G.S.*‡—A section accompanies this paper, giving the author's views of the general succession of the rock-masses of West Somerset and North Devon, in which he places the Cannington-Park Limestone at the base, and below the Foreland and Dunkery sandstones, and Lynton slates; he divides the rocks into nine groups in ascending order—the carbonaceous strata and their flora being erroneously placed below the Old Red Sandstone and the Carboniferous Limestone.

1837. *Austen*.—R. Godwin-Austen, Esq., in a masterly paper "On the Geology of the South-east of Devonshire"§, discussed the structure of the rock-masses of that area generally, and, after describing the succession of the Tertiary deposits and Secondary formations, also noticed the culmiferous or Carboniferous series, its position and succession, and then remarked upon the Transition System (then so called), believing that the culm-measures rested unconformably upon them. He divided this series into five groups, also noticing the igneous and trap rocks.

1838. *Weaver*.—Thomas Weaver, Esq., communicated to the Geological Society an important paper on the "Geological Relations of North Devon"||, in which he describes the structure of that area, from Bideford, on the south, to the Foreland, east of Lynton, on the

* Report, 1836.

† "On some fossil wood, &c., low down in the Grauwacke of Devon, &c."

‡ I do not purpose commenting upon the views held by any of the older authors in this notice of the History of the Devonian Rocks.

§ Proc. Geol. Soc. vol. ii. 1833-38, p. 584.

|| Proc. Geol. Soc. 1838, vol. ii. p. 589.

north, and employed a nomenclature derived from those localities where the strata were best developed or exhibited, in ascending order, from the Foreland to the culmiferous beds south of Barnstaple; he believed the whole series to be connected and to pass from one to the other, showing one general sequence with a southern dip. The term "transition" was adopted by him for the rocks subsequently called "Devonian." This paper was a valuable contribution to the then state of our knowledge upon this area.

1838. *Austen*.—Mr. Godwin-Austen, in another paper, "On the origin of the Limestones of Devonshire"*[†], clearly showed their origin to be due to the laws of organic life, and drew comparisons between them and the modern coral-reefs. The localities and facts mentioned are important as bearing upon the question of the Middle Devonian limestone.

1839. *Williams*.—The Rev. D. Williams communicated to the Geological Society his paper upon the "Transition or Grauwacke System as exposed in the Counties of Somerset, Devon, and Cornwall"†. This was also a valuable paper, and a correction of former views held by him. The upper members of the North Devon Rocks are the only series commented upon, the lower rocks being reserved for a subsequent notice.

1839. *Sedgwick* and *Murchison*.—"Classification of the Older Rocks of Devon and Cornwall"‡. The rocks of North Devon and Cornwall are described in this paper in descending order in four groups; and a nomenclature is proposed differing from that formerly propounded at the meeting of the British Association held at Bristol in 1836. They held that the succession of the rocks in North Devon was complete and conformable, from the carbonaceous series to those of Baggy and Marwood, which succeed them, and thence to the Ilfracombe and Lynton beds below; and they associated the Quantock series with the oldest or Lynton slates and sandstones. The authors showed the same succession for South Devon and North Cornwall; they also proposed to substitute the term "Devonian" for "Old Red Sandstone," as suggested by Mr. Lonsdale, after his examination of the fossil contents of the slates and limestones of South Devon.

1839. *Austen*.—"On the structure of South Devon." This paper was supplementary to the memoir read in 1837 (Proc. Geol. Soc. vol. ii. p. 584), and in it the author showed the general relations of the various bands of slates, limestones, and sandstones in South Devon. Six important considerations and conclusions are here given; and Mr. Austin then considered that the carbonaceous rocks of Central Devon formed no part of the older deposits named therein.

1839. *Williams, Rev. D.*—"On the Great Graywacke System, as is comprised in the Group of West Somerset, Devon and Cornwall." The author wrote this paper as a supplement to his former communication in 1839 (Proc. Geol. Soc. vol. iii. 1839, p. 115). In it

* Proc. Geol. Soc. 1838, vol. ii. p. 669.

† Ibid. vol. iii. 1839, p. 115.

‡ Ibid. vol. iii. 1839, p. 121.

he corrects certain errors, and gives much valuable research bearing upon the succession of the whole series in West Somerset and Devon. In the history of the Devonian controversy it is important, but needs no special comment here. The author, however, states his opinion that ten consecutive series occur in and occupy the whole country from Cannington Park and the Quantock Hills in West Somerset to the Land's End in Cornwall. (Proceed. Geol. Soc. vol. iii. 1839, pp. 158–162.)

1839. *De La Beche*.—"Report on the Geology of Cornwall, Devon, and West Somerset"*. In this important memoir the author discusses the above three areas in all their aspects, still retaining the term "Greywacke" for the whole of those rocks below the carbonaceous deposits. In the 5th chapter (pp. 127–155) these two groups receive important notice, and the views and opinions of continental authors, both physical and palæontological, are given as bearing upon the relation of the two systems. Accompanying, or as part of, this work, appeared in the year 1841 Prof. Phillips's 'Palæozoic fossils of Devon, Cornwall, and West Somerset,' being a description of all the then known organic remains of the Devonian rocks, to be noticed hereafter.

1840. *Sedgwick and Murchison*.—"On the Physical Structure of Devonshire, &c."†. In this elaborate paper, which at the time exhausted the subject, the five regions into which the authors divided Devonshire are graphically and clearly described, their views upon the geological structure of which was received then, and cannot now be controverted. The chapters descriptive of the succession of the deposits in North Devon between the north coast and the culmiferous series, and of those between Dartmoor and the south coast in South Devon, should be read and consulted by all who would seek to understand the physical structure of Devon. The second part of their paper, "On the Classification of the older stratified Rocks of Devonshire and Cornwall, &c."‡, contains much information upon the organic remains, and their distribution through the divisions therein proposed.

1840. *Lonsdale*.—"On the Age of the Limestones of South Devon"§. This paper was intended to show again that the author was the first to infer from zoological evidence that the Limestones of South Devon would prove to be of the age of the Old Red Sandstone. It is a complete résumé and summary of the opinions previously entertained respecting the age of the limestones which are associated with the slates, &c., of Devon and Cornwall. The older authors had placed these Limestones in the Primary-transition or Greywacke and Carboniferous series, though Mr. Prideaux had previously assigned them in part (or in mineral characters) to the Old

* Published by order of the Lords Commissioners of Her Majesty's Treasury, 1839.

† Trans. Geol. Soc. 2nd series, vol. v. p. 633.

‡ Ibid. p. 688.

§ Proc. Geol. Soc. 1840, vol. iii. p. 281. Trans. Geol. Soc. 2nd series, vol. v. p. 721, &c.

Red Sandstone*; and Prof. Phillips† would not confidently place them in a definite position in consequence of the resemblance of their fossils to many of the species occurring in the Mountain-limestone. The labours of other authors are commented upon in this paper, and comparisons are made with other systems‡.

1841. *Phillips*.—"Figures and Descriptions of the Palæozoic Fossils of Cornwall, Devon, and West Somerset."§ This volume accompanies Sir H. De la Beche's Report, and contains accurate descriptions and figures of all the species of Devonian fossils then known; and when we consider the fragmentary nature and unsatisfactory condition of the fossils that occur in these slates and limestones, and the materials out of which Professor Phillips compiled his work, it is one of the highest classical value, which we must ever apply as our standard of reference. The divisions and sequence therein adopted require little or no change at my hands, and have been fully confirmed by recent investigations.

1842. *Sedgwick and Murchison* ||.—"On the Distribution and Classification of the Older or Palæozoic Rocks of North Germany and Belgium, &c."; accompanied by a description of the Fossil Mollusca, &c., by Viscount d'Archiac and M. E. de Verneuil. The Carboniferous rocks of Westphalia, as well as the Devonian limestones and shales of Mettmann, Elberfeldt, Hagen, and Iserlohn, and the calcareous rocks of Pfaffrath, Refrath, &c., on the right bank of the Rhine, are elaborately described in the first part of this paper. The second part contains an explanation of the structure of the country on the left bank of that river, comprising the rocks of the Eifel and the older rocks of the Moselle and the Rhine, with the formation of the Hunsrück and the Taunus. Part the third embraces descriptions of the Devonian rocks which constitute the Thüringerwald, Upper Franconia, and the Fichtelgebirge, and descriptions of Hof, Elbersreuth and Gerolsgrün, &c.

In this important memoir the authors with much detail describe the whole of the Devonian deposits, occupying a large portion of the Rhenish province and Belgium. It is followed by a long and important memoir by Viscount d'Archiac and M. Edouard de Verneuil descriptive of the organic remains which occur in the rock-masses, commencing with a general survey of the fauna of the Palæozoic rocks known at that date. Pp. 336–410 are occupied by carefully detailed descriptions and notices relative to the species and their distribution through the Lower, Middle, and Upper divisions of the Devonian rocks; and the paper is concluded by a table showing the ranges, and giving other important information relating to the British and Rhenish fossils.

* Trans. Plymouth Instit. pp. 36–43, 1828, 1830.

† Encyclop. Metropolitana, 1836.

‡ This paper by Mr. Lonsdale contains a complete list of authors and their opinions, extending from the time of Woodward in 1729 to those of Sedgwick and Murchison in 1839.

§ Published by order of the Lords Commissioners of Her Majesty's Treasury.

|| Geol. Trans. 2nd series, vol. vi. 1842. (Paper read May 13th and 27th, 1840.)

1846. *De la Beche*.—"On the Formation of the Rocks of South Wales and South-western England, &c."* This remarkable memoir enters fully into the question of the structure and succession of the Devonian rocks of the West of England; pages 65 to 105 are devoted, with others, to their consideration. It is too long for more than mere notice, and is replete with important matter. The author refers to the labours of those who have investigated the structure of North and South Devon, especially Mr. Godwin-Austen, from whose researches, and those of Prof. Phillips, the materials are largely drawn.

1848. *Peach, C. W.*—"On the Fossiliferous Strata of part of the South-east Coast of Cornwall" †. This paper has reference to supposed fish-remains in the region mentioned, and is the first notice of ichthyic remains in the Devonian rocks; *Onchus*, and an *Asterolepis* are stated to occur at Lentivet Bay and Pencarra. Many important facts are communicated in this notice.

1848. *Pattison, S. R.*—"On an insulated patch of Devonian strata in the parish of St. Stephen by Launceston" ‡. Notice of the Yealm-bridge flagstones and other rocks, with fossils from the Upper Devonian beds, with a list of the few species found.

1850. *Pattison, S. R.*—"On the Petherwyn Beds" §. This paper contains a concise, but clear, description of the strata at Petherwyn, their economical uses, relation to other deposits, and a copious list of organic remains, compiled chiefly from Prof. Phillips's 'Palæozoic Fossils of Devon and Cornwall,' 1841. Mr. Pattison here mentions the coarse unfossiliferous sandstones that underlie the Upper Devonian rocks in North Cornwall. I believe them to be the equivalents of the Pickwell Down sandstones in North Devon.

1850. *Pengelly*.—"On the Ichthyolites of East Cornwall" ||. An important communication upon these obscure, yet valuable, remains at Looe Island and Harbour, St. Veep, &c. Subsequent research has revealed other and better specimens of the genus *Onchus*, &c., which are now in the possession of Mr. Pengelly.

1851. *Sedgwick*.—"On the Slate Rocks of Devon and Cornwall" ¶. This paper is of great value, especially so as relating to Cornwall, the slates of which are correlated with those of Devon. The position of the Petherwyn and Baggy Point, Marwood, and Barnstaple beds are noticed here, and also the overlying *Posidonia*-shales and limestones, with the succeeding Culm-measures. The results of much physical research are given in this memoir.

1853. *Sharpe, D.*—"Review of the Classification of the Palæozoic Formations, &c. &c."**. Much important matter is contained in this paper, in which are compared the equivalent strata of Belgium &c.; reasons are given by the author for considering that much of the so-called Devonian should be classed with the Carboniferous (or

* Mem. Geol. Surv. of Great Britain, 1846. Vol. i.

† Royal Geol. Soc. Cornwall, 35th Annual Report, p. 57, 1848.

‡ Royal Geol. Soc. Cornwall, 35th Ann. Rep. p. 63.

§ Royal Geol. Soc. Cornwall, Ann. Rep. 1850, p. 132.

|| Royal Geol. Soc. Cornwall, Ann. Rep. 1850, p. 116.

¶ Quart. Journ. Geol. Soc. vol. viii. pp. 1-19. 1852.

** Quart. Journ. Geol. Soc. vol. ix. p. 18.

système Condrusien of Dumont); and the South Devonian Limestone, with peculiar modifications, is made to succeed the Old Red Sandstone, or Rhenane series, and the Old Red Sandstone to overlie the Ilfracombe or calcareous group of North and South Devon.

1853. *Godwin-Austen*.—"On the series of Upper Palæozoic groups in the Boulonnais." This remarkable district is ably deciphered by Mr. Austen. The author divides the series into two divisions—(1) the limestones above and below the Cove, and (2) the Yellow Sandstone group; he subdivides the two into seven series, showing succession of beds and conditions indicated. A note accompanies this paper from Mr. D. Sharpe (p. 246), containing a list of the organic remains; this note is of much value, though I cannot agree with the author's conclusion relative to the position of the Petherwyn beds, or fossils.

1854. *Siluria*, *Murchison*, *Sir R.*—Noticed under the third edition, in 1859.

1855. *Jukes and Salter*.—"Notes on the Classification of the Devonian and Carboniferous Rocks of the South of Ireland" *.

1855. *Murchison and Morris*.—"On the Palæozoic and their associated Rocks of the Thüringerwald and the Harz." In the first part of this memoir reference is repeatedly made to the Devonian series of Thüringerwald. The Upper Devonian, "Younger Greywacke" of Credner and Richter, consists of the Upper Devonian and Lower Carboniferous, united by these authors into one subgroup, which appears to constitute one physical mass covering over, or abutting against, the Lower Silurian rocks.

In part ii. the Devonian Rocks of the Harz, as well as on the Rhine, are shown to be composed chiefly of the Spirifer- or Coblentzian sandstone and slates, which contain the same characteristic fossils as the rocks of the same age in Devonshire. The deductions bearing upon the distribution and condition of the Devonian series throughout the communication should be consulted, as they are additional to, and confirmatory of, the views propounded by Sedgwick and Murchison in 1842.

1856. *Godwin-Austen*.—"On the possible Extension of the Coal-Measures beneath the South-eastern part of England." Speculative as this paper is, and necessarily must be, the generalizations and philosophical and suggestive views put forward by the author are of the highest and most important order; they relate to the Devonian as well as to the Carboniferous Rocks and their distribution. The lacustrine condition of the Old Red Sandstone and the area occupied by that formation are discussed, and the physical conditions of the old land-surface, &c., are carefully noticed. Those details in the paper bearing upon the condition of England and Europe during the deposition of the Old Red Sandstone, Carboniferous Limestone, and the growth of coal, are important, and command the attention of all the physicists.

1859. *Murchison*, *Sir R.*—'*Siluria*' †. The third edition (in-

* Dublin Geol. Journ. vol. vii. June, 1855.

† History of the oldest Fossiliferous Rocks, and their Foundations, &c. 1859.

cluding the 'Silurian System') of this elaborate work, descriptive of the Silurian deposits of the world, embraces much information, if not the most complete *résumé* known of the Devonian and Old Red Sandstone systems, leaving, for the purposes of generalization, little to be done. Pp. 269 to 292 are descriptive of the Old Red Sandstone of England, Wales, and Scotland; they are succeeded at p. 292 by a masterly description of the Devonian Rocks in Devon and Cornwall, and Ireland; pp. 405 to 410 are devoted to the Devonian rocks of Saxony &c., and pp. 417 to 471, inclusive, to those of the Rhenish Provinces, Belgium, France, America, and Spain. The literature of the Devonian question is here nearly exhausted.

1860. *Pengelly*.—"On the Chronological and Geographical Distribution of the Devonian Fossils of Devon and Cornwall"*. Important tables accompany this paper, as well as a *résumé* of the views held by earlier authors; and Mr. Pengelly in the latter part of his communication discusses the relations existing between the Silurian and Devonian, and between the Devonian and Carboniferous species.

1861. *Pengelly*.—"On the Devonian Age of the World"†, the substance of six lectures delivered at the Royal Institution, in which much valuable matter is brought together relative to the whole Devonian question. The distribution of groups and species is detailed, &c.‡, and elaborated into a commentary upon their peculiarities, forming a digest of the subject.

1862. *Pengelly*.—"On the Geological and Chronological Distribution of the Devonian Fossils of Devon and Cornwall"§. This is a more detailed account of the distribution of the Devonian fossils than that given in the 'Brit. Assoc. Report,' Oxford, 1860; numerous tables, showing relative and absolute distribution, and the value of the several species, as well as calculated deductions, and data *for future labours yet*, upon the Devonian fauna of Devon and Cornwall. These two papers should be consulted by all students of Devonian geology.

1863. *Salter, J. W.*—"On the Upper Old Red Sandstone and Upper Devonian Rocks"||.—An important communication upon the Upper Old Red Sandstone and Upper Devonian beds, in which the author clearly establishes the value of this division. He describes the South Pembrokeshire Old Red Sandstone generally, especially those beds at Drinkim Bay in Caldy Island, where it is shown, as in the Avon section at Bristol, that the Old Red is definitely distinct from the overlying Lower Limestone Shales in every particular, especially so in the total absence of fossils. The author, however, notices a bed of *Serpula* some fifty feet down in the Old Red Sandstone, which perhaps is the only marine form known in this

* Brit. Assoc. Report, 1860.

† Six Lectures delivered at the Royal Institution, in May and June 1861.

‡ Published in the 'Geologist,' vol. iv. p. 332.

§ Geologist, vol. v. p. 10; and Brit. Assoc. Report, Oxford, 1860; also Royal Geol. Soc. Cornwall, Report 1860, p. 388. Earlier notice.

|| Quart. Journ. Geol. Soc. vol. xix. 1863.

upper part of the series. North Devon is then described, so far as concerns the area south of Pickwell Down, which region is occupied by the Upper Old Red and Devonian rocks; these are compared with the South Wales beds. The Petherwin and Land-lake series are carefully noted, and their position below the Marwood, Pilton, and Barnstaple group established. Mr. Salter then notices the Old Red Sandstone of Somersetshire, Gloucestershire, and Shropshire, adding important matter relative to the South of Ireland, as regards the Carboniferous slate and the Coomhola series. The "Foreign Equivalents" of the Upper Devonian, with the results of his investigations, conclude this paper.

1864. *Jukes*.—"Memoirs of the Geological Survey of Ireland. Explanations of sheets 187, 192, 195, 196, 199, &c., with Palæontological Notes by W. H. Baily, F.G.S., &c." It is unnecessary to do more than mention that in the concise description of the country to which these "Explanations" refer, much valuable matter is contained relative to the Old Red Sandstone and Carboniferous beds of the South of Ireland; and in them (especially the memoirs upon sheets no. 187, 195, and 196 of those above enumerated) are embodied the views held by Prof. Jukes relative to the two formations, which are reproduced in his paper upon North Devon and Rhenish Prussia*, and also in his paper on the same subject in the Quarterly Journal of the Geological Society †.

1865. *Kelly*.—"Remarks on the Doctrine of Characteristic Fossils" ‡. The Table given in this paper, showing the distribution of the Pilton, Petherwin, and Newton-Bushel species, apart from theoretical views, and from the determinations of the Devonian and Carboniferous species, and as part of the literature of the Devonian series, may be consulted: its value must be determined by the reader, after careful and critical examination.

1865. *Jukes*.—"Notes for a Comparison between the Rocks of the South-West of Ireland and those of North Devon, and of Rhenish Prussia in the neighbourhood of Coblenz" §. This paper is a *résumé* of the two previously noticed, to which is added an account of the author's researches in Rhenish Prussia, chiefly in the neighbourhood of Coblenz. The South-Irish beds are briefly described here, followed by a statement of Professor Jukes's idea of the contemporaneity of the Carboniferous Slate and Carboniferous Limestone. North Devon is then cursorily noticed, especially Baggy, Croyde, Braunton, and Pilton. The Middle or Ilfracombe beds receive a passing notice only. Comparative lists of fossils from Ireland and North Devon are given from different localities ||, followed by those

* Notes for a comparison between the rocks of the South-West of Ireland and those of North Devon, and of Rhenish Prussia in the neighbourhood of Coblenz.

† "On the Carboniferous Slate (or Devonian rocks) and the Old Red Sandstone of South Ireland and North Devon" (Quart. Journ. Geol. Soc. Aug. 1866, vol. xxii. p. 321).

‡ Journ. of the Royal Geol. Soc. Ireland, 1865, vol. i. pt. 1. new ser.

§ *Loc. cit.*

|| I differ much from Prof. Jukes relative to the distribution of the species.

of the Carboniferous Slate. The Coblentian beds are noticed, with Prof. Jukes's views upon them.

1865. *Pengelly*.—"On the Co-relation of the Slates and Limestones of Devon and Cornwall with the Old Red Sandstones of Cornwall"*. This paper refers particularly to the evidence of the fossil fishes in the Devonian strata, and is an endeavour to co-ordinate the Old Red and Devonian rocks.

1865. *Hall, T. M.*—"The Geology of North Devon"†. In this lecture on the "Geology of the country around Barnstaple, Bideford, Ilfracombe, Lynton, and Clovelly," &c., the author proposes a new nomenclature for the North Devonian rocks, which he divides into seven series—"the *Foreland Group*, *Lynton Zone*, *Martinhoe beds*, *Ilfracombe Group*, *Marwood Zone*, and *Pilton beds*." Whatever local value may be attached to these divisions, they, with his descriptions, clearly express their succession and position below the Carbonaceous series south of Barnstaple.

1866. *Jukes*.—"On the Carboniferous Slate (or Devonian Rocks) and the Old Red Sandstone of South Ireland and North Devon"‡. The Introduction to this paper contains the sum of the differences that exist between Mr. Jukes and the older authors upon the physical structure of North Devon and West Somerset; and in it he endeavours to remove from the British rocks the Devonian series, as a system, altogether§. The author gives physical and palæontological reasons for his conclusions. The second part is devoted to the structure of South Ireland, as derived from his experience in that region; part the third to the geological structure of North Devon and West Somerset, in which are elaborated the distinctive views held by the author, and the reasons he assigns for his change of nomenclature, and the difference in the conclusions arrived at by him, as compared with those of other writers.

1867. *Jukes*.—"Additional Notes on the Grouping of the Rocks of North Devon and West Somerset, with a Map and Section"||. This pamphlet, so far as regards the subject matter, is intended to supply the deficiency in the author's communication to this Society in 1866, relative to the more complete examination of the series of rocks below the Upper Old Red Sandstone of Pickwell, Devon; consequently the Wiveliscombe, Dulverton, Combe Martin, Dunster, Minehead, and Quantock region are partly described. This paper is accompanied by a map and section of North Devon and West Somerset.

III.—STRUCTURE AND SUCCESSION OF THE ROCKS OF WEST SOMERSET.

1. *Cannington Park Limestone*.—In the midst of faulted ground the outlier of limestone at Cannington Park is a conspicuous feature.

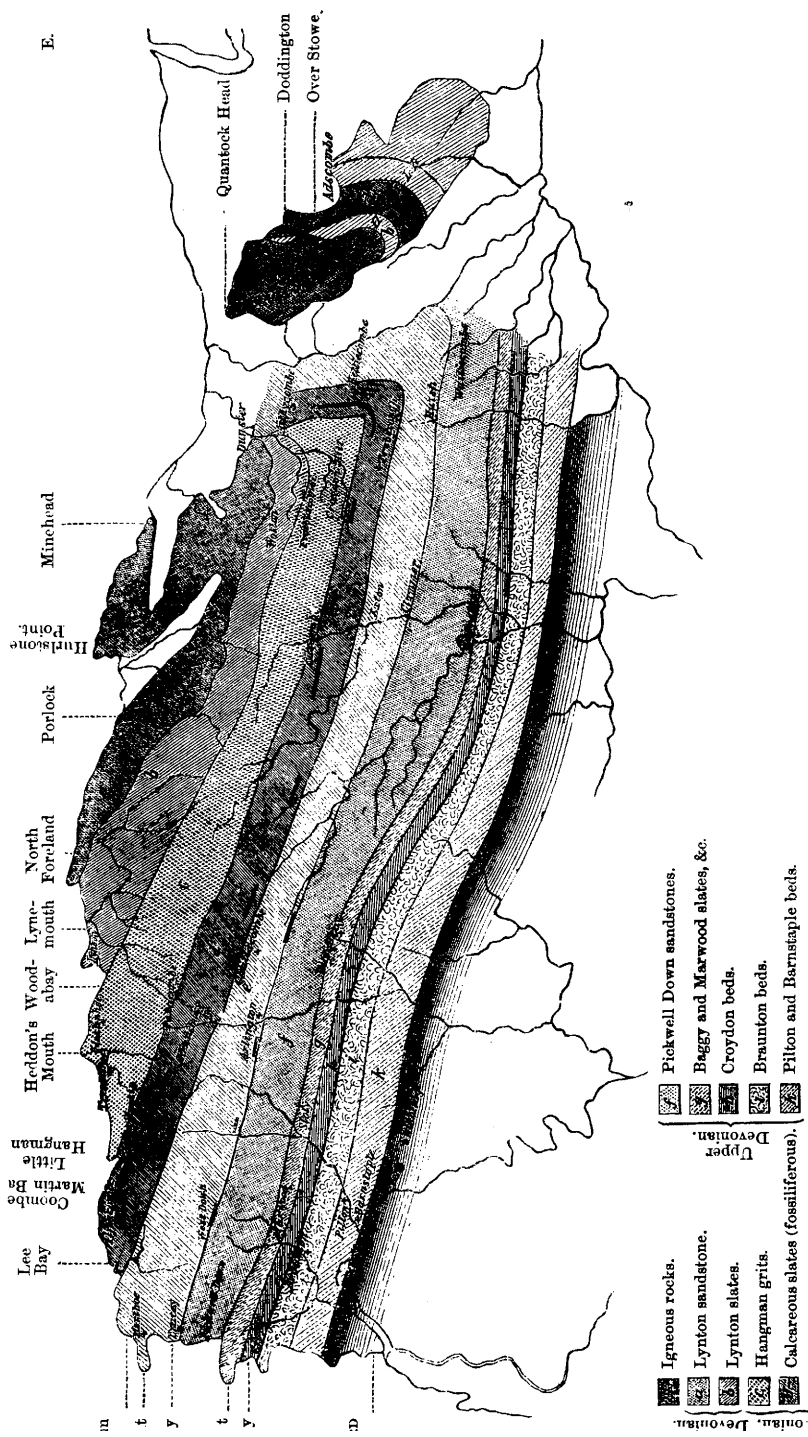
* Royal Geol. Soc. Cornwall, 1865, p. 441.

† A lecture delivered before the members of the Exeter Naturalists' Club, at "Westward Ho," Northam, Sept. 23rd, 1865.

‡ Quart. Journ. Geol. Soc. vol. xxii. March, 1866.

§ This view is discussed in my present paper.

|| Printed for private circulation among the Fellows of the Geological Society of London, 1867.



It is surrounded on all sides by the Lower New Red Sandstone ; and to the south and east there occurs a series of fissile, thin-bedded, chocolate-coloured slates, which agree in every particular with those on the eastern slopes of the Quantock Hills. These slates contain no fossils, so far as I was enabled to determine ; but that they are connected (beneath the thin covering of the New Red) with the main mass of the Quantock Hills is evident ; for exposed masses at Ashford, Radlet Farm, and Halsey Cross connect the slates of Nether Stowey (which are of Middle Devonian age) with those of the village of Cannington, between which, as before stated, and Cannington Park to the north, a considerable exposure of red slates takes place, which are again seen at Charlinch, two miles to the south-east, where an extensive fault brings them to the surface. Considerable doubt has arisen as to the age of the limestone of Cannington Park. It has generally been assigned to the Carboniferous period, but the almost total absence of fossils renders the task of fixing its true place extremely difficult ; if, however, position, lithological characters, what few fossils there are, and peculiarities of structure may be depended upon, it so strongly resembles the smooth blue, pink, grey, and red-veined argillaceous porcelain-like limestones of Torquay and Newton Bushel in South Devon, and those of Adcombe and Stowey on the Quantocks, that, to my mind, it cannot be distinguished from them : and, again, it has no resemblance to any division of the largely developed series of Carboniferous Limestone of the adjacent Mendip Hills, nor to any in the Bristol area. This limestone dips to the south-east ; and upon it rest the chocolate-coloured slates, which are rolled or contorted, but so masked by the overlying New Red Sandstone, that its *clear* connexion with the limestones and slates of the Quantock Hills cannot be satisfactorily traced ; nevertheless, from its character, position, and association with the slates, there is every probability that the limestone of Cannington is of the age of the slates amongst which it exists, and by which it is surrounded. It is the most easterly outlier of the Devonian rocks in West Somerset*.

2. *The Quantock Hills.*—This range of hills, which stretches across West Somerset from Quantock Head on the north-west to West Monckton on the south-east, is composed on the west side (or along its strike, which corresponds to its geographical bearing) of coarse and fine red and grey sandstones, which form the base of the series of rocks constituting the structure of the Quantock range. All the rock-masses beneath and to the west of Staple-Hill Foot, Bicknoller, Crowcombe, Bagborough, Cothelstone, Kingstone, &c. are covered by the Lower New Red Sandstone and Conglomerate, which occupy the valley from Williton and Stampford Brett on the north, to Stogumber, Lydeard St. Laurence, Milverton, and Taunton on the south.

* The section (fig. 2, p. 584) will show, through the patches of exposed slates between Cannington and the Quantock Hills and those that surround it on three sides, how these limestones by an opposite dip are related to those of Adcombe and Over Stowey to the west, all further evidence of them being lost to the east of Cannington, under the New Red sandstones and marls, and the alluvium of the Somersetshire marshes.

The base, therefore, of the Quantock series, as at Lynton, cannot anywhere be satisfactorily determined; but that the Red sandstone and grits before mentioned are of the same general horizon as those of Grabbist and Croydon hills, and partly also of the same red sandstone which occurs at the Hangman and Tren-tishoe, &c., to the west, I do not doubt. They occupy the same position, and have the same relation to the slates and limestones of Asholt, Adcombe, and Over Stowey on the eastern side of the Quantock range that the slates and associated limestones of Ilfracombe, Combe Martin, Twitchin, Simonsbath, Newland, Luckwell, Luxborough, Higher Broadwater, &c. do to the same sandstones above mentioned, which stretch from Croydon Hill on the east to the Little Hangman in Combe Martin Bay on the west. It is important that this should be understood, because whatever might have been the cause of the great bend, horizontal curve, or movement now hidden by the New Red series of the Stogumber Valley, it is clear that the succession of the Lower sandstone and grits, and that of the succeeding slates and limestones of the Middle group, are as complete in the Quantock Hills as those of Lynton or Combe Martin—a fact unmistakeably borne out by the lithological characters of the rocks as well as by the palæontological contents of the limestones and slates. The general dip of all the slates and associated coral-limestones on the eastern side of the Quantocks is to the east; the great limestone beds in the quarries at Adcombe and Over Stowey dip north-east 35°; at the former place they are in solid beds, from 4 to 9 feet in thickness, with partings of shale containing many corals. The character of the limestones in every particular closely resembles the hard crystalline grey and red-veined series of Torquay; they contain many of the same corals, viz. *Cyathophyllum cæspitosum*, *C. Hallii*, *Favosites cervicornis*, *Stromatopora concentrica*, all abundantly distributed, with *Heliolites porosus*, and many Polyzoa*.

At Ashholt-Wood and Lower-Ashholt quarries, thick-bedded limestones, interstratified with red slaty bands and red grits, are extensively worked. These beds occur on the same line of strike as those of Adcombe, but have a south or reversed dip S.S.W. 30°; they are lower in the series than those of Over Stowey and Adcombe; and, from compass-bearings taken at Cockercombe and to the west of the new court (where the great greenstone, or porphyritic felstone beds are so finely exposed), I have no doubt that a line of disturbance occurs from these latter places through Ashholt, thus reversing the dip in so short a distance. This felstone-porphyry is interstratified with the slates, to the thickness of 700 feet†.

* These limestones take the highest polish, are worked for statuary purposes, and are equal in every respect to those of Plymouth, Newton, Torquay, &c.; and Lord Taunton has extensively used them in the construction of his mansion at Adcombe, where they are worked into columns, pillars, mantel-pieces, &c.

† This pale-green porphyritic felstone has been extensively used by Lord Taunton in constructing the new court at Adcombe; it also takes a fine polish, and his lordship has used it in the construction of the fireplaces &c.

In the Ashholt, Adscombe, and Stowey quarries I obtained the following fossils:—

Alveolites suborbicularis.
Heliophyllum Hallii.
Endophyllum abditum.
Acervularia.
Favosites cervicornis.
—— *reticulata.*

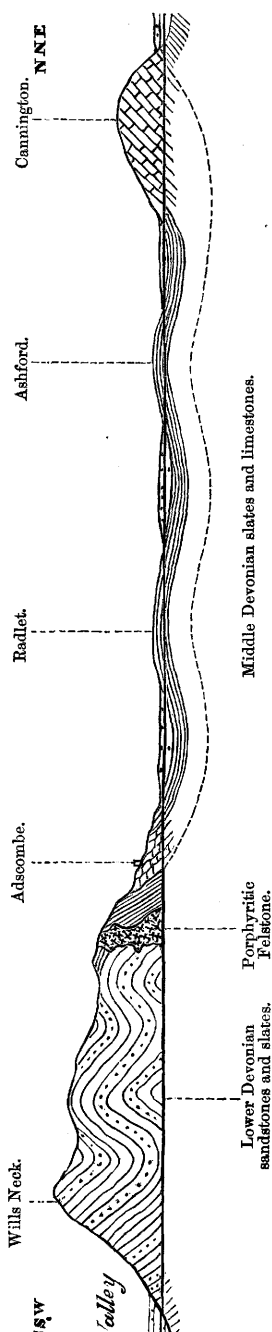
Cyathophyllum cæspitosum.
Stromatopora concentrica.
Atrypa desquamata.
Petraia.
Heliolites.

The entire thickness of the limestones could not be determined, owing to their forming the base or floor of the quarry; but they are more massive and less regularly bedded than those of Adscombe and Over Stowey to the north. These slates and limestones belong to the Middle Devonian, or Ilfracombe, group, and are the same as those which range from Widmouth, Combe Martin, Lee under Nutcombe, and Westleigh &c., and then strike across the country south of Exhead, Dure Down, Black Barrow, and on to Treborough and Nettlecombe. They are the lowest limestones in the North Devon and West Somerset area; but it must be borne in mind that nowhere in North Devon are the limestones exhibited on so gigantic a scale as in South Devon, being, west of the Quantock Hills, chiefly, if not entirely, interstratified with the slates in thin lenticular masses and bands, but nevertheless always yielding the same corals, though apparently not so large an assemblage of mollusca.

A section crossing the Quantock Hills from the village of Crowcombe on the east, over the Fire Beacon to Over Stowey, Radlet, and Ashford, and thence to the slates and limestones of Cannington Park, will show the succession of the Lower red sandstone and grits, or the Lynton series, and the Middle, or Combe Martin and Ilfracombe slates and limestones; and if the higher members of the Middle group, or the equivalent of the Morte series, are present here, they are buried beneath the New Red Sandstone which abuts against the slates of Over Stowey, and which constitutes the plain surrounding the Devonian outliers at Radlet, Charlinch, Ashford, and Cannington. The annexed section (p. 584) will give the succession. I regard the structure of the Quantock Hills as essentially the same as that of the north part of North Devon. The base, or western side, or escarpment, is composed of coarse red, grey, green, and yellow saccharoid sandstones, flaggy and micaceous in places, which, as they ascend higher in the series, become slaty, being again succeeded by a higher series of red gritty sandstones and slates, agreeing in every particular with the higher portion of the grits and slates as exposed in the Lynton area above the Valley of Rocks, and at Woodabay, Trentishoe, Heddon's Mouth, and the Hangman, and with the beds occupied by Seven-Wells Wood. The limestones of Doddington, Adscombe, and Over Stowey represent the Combe Martin and Ilfracombe series, being, however, much thicker and more extensively developed than the limestones at Combe Martin, and rich in organic remains, although few have been obtained.

Whether the New Red series on the east, towards Bridgewater or

Fig. 2.—Section from Wills Neck across the Quantock Hills to Cannington Park.



Stockland, Bristol (the upper New Red Sandstone), covers still higher sandstones resembling the Morte-Bay and Pickwell-Down beds, I am not justified in asserting, though I see no reason why it should not occur. Similar arguments may be used relative to the connexion of the western side of the Quantock Hills with the eastern portion of the Exmoor range at Croydon and Brendon Hills, which are separated by the narrow valley, composed of the Lower New Red Sandstone and Dolomitic Conglomerates of considerable thickness, which extends to Carhampton, Dunster, Watchet, and Minehead, but which is separated from the deep valley of Luckham and Porlock by an isthmus of Old Red Sandstone connecting Croydon Hill and Dunster Park with Grabbist Hill and North Hill over Minehead. These two valleys, continuous in direction, though disconnected at Higher Kitswell, appear to occupy the line of a great fault, or they are in a trough or synclinal basin; the Great St.-Decumans and parallel faults at Watchet, Quantock Head, and Little Stoke, which extend for fourteen miles, are traceable by the depression of the Porlock valley and the reversed dips of the rocks into it. This line also corresponds with the anticlinal of the valley of the East Lynn, south of the Foreland, and the high coast-land from Porlock, the beds comprising the structure of which all dip continuously north (north of the anticlinal from 20° to 40°) to Culbone, Glen-thorne, and on to Porlock, thence through North Hill to Minehead, south of the anticlinal, or the gorge of the East Lynn, from Lynton to Lucott Hill, Stoke Pero, and Timberscombe, south-east of Dunster. The grits, sandstones, slates, and limestones of the whole of North Devon and West Somerset have one uni-

versal general dip to the south, *i. e.* from Lynton or Ilfracombe on the west to Croydon Hill and the Quantocks on the east, to the Culm-measures south of Barnstaple, Dulverton, and Wiveliscombe; and I hope to show, both on physical and palæontological evidence, that the Lower, Middle, and Upper Devonian series are still the groups of rocks that occupy the area assigned to them by Weaver, Murchison, Sedgwick, Sharpe, Lonsdale, Phillips, and others.

3. *Dunster, Minehead, and Porlock Areas.*—West of the Quantock Hills and in the most northerly part of West Somerset is Grabbist Hill, and North Hill, also Porlock, Culbone, and Oare Hills, the three latter overhanging the Bristol Channel; and the lowest beds throughout all North Devon and North Somerset are exposed along their southern flanks. It is impossible not to believe that you are here examining the genuine Old Red Sandstone of Scotland, South Wales, and the Silurian area. Coarse red, grey, and pale-yellow, and mottled thick-bedded sandstone, with alternating fine-grained, flaggy beds, constitute the rock-masses of these hills; and the general dip is to the north-east from 15° to 50° ; observations along their strike give the mean dip of 35° .

No organic remains whatever are known to occur in these sandstones. From the bent and contorted condition of the beds along a given line, *i. e.* from the Foreland through Desolation Point to Hurlestone and Greenlay Points on North Hill (over Minehead), it would appear that they are rolled from north to south, and thus are explained the reversed dips occasionally noticed along this line. At Hurlestone Point this rolling is well seen, the beds in the space of 50 feet being inverted, those seaward, and forming the north head of the Point, dipping 10° south-east, those immediately south dipping 55° north-north-west. The fault being a down-throw to the south, this line of disturbance is traceable from the Foreland on the west, to Quaytown and Minehead on the east, and perhaps passes into the *grand system* of faults that occupy the bay and shore of Watchet, Quantock Head, and Little Stoke. These red sandstones, on assuming their southern dip, constitute the base of the series of slates and grits that stretch across the country from Lynton to Timberscombe and Dunster Park; they underlie and are conformable to the Lower Devonian, Coblentzian, or Spirifer-grits, sandstones, and slates of West Somerset.

Along the summit of North Hill the coarse-grained micaceous Lower red sandstones dip north-north-east and north 18° ; in a quarry near Woodcombe they dip due east 20° .

At Greenlay Point and Minehead the beds form an anticlinal and are faulted, dipping at opposite points, north 45° and south-west 15° , thus agreeing with, and showing the extension of, the east and west fault from Hurlestone Point to Quaytown. At Greenlay Point the rocks are alternating coarse and fine-grained red, green, grey, and yellow sandstones. Lower members of this red sandstone series appear to the south of the Minehead valley at Lower Hopcott, where they still dip north-east 15° ; they are massive beds of red and grey crystalline grits, banded, and stained deep-red, from

three to four feet thick, and much jointed; partings of falsely bedded clayey shale occur, and the whole quarry is apparently much disturbed.

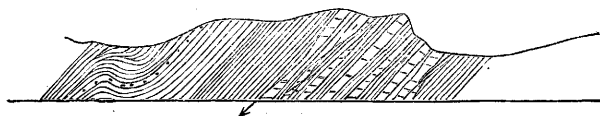
South of Hopcott the red sandstones comprising the structure of Grabbist Hill all dip to the north and north-east, and continue to do so until they reach the deep Wotton-Courtney valley, between Grabbist and Croydon hills, where, along the course of the river, a reversion of dip takes place, either through faulting or a depressed anticlinal; this change is in a direct line with the St.-Decumans fault on to Quantock Head. This reversion and change is traceable from Dunster to the Foreland and Lynton; and the southern dip of these sandstones constitutes them the base of the *whole of the superincumbent Grits, Slates, and Limestones* of West Somerset and North Devon: in other words, these red sandstones underlie, and are conformable to, and form part of (the natural base) the Lower Devonian grits and slates of the North Devon area.

4. *Dunster to Dulverton.*—Having endeavoured to show along a given line that we have a natural and conformable base for the higher or succeeding series of grits and slates, I will now trace the junction and the changes of character on the line of dip in West Somerset, both as regards the physical structure of the rocks and the palaeontological value of their fossils, and will do so over two areas, one south of Dunster, viz. from Dunster to Dulverton, and the other east of Dunster to the Brendon Hills, through Withycombe, Higher Broadwater, Nettlecombe, and Treborough. At Timberscombe, Bickham, and Oaktrow, south-west of Dunster, the sandstones and grits retain their character, but are more thinly bedded and more fissile than those to the north, and the partings are more slaty. These beds are an easterly extension of the second series of red grits exposed at Woodabay, Trentishoe, and the Hangman. Between Oaktrow and Ashwell a gradual change takes place in the lithological character of the sandstones; the grit beds become thinner, and give way to thicker masses of interstratified slaty rocks; and at Cutcombe the change becomes complete. We here lose the red grits and fine sandstones altogether; the passage from arenaceous to argillaceous rocks being complete. We have here, then, as at Combe Martin Bay, evidence of the grits, sandstones, and slates of the Hangman group passing insensibly into the second, or Ilfracombe series, and that in the clearest manner. South of Cutcombe, on the ridge at Wheddon Cross, we meet with the lowest series of limestones in the Ilfracombe group, which are here lenticularly arranged masses of calcareous matter, due chiefly to organic influence, and interstratified amidst the slate. In places these limestones are of considerable thickness, and are used both for building and agricultural purposes, especially at Newland, Court Hill, and Luckwell; they are also extensively developed to the east of Croydon Hill, at Higher Broadwater, Lod Huish, and Nettlecombe. *Favosites cervicornis*, *Stromatopora concentrica*, and *Cyathophyllum*, &c. occur in the limestone-bands at Wheddon Cross and Luckwell.

No mollusca were observed; their absence is somewhat remark-

able. It is singular how destitute the slates of West Somerset are of molluscan remains and other associated life, though it may be accounted for from the fact that the largely developed series of argillaceous rocks of this region were accumulated in a deep sea, and probably in an area of depression, and hence the preponderance of *Coelenterata* in the definitely marked line of limestones striking from Ilfracombe and Combe Martin to Nettlecombe and Withycombe; and, again, the persistency of the conditions under which these limestones were deposited, along so extensive a line, clearly indicates deep water, depression, and a fringing reef-like growth of coral-masses. Fourteen species of corals are known to occur in these lenticular bands of calcareo-argillaceous deposits in West Somerset, at Withycombe, Nettlecombe, Goldsoncot, Roadwater, and other places in that area; and the same facies is preserved in all the limestones.

Fig. 3.—Section in a Quarry at Wheddon Cross, showing the lenticularly arranged limestone bands in the midst of the slates.



At Wheddon Cross the beds dip 45° south; and this angle of dip appears to be general (south of Exton). Continuing our examination of the limestones and slates from Wheddon Cross and Luckwell, both along the road and down the valley of the Exe, beyond Eyeson Hill, we are still in the lower part of the Middle or Ilfracombe beds, or that division of them which rests upon the upper part of the series of red grits at the Little Hangman &c., and which is well seen in ascending order along the coast from West Challacombe through Combe Martin Bay, Watermouth, Widmouth, Helesborough, and Ilfracombe to Lee Bay, and upon which the Upper division, comprising the glossy slates of Morte Hoe (and Lundy), sets in. South of Eyeson Hill, the river- and road-sections give unmistakeable proof that we are in, and crossing the strike of, these grey glossy Morte-Hoe slates, their physical condition and marked characters being most prominent. In the gorge of the river, at the picturesque village of Winsford, two miles west of the main road to Dulverton, and near the bridge, fine sections occur, showing the dip of the same beds to be $S. 60^{\circ}$, and the cleavage vertical. From this point south, through Exton and Clammier, and as far as Browford, the dip is in the same direction. These slates here are frequently folded, and exhibit a reversed dip, but no local dislocation or faulting between Browford and Oxgrove. This reversion therefore seems due to extensive undulations of the strata; for, west of Shircombe, these pale-grey fissile slates dip 65° S., at Browford S.E. by S. 50° , at Kent's mill the same, and 100 yards north of Chilly-Bridge gate they still dip S. 80° ;

but close to the turnpike gate they appear to dip north, or are nearly vertical, and shortly regain their dip to the south at 80° , but again undulate and dip to the north as far as Oxgrove, where, on approaching the red grits and sandstones, they are again bent and folded, though not immediately in contact with them. These easterly extended Morte slates as clearly underlie the Dulverton or Pickwell-Down sandstone here as the same slates at Morte and Woolacombe clearly and unmistakeably underlie the Pickwell-Down sandstone in Morte Bay, hereafter to be described.

Between Oxgrove and Lousy Gate two distinct undulations and reversed dips take place in these Upper Old Red Sandstone beds. Below, or south of, Oxgrove they dip south-south-west 65° , and are thick-bedded, earthy, red, grey, and chocolate or purple gritty sandstones. Both roads were traversed from Exton to Dulverton, viz. that following the course of the river Exe, and the Exton Hill, Bromton Regis, and Lousy Gate road, and subsequently the courses of the three rivers—the Barle, the Exe, and the stream west of Haddon Down,—all with a view to determine if there existed any evidence of a fault, or other movement of sufficient magnitude (said to occur) to at all alter our reading and understanding the physical structure of North Devon and West Somerset. From the latitude of Morte Bay on the west to the southern part of the Quantock hills on the east of the county, no such movement, due to either fault or anticlinal, was I enabled to determine in all the traverses made. At Oxgrove, as above stated, the Morte slates are seen *in position below*, or underlying, the red Pickwell sandstones (third series)* (Upper Old Red Sandstone), which here dip south at 45° , but extensively undulate before reaching Barham Down and Lousy Gate, where they resume a steady dip south-west at 50° , and then pass under the conformable Upper Devonian, or Dulverton and Baggy slaty series to the south. The transition from the thick-bedded, many-coloured, gritty beds through the mottled micaceous softer grits and fissile marls &c. south of Lousy Gate, to the yellow and brown Baggy slates south of the town of Dulverton to Pixton Park, is complete, and without any disturbance whatever. No section can be clearer than that of the upper or superimposed series; nor is there a clearer or better base than that afforded by the Upper Old Red Sandstone (Upper Devonian) for the Lower Carboniferous rocks which lie to the south of Dulverton, at Brushford and East Anstey &c.; for immediately south of the thick-bedded red sandstones and shales at Lousy Gate, the fissile or slaty series set in, as at Vention, on the south side of Morte Bay, and, after continuing red for some distance, finally alternate with the pale-brown and greenish-yellow slates of Dulverton, where they are all of one character, again succeeded by the Pixton-Park (Marwood) and Brushford beds. It is clear, therefore, that here the upward succession is complete, and that the Upper Old Red Sandstone of Pickwell &c. determines the top of the Middle or Ilfracombe beds, and the base of the Upper Devonian series, the

* 1st, or lowest, the Foreland Lower Sandstones. 2nd, the Hangman, or Middle Sandstones. 3rd, the Pickwell-Down or Upper Sandstones.

higher divisions of which pass into the Carboniferous Slates of the Barnstaple and Bideford area, &c. ; and in the traverses from Dunster to Dulverton, in which the entire series of the rocks of West Somerset are passed over in the direct line of their dip or deposition, I have been enabled to determine that the succession is complete. From Timberscombe through Oaktrow to Ashwell, the lower red sandstone and slates belong to the Lynton group, being immediately and conformably succeeded at Cutcombe and Wheddon Cross by the grey gritty slates of the Ilfracombe series, the two divisions of which, the Ilfracombe proper and Morte-hoe beds, occupy all the country to the latitude of Oxgrove, being here and there (as on the coast) in this distance rolled or undulated, but nowhere showing any evidence of an extensive fault or inverted order. At Oxgrove, as at Huish Champflower (Wiveliscombe) on the east, and Morte-hoe on the west, they unmistakably pass under the superincumbent Upper Old Red Sandstone of Pickwell, Dulverton, and Main Down &c., without any visible fault, or any evidence of a deep-seated one of sufficient magnitude to invert the order of the rock-masses of the two areas (that is, the south and north). This so-called (by Professor Jukes) "Old Red Sandstone" is the base of the upper division of the Devonian rocks, on which rest the slates of Baggy, George Ham, Marwood, Sloly, High Bray, &c., which constitute palæontologically the Upper Devonian series, and which are succeeded by the *probable* equivalents of the Irish Coom-hola beds at Croyde, Braunton, Barnstaple, &c., and so on into the true Carboniferous series. Thus, in this, to me, highly typical inland succession, as contradistinguished from that seen on the coast, where the whole series may be determined *in situ* and their masses compared, we have no break or fault of any magnitude whatever, no movement of the strata to any extent, certainly not sufficient to cause inversion ; for the undulations of the slates near the base of the thick red sandstones are such only as would occur in yielding and softer beds during either sudden or long-continued movements, especially when overlain by some 3000 feet of massive, thick-bedded sandstones, and along an extensive tract of country. The undulations and local reversions of dip in the slates of the Middle Devonian or Ilfracombe group are not of great magnitude throughout their entire strike. Its base rests upon the second series of sandstones, or the Hangman and Woodabay beds ; and at its summit are the Pickwell and Dulverton Upper Old Red Sandstones, which are unfossiliferous throughout.

5. *Valley of the Barle and west of Dulverton.*—The valley which the river Barle traverses, and the rocks through which it passes, afford good sections of the "Old Red Sandstone." The country from Dulverton to Mauncy Castle is occupied by the Pickwell-Down (Dulverton) red grits and sandstones, which have reversed dips and undulations corresponding to those described on the Exe river, and on the roads east of Dulverton ; but they are better shown here, on account of the greater exposure of the rock-masses. A little north of Dulverton, some 1500 feet of thick-bedded, highly

micaceous red sandstones, having numerous partings of purple, grey, and red marly shale, dip south-east 50° to 60° , and in places near the town are much undulated; the cleavage imparts a peculiar feature and structure to both marls and sandstones, and is highly inclined to the north. At Northcombe Bridge hard gritty sandstones appear to dip north, or are rolled to the north and towards Ashwick; they appear in anticlinals from the undulations, as at Barlynch; to the east, at Ashwick, they again dip south-west 15° , are again rolled before reaching Mauncy Castle, where they continuously dip south, and are again succeeded to the north by the glossy grey Morte-Hoe slates, which conformably underlie them. In the deep valleys south of Ashwick Bridge and under Dulverton Common the features are the same, and show the rolling and the final south dip at East Lipscombe, where the Baggy slates set in. This area was searched expressly with the view of ascertaining if there existed marked evidence of either a fault or a depressed anticlinal, either of them of sufficient magnitude to support the hypothesis entertained by Professor Jukes, that the "Lynton, Baggy, and Marwood beds are on the same horizon, and thus accounted for," all evidence, however, nevertheless being to the contrary. *I failed to detect any evidence to support this view.*

6. *South of Dulverton.*—A line drawn east and west from North Anstey through the south part of the town of Dulverton, Hill Bridge, and Skilgate, defines the conformable upper junction of the "Upper Old Red Sandstone" grits and marls, with the fissile Baggy and Marwood slates and sandstones, which continue south to Brushford, and south of which the carbonaceous slates &c. of Barnstaple and Bideford commence, the impure

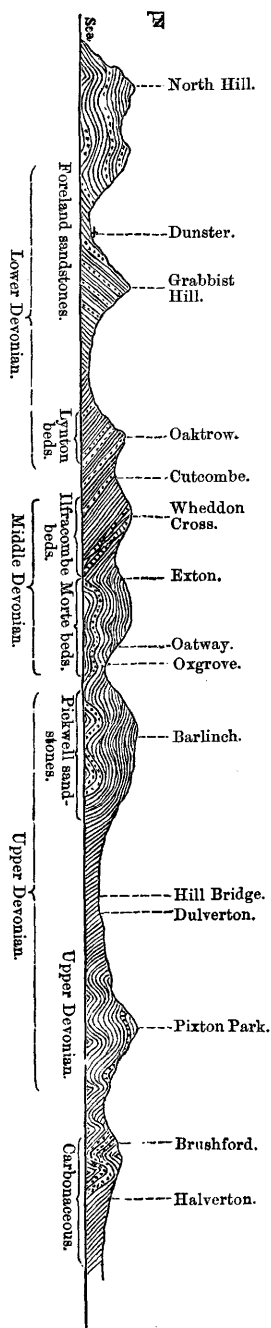


Fig. 4.—Section across West Somerset from North Hill to Dulverton and Pixton Park.

limestones of Pixton Park, Coombe, and Clayford being of the same age as the dark-grey limestone and brown sandstone series of Sloly and Marwood, which weather rusty, and then exhibit their fossil contents in the form of casts and moulds. At Combe, *Strophalosia productoides* and casts of *Petraia* and *Rhynchonella pleurodon* were observed.

The succession from the red grits and Lower sandstone of Timberscombe and Bickham, through the succeeding Middle sandstone and slates at Oaktrow and Cutcombe, with their associated coral-limestones at Wheddon Cross, and the succeeding mass of undulating Morte slates, to the base of the Upper Old Red Sandstones of Dulverton Down, is complete and continuous; neither is there any sign of unconformity between this sandstone band and the underlying slates; they constitute one complete and continuous series, with no break in the succession up to the Brushford beds on the south, where, both on physical and palæontological grounds, a marked change takes place, and we are fairly at the base of the Carboniferous (carbonaceous) series.

7. *Dulverton to Wiveliscombe*.—Immediately to the south of Haddon Down, at Hele, Ford, Upcots, Beckham, &c., the upper beds of the Upper Old Red Sandstone are visible in many places; they are red and chocolate-coloured, thin-bedded, slaty, micaceous, earthy sandstones, passing insensibly into the slates of the Baggy group; in the valley half a mile south-east of Upcots, they are well exposed in a quarry, as well as in natural sections, and dip south 45°.

The structure of Haddon Down is precisely the same as that of Dulverton Down and Hawkrigge Common and all the range to the west; and traverses made on the route to Wiveliscombe, over Haddon and Heydon Downs, showed the same conditions; and the deep gorge of the river at Challick Farm, south of and under Main Down, and at Chipstable, proved the conditions to be the same as at Dulverton, the strike of the sandstone and slates and the conformity being evident from west to east (from Dulverton to Wiveliscombe). My attention here was chiefly confined to the northern side of Main and Heydon Downs, extending from the Oakhampton slate-quarries along the line of fault in Langley Marsh to Huish Champflower, Raddon, and Washbattle Mills, &c.

This point was selected as being the only place where a fault had been laid down by Sir H. De la Beche along the line of country which has been assigned to the *supposed* great east and west fault, having a downthrow to the north, and thus causing that ideal inversion of the rock-masses of North Devon which has been said to have placed the great band of sandstone striking from Pickwell Down to Main Down, Wiveliscombe, and the Quantocks, below the underlying Lower Devonian sandstones, grits, and slates of Lynton, placing the Foreland and Lynton group on the same horizon as that of Baggy and Marwood, &c. In other words, this fault admitted to the extent required, and according to the views advocated, the whole of the intervening slates and limestones of the Ilfracombe group and their underlying Hangman grits and sandstones, with the entire

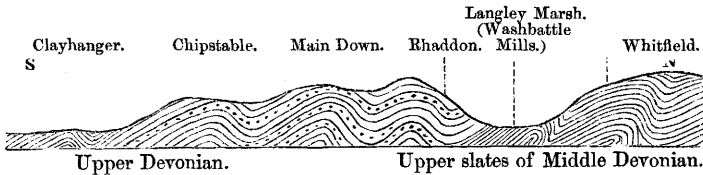
Lower or Linton slates to the north of the fault, to the extent of some 15,000 feet, would be the repeated equivalents of those beds to the south of this sandstone range, or the Baggy, Marwood, Croyde, and Pilton beds—the Upper Devonian of most authors, the Carboniferous Slate of Professor Jukes. Much care was taken in examining this fault, which is with difficulty traceable on the east in the slates, and along the marshy ground at Langley, and which appears to extend from Chapel Leigh to Langley Marsh, a distance of four miles east and west. From Hawkham through the Oakhampton-House Quarries, Whitfield, &c., we are unmistakeably in the grey fissile slates of Mortehoe and Morte Bay, which here dip south from 65° to 70° , with cleavage coincident, but in some places nearly vertical; the same system of quartz veins that occurs at Lee, Mortehoe, and Woolacombe occurs here—a circumstance, connected with other features, tending to clearly identify their position below the range of the Upper Old Red Sandstone before mentioned. The New Red sandstone and conglomerate of the lower members (Permian?) abut against the fault, and conceal the continued strike of the Pickwell and Haddon-Down sandstones between Wiveliscombe and Kingston to the Quantock Hills on the east. At Langley Marsh, marshy ground only determines its position. West of that point all evidence is lost; it may be assumed, but cannot be proved. It may, however, be owing to the difficulty we have in tracing a fault through highly fissile and nearly vertical slates, without hard or interstratified masses to guide us; but there is no apparent break or unconformity between the slates of Clatworthy, Tuck Mill, and Huish Champflower.

With the overlying gritty, hard, red, micaceous sandstones of Main and Heydon Downs the passage and sections are complete, and may be examined in the brook from Tuck Mill to Washbottle Mills, and along the road above the mill, where the rocks gradually change colour from pale-grey to red, becoming marly and fissile gritty slates, and finally passing into the coarse sandstones of Main and Heydon Down. The brook passes over highly inclined slates, with cleavage 80° south, and the junction is clearly shown at the mill-bridge and in the road above it, and also in the gorge leading to Chalich.

The quarries at Higher and Lower Rhaddon, north of Main Down, situated in the lowest part of the Main Down beds, are opened in micaceous, mottled, marly, red and grey earthy sandstone, thick- and thin-bedded, dipping south from 45° to 60° ; these conditions continue under the north flanks of Main, Heydon, and Haddon downs; and the sandstone graduates into the slates below through a gradual change of character, as at Woolacombe and Morte Bay.

At Withycombe, Wiveliscombe, and Main Down we have the same undulations and small anticlinals in the sandstone as seen east of Dulverton and the river Barle; but it regains its south dip south of Wiveliscombe, and this prevails all along the southern side or flanks.

Fig. 5.—Section from Clayhanger over Main Down to Whitfield.



8. *Dunster to the Brendon Hills and Nettlecombe*.—This route was selected for an examination of the Devonian beds in ascending order, especially those members of the Middle group that mantle and sweep round the southern and eastern flanks of Croydon Hill, where two, if not three, distinct series of succeeding limestone bands are well exposed. It is, indeed, a precise repetition of the conditions observable at Combe Martin and Ilfracombe on the west. Not only is the succession clear, but the relations of the slates to their accompanying coral-limestones can be well examined. A line drawn from Dunster Park, north of Langcombe, Lod Huish, and Croydon, and round to Treborough Wood, Drucombe, and Clicket, to Ashwell, before mentioned, will describe approximately the boundary between the red gritty sandstone series of Croydon (the Hangman and Trentishoe grits) and the succeeding slates and limestones of the Middle Devonian or Ilfracombe group, which conformably rest upon these upper red beds of the Hangman grits. All the band of country east and south of this line to the base of, or junction with, the great sandstone band described as striking from Morte Bay to Wiveliscombe is occupied by the Ilfracombe slates and limestones, and its higher member the grey, smooth, non-fossiliferous slates of Lee, Rockham, and Morte-hoe. It is the lower calcareous and fossiliferous division, however, which we have chiefly to deal with.

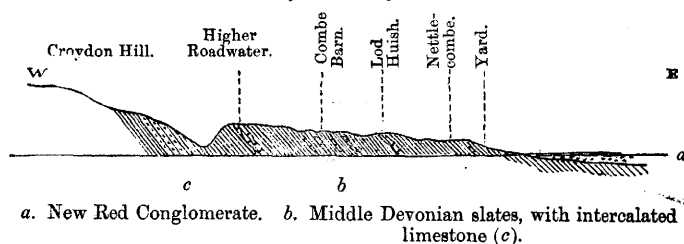
9. *Withycombe by Dunster*.—We have here the first exposure of a continuous band of limestone rich in corals, which can be traced round the Croydon promontory to Treborough, the species occurring here being the same as those in the limestones at Newton Bushel, Torquay, and Plymouth in South Devon. From these limestones at Hill Farm have been obtained no less than fourteen species of Corals and Polyzoa, as well as Brachiopoda; and the same forms are distributed generally through these West Somerset Middle Devonian beds. The following are those that have been found by Spencer G. Perceval, Esq., of Severn House, Henbury, near Bristol:—Coelenterata: *Favosites cervicornis*, Blainv.; *Favosites reticulata*, Blainv.; *Alveolites suborbicularis*, Lam.; *Cyathophyllum Damnoniense*, Lonsd.; *C. caespitosum*, Goldf.; *C. Bolloniense*, Blainv.; *Cystiphyllum vesiculosum*, Goldf.; *Heliophyllum Halli*, M. Edw.; *Endophyllum abditum*, M. Edw.; *Amplexus tortuosus*, Phill.; and *Syringophyllum*. Polyzoa: *Fenestella antiqua*, Goldf. Amorphozoa: *Stromatopora concentrica*, Goldf. Six of the species here enumerated are abundantly distributed, and are all typical of beds of the same

age in South Devon*, a significant and important fact as bearing upon the physical structure and stratigraphical position of the rocks of West Somerset.

10. *Goldsoncot*.—On the strike of the same lower calcareous zone at Goldsoncot Farm quarry is another fine exposure of red, purple, and grey-veined variegated limestone in thick beds; a band about twenty feet thick occurs here, and is succeeded by others interstratified with the purple slates and indurated shaly and marly beds; the limestone is encrinital, containing also many corals, *Cyathophyllum cespitosum*, *Favosites cervicornis*, *Stromatopora* and others resembling those from the Withycombe series; but the rock was too crystalline for me to be certain as to other species. The beds dip north-north-east 20° .

11. *Higher Roadwater, Traphole, and Lod Huish*.—The same zone of limestone and its associated slates and corals here regularly dip south and south-east 30° ; the beds are massive and thick in places, but lumpy, or in hummocks, and lenticularly arranged in the slates. The corals, which are less abundant than at either Goldsoncot or Withycombe, can nevertheless be detected, on close examination, directly east of Roadwater; and higher in the series are the well-known quarries and limestones of Lod Huish and Nettlecombe. Upwards of 1000 feet of slates intervene between these two calcareous belts; and viewing this Huish and Nettlecombe group as one series of associated limestones and shales, it also cannot be less than 1400 feet thick. The following section will show their relative position.

Fig. 6.—Section from Croydon Hill to Yard.



IV. STRUCTURE AND SUCCESSION OF THE ROCKS OF NORTH DEVON.

A. LOWER DEVONIAN GROUP.

1. *Porlock to Lynton*.—The grand range of hills which at three points of the compass immediately surrounds the Porlock Valley, is apparently composed of one group of sandstones, all from the latitude of the Foreland, Countisbury, Oare, and Porlock Hills, dipping north-east, or towards the Bristol Channel. The same may be said of North Hill and Grabbist Hill to the east, which are cut off or separated from Croydon and Luccott Hills, and Dunkerry Beacon to the

* Mr. Perceval has presented a complete series of the species to the Museum of Practical Geology, Jermyn Street. I obtained several specimens from the same locality.

south by a deep depression in the Porlock valley, caused either by a great fault or depressed anticlinal. Whatever may be the cause, it is now hidden, and covered by red sandstone and conglomerate of Triassic age. This valley is continuous in direction with the Lynton anticlinal, and appears to be connected with the extensive east and west faults that traverse St. Decumans, Watchet, Quantock's Head, and Little Stoke, which are post-Liassic in time, and greatly disturb the country.

This range is the most elevated land in Somersetshire; and the entire mass is composed of hard red, grey, and variegated gritty sandstones (micaceous in places), having partings of compact or hard shales. The splintery nature of these grits and sandstones is peculiar, and unlike the general condition of the Old Red Sandstone of other areas in having a different fracture, and breaking up into smaller cubical fragments under atmospheric denudation or the hammer. They seem to have been deposited under different conditions from the normal Old Red; still they are the only members of the West Somerset Palæozoic rocks that at all resemble portions of the Lower Old Red Sandstone series of the Welsh, Hereford, and Gloucestershire areas.

Constant research has failed to detect any organic remains, if we except a few undeterminable plant-like remains (Fucoids), and, here and there, what appear to be Annelide-burrows. Many excellent sections are exposed between West Porlock and Culbone (the seat of Lord Lovelace), along the picturesque road overhanging the sea; and everywhere the beds dip north-east, at angles varying from 15° to 40° , or about a mean of 30° ; their character is the same all the way to the Foreland. This strip of high land, about two miles wide, from Countisbury to Porlock Hill, is the northern face of the anticlinal, the axis of which is in the gorge and valley of the East Lynn; the course of the stream from Oare is nearly coincident with the direction of this anticlinal.

The lowest members of these lower red sandstones are nowhere exposed in this area; and they are not to be sought for either along this high ridge or in the elevated valley of the Lynn; as the anticlinal nowhere clearly exposes them, it may not affect the lowest beds. All that can be said is, that south of the gorge the Lynton or Lower Devonian slates and grits are nearly horizontal for a considerable distance; they then assume a southern dip, without inversion. The characters of these two masses, *i. e.* the lower red slaty sandstones and the grey slates that repose upon them, are marked and striking, structurally, physically, and palæontologically.

These are the sandstones, slates, and associated grits which Professor Jukes asserts to be the same (or on the same general horizon) as those of Pickwell Down, Baggy Point, Marwood, &c., ten miles to the south-west. This assumption is based upon the supposed existence of a great fault to the south with a northern downthrow of many thousand feet, or a concealed anticlinal rolling the beds on the south to the north, where they again appear, and thus placing these Foreland sandstones and grits in the same geological posi-

tion as those of the parallel range of Pickwell, Dulverton, and Main Downs, &c.; and the Lynton and Ilfracombe slates, that rest upon the Foreland sandstones, are therefore made to be of the same age as those of Baggy, George Ham, Marwood, Sloly, and Brushford, &c., on the south of the upper range of Old Red Sandstone above mentioned. From these views of Professor Jukes I entirely differ, both as to his premises and his conclusions, relative to the Devonian question, differing from him in the reading of the structure of the typical Devonian country, and also upon palæontological grounds.

Similarity is not identity; and however much certain portions of these slates and grits may resemble each other in some few external features, yet between the Baggy and Croyde slates and those of Lynton and Ilfracombe there is on the whole a most strongly marked difference, both in physical structure and organic contents; indeed no two groups of slate rocks, when minutely examined, differ more, as a mass, or amongst themselves, than those under discussion, which occupy the country extending from Lynton on the north-east to Pilton and Barnstaple on the south-west; and no more striking contrast amongst a slaty group can be determined than between those fissile and calcareous sandstones that occur between the Lower red sandstones of the Foreland series and the Upper red sandstones of Pickwell Down (in Morte Bay), which continuously strike across the country to Wiveliscombe.

There is no resemblance between the fissile beds of the southern area and those of the northern, *i. e.* taking the line of Upper Red Sandstones of Pickwell as our east and west line of demarcation. The great group of unfossiliferous slates of Morte-hoe, Lee, &c., of peculiar physical structure and some 5000 feet thick (and not known to the south), exists at the base of the Pickwell sandstones, and has to be accounted for through either of the hypotheses put forward, *viz.* that "of a downthrow fault to the north, or an anticlinal line across the country," neither of which can account for the total loss of these slates, or of the thick slates and associated limestone of the Ilfracombe series, or the second series of red sandstones below them, and capping the hills above the Valley of Rocks at Brendon, above Watersmeet, and constituting also the thick red and grey grits of Woodabay, Martinhoe, Trentishoe, Heddon's Mouth, and the two Hangman Hills, all on the north side of this supposed fault, and overlying the Lynton fossiliferous slates, which, as before stated, repose upon the Foreland and Countisbury red sandstones. In fossil-evidence, also, we have an equal discrepancy, or an amount of difference alone sufficient to cause a doubt respecting the identity of the age of the rocks of the two areas, and to show conclusively that there is an ascending order or sequence in the rock-masses of North Devon, as well as in their fauna, and that we should reasonably expect that many species occurring in rocks of older age, or in the Lower and Middle Devonian groups, should continue to live on, and either die out or migrate to other areas or provinces, if the conditions favourable to their prior existence changed.

2. *Foreland, east of the River Lynn.*—Immediately east of the river,

the beds of gritty slates are much disturbed, and dip at various angles, as well as being arched, rolled, or folded; but the talus on the steep slopes of the cliff prevents any accurate observation from being made as to the precise place where any junction of the slates and red sandstones occurs here, and any direct evidence from being obtained as to the cause of the disturbance; here commence the lowest slates of the Devonian series, which contain *Spirifera lævicosta*, Valenc. (*S. ostiolata*, Phill.), *Orthis arcuata*, Phill., and what I believe to be masses of *Stegano dictyum* in the indurated slates, the two former being abundantly distributed. Large fallen blocks of grey indurated gritty calcareo-siliceous slates, with the planes of bedding full of fossils, occur on the shore on the east side of the Lynn, or between Lynmouth and the Foreland; it was, however, impossible to obtain specimens, owing to the extreme induration of the beds; but nests of *Favosites cervicornis*, *Fenestella antiqua*, and *Orthis arcuata* were readily detected. These beds on the east side of the river appear again on the west, where they dip at a low angle to the south, and also constitute the base of the succeeding mass of the Lower Devonian grey gritty slates which rise from the sea to the summit of the Valley of Rocks; these lower slates, &c., are about 1500 feet thick. A gentle dip and undulation enable us to trace them to Lee and Woodabay, where they dip south from 15° to 20° , and are then conformably overlain by a series of thick red grits and sandstones (the Hangman Grits, &c.).

The summit of the steep escarpment above the Devil's Cheeseering is also composed of these red, grey, and pale-yellow grits and sandstones, which constitute the tableland above Lynton. These are a second series of red sandstone resembling both the lower at the Foreland, and the higher at Pickwell Down; and their conformable junction is well seen at Woodabay, resting upon the uppermost beds of the fossiliferous Lynton slates, which insensibly pass up into them; these red beds are not, in my opinion, a repeated series, or a repetition of the Foreland and Countisbury grits, caused by the anticlinal of the Lynn valley, but a higher and succeeding series of red sandstones, on which again rest the Middle or Combe Martin and Ilfracombe series south of the Hangman and stretching all across North Devon. The fossils occurring at Woodabay, as at Lee and the Valley of Rocks, are characteristic of these Lynton or Lower Devonian slates, and are the following:—*Fenestella antiqua*, *Megalodon cucullatum*, *Orthis arcuata*, *Orthis granulosa*, *Spirifera lævicosta*, *Pleurotomaria aspera*, *Bellerophon globatus*, *Orthoceratites*, with *Tentaculites* and numerous casts and remains of Crinoidea.

No one can fail to distinguish this division of the Devonian series, and the stratigraphical place it occupies; and it possesses so marked a marine fauna, that it shows a complete, if not an *absolute*, change from that of the Silurian series, which, I believe, it succeeds in time.

The gorges of both the east and west Lynns show the same succession of beds and physical changes on the line of dip; and the road—as well as the river-sections prove the position, flattening, and southern

dip of the slates under the red sandstones south of Brendon at Barton, Cherriton, Sparhanger, and Farley, which are the Hangman red grits and sandstones of Woodabay, and the higher lands of Malacot, Trentishoe, Barrow, &c., and on to the Hangman; they are from 800 to 1000 feet thick, and completely exposed in the cliff-sections, and constitute the high Downs to the south and south-west.

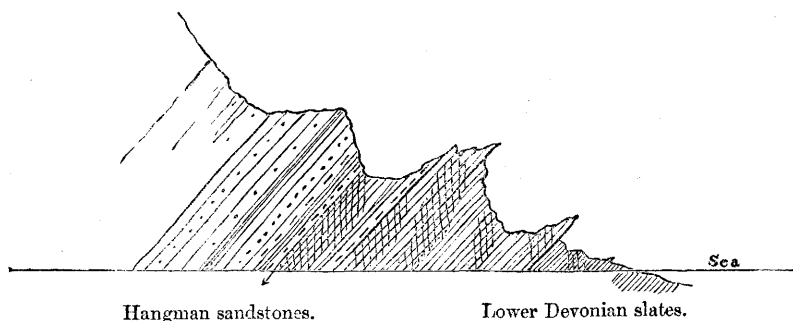
The slate rocks overhanging Watersmeet are extremely rich in fossils, some of the beds being entirely composed of one species of *Orthis*, *O. arcuata*, Phill. (*O. longisulcata*, Phill.), a form not known out of or above the Lower or Lynton group in North Devon, but every where found in the upper part of the series at Watersmeet, Lynton, Valley of Rocks, Woodabay, West Lee, Heddon's Mouth, &c., in some places profusely crowded, and usually distorted.

The entire succession of these lower slates is to be seen and examined in the cliffs west of Lynmouth, especially at and under the Castle Rock, Valley of Rocks, and its overhanging escarpment; nearly the whole series is fossiliferous, although the fossils are badly preserved. It is somewhat remarkable that out of the species of Brachiopoda known in the Devonian rocks one only, *Chonetes* (*Leptæna*) *sordida*, Sby. (*C. Hardrensis*, Phil.), is said to be common to these Lower or Lynton beds and to the Carboniferous rocks; in other words, only one species of this group passes up or ranges from the Devonian to the Carboniferous strata. Doubt has been thrown as to this form being the true *C. Hardrensis*, and also as to its occurrence in the Middle or Ilfracombe group. It is, however, an unsatisfactory and doubtful shell upon which to build any theory; but if it be not this species, we have none in common. Again, on following the series in an upward succession from Lynmouth to Lynton by the path overhanging Lynmouth, about 100 feet above the sea, and also up the main road, and along the north face of the cliff, the grey bands of hard crystalline limestone are seen weathering rusty and to be highly fossiliferous. In these beds occur *Spirifera hystérica*, Schloth., *P. levicosta*, Valenc., *Orthis arcuata*, Phill., *Favosites cervicornis*, Blainv., *Alveolites*, crinoidal stems, &c.; and higher still (400 feet above the sea), immediately below the sharp bend in the road to Lynton, beds of grey limestone occur, from 20 to 40 feet thick, containing casts of numerous fossils; these are immediately succeeded by thick grey slaty beds much cleaved; and it is in the upper part of these slates, at Watersmeet and the Valley of Rocks, that the *Orthides* and *Spiriferæ* &c. occur.

3. *Woodabay and Heddon's Mouth*.—As the strike of the Lower or Lynton slates at Lynmouth is E. by S. and N. by W., and the coast-line bears east and west, it is clear that we have not their base exposed, forming as they do the foreshore, and below low-water mark; and, as before mentioned, the very disturbed nature of the same beds east of the river, near the anticlinal, forbids our satisfactorily obtaining it there; so that the whole series of slates is not seen, either under the North Cliffs on the precipitous face of the Castle Rock, or on the eastern side of the river under Countesbury Hill; and it is the southern recession and indentation of the coast-

line a little westward, and the continued seaward strike of the slates, that bring the uppermost beds of the Lynton slates into visible contact with the Hangman Grits, or second series of red sandstone in the steep cliffs and bay of Woodabay. These slates are fossiliferous up to their junction with the red grits, and contain the same species that occur in the Valley of Rocks, with the addition of *Bellerophon striatus*, *Pterinea spinosa*, and casts of Crinoidal stems, &c. These beds between Lee and Woodabay are certainly higher in position than those which occur at Watersmeet or the Valley of Rocks, and are evidently the same as those underlying the red grits and sandstone at Heddon's Mouth, to be now noticed.

Fig. 7.—Section at Woodabay.

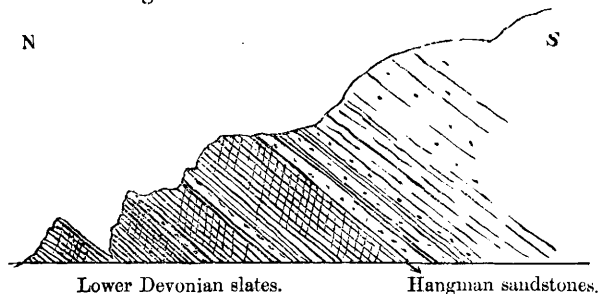


Gentle rolling of the strata along the coast to Highwear Point and Heddon's Mouth keep the slates above the sea, beyond which headland the Lower or Lynton group can no longer be well examined.

It is thus clearly seen that these Lower slates are conformable to and succeeded by the grits of Woodabay, Heddon's Mouth, and the Hangman; and their organic remains entirely cease on passing up into the red series, it being only in the highest and fissile beds of the Hangman Grits at Challacombe, Nertherton, &c., near Combe Martin, that casts of a *Myalina* and *Natica* &c. are found; and these beds graduate into the lower part of the Middle Devonian slates of Combe Martin Bay, immediately south of Knap-Down Mine and the places before mentioned. The lower part of the Lynton group is much more calcareous than the upper, and the beds seem persistent and uniform throughout over the Lynton area; but as regards organic remains, and especially the Cœlenterata, we have only a small fauna, as compared with the numerous species occurring in the deeper-sea accumulations of the Ilfracombe group; and the evidence adduced by ripple-marking and false bedding distributed generally through the Lynton group, added to the gritty character of both the slates and limestones, clearly shows their littoral and shallow-sea origin, yet apparently under continued depression; for there is no evidence in the surmounting red grits and sandstone of Woodabay and the Hangman, &c., to show that

they were not accumulated in a deep sea ; and this continued depression and great development of organic limestones and slates, rich in *Cœlenterata* and *Brachiopoda*, were continued through and during the accumulation of the whole of the Ilfracombe group, being followed by the deposition of the fine-grained, smooth, grey, glossy, unfossiliferous slates of Lee, Rockham, Mortehoe, and Winsford (inland), in which as yet no traces whatever of organic remains have been found. They bear all the evidence of deep-sea accumulation.

Fig. 8.—Section at Heddon's Mouth.



4. *Conclusions relative to the Lower Devonian Series of West Somerset and the Lynton area &c.*—(1) That the great series of the Foreland red sandstones and grits forming the northern part of the area under description is nowhere (from the Quantock Hills on the east, to the Foreland on the west) seen in its entire thickness, neither the base nor upper portions being clearly visible. The anticlinal in the Valley of the Lynn, nowhere along its line of elevation discloses this, being concealed either by the overlying Lower Devonian slates, which are conformable to its southern dip, after crossing the anticlinal, or by faulting along the course of the anticlinal also.

(2) That the great series of red and grey sandstone and grits constituting the base of all the North Devon and West Somerset deposits is the oldest of the Palæozoic series exposed in that area, and that its mass is greatest from Dunster and Wooton Courtney on the south to the northern and precipitous escarpment of North Hill on the north, overhanging the Bristol Channel, where it is believed we have higher beds than are exposed along the Porlock, Culbone, and Foreland range. An extensive fault and undulation of the strata along North Hill, as exhibited at Hurlstone and Greenlay Points, may, however, modify this apparent thickness, though the strike of the beds seaward and north of the Foreland series would indicate the position of higher beds.

(3) The dip is much greater on the northern side of the anticlinal than on the southern (a mean of fourteen observations along the strike for 13 miles determining it to be 34°), and the beds are much more disturbed. No organic remains are known to occur in these Lower Red Sandstones.

(4) South of the anticlinal of the valley of the East Lynn, and reposing upon the sandstones, there occurs a series of fossiliferous grey and purple slates and grits, with subcrystalline beds of limestone, the whole about 1200 feet thick, in many places rich in organic remains which are characteristic; but, owing to cleavage and the nature of the matrix and lamination, they are badly preserved. These are the Lower Devonian slates—the Lynton group.

(5) The fauna of this lower group of slaty deposits is purely marine, almost peculiar to itself, being entirely and importantly different from that of the Silurian epoch which preceded it, having only one species said to be common, after the obscure and doubtful forms of *Corals* and *Polyzoa* are eliminated; the remaining fauna sufficiently determines it to be a distinct and great life-period existing between the Silurian below, and the Upper Devonian and Carboniferous above.

(6) The community of species, both of the Lynton or Lower Devonian group and of the succeeding Ilfracombe or Middle Devonian (to be hereafter mentioned), added to their equally well-defined physical characters, well enable us to unite, but at the same time to separate them, both in this typical Devonian area and in the equally illustrative and allied districts of the Rhenish provinces and Belgium.

(7) Succeeding these lower slates, and conformable to them, a second great series of red gritty sandstones occurs, nearly devoid of fossils, and parallel to the strike of the lower or Foreland beds; these are the Hangman, Oare Hill, and Exmoor grits, which constitute a base for the succeeding Middle Devonian, or Ilfracombe slates and limestones, but which physically connect the two groups above and below.

(8) A marked and important difference occurs in the structure of the slate masses, as well as the fossil grouping of these two areas—a change by which both may be well correlated and coordinated with those of South Devon, on the one hand, and the Rhenish, Belgium, and French deposits on the other.

B. MIDDLE DEVONIAN GROUP.

1. *Heddon's Mouth to Barnstaple*.—This traverse across the middle of North Devon was made for the purpose of establishing a comparison with the succession of beds examined between Dunster and Dulverton in West Somerset, and also with the view of detecting any evidence of the supposed fault, or anticlinal, along the northern base of the Pickwell and Span-Head sandstones, midway between the Valleys of the Barle and Exe on the east, and Morte Bay on the west; better sections could also be obtained along this route than over the wilder parts of the Exmoor Forest, which had been partly traversed from Lynton to near Exe Head on the Moor.

Commencing my observations at the sea at Heddon's Mouth and Highwear Point, I obtained conclusive evidence of the position and presence of the upper part of the Lower or Lynton slates, dipping south, which are here grey, green, and red in colour, and crowded with *Orthis arcuata* (*O. longisulcata*), and, here and there, *Chonetes sordida*

(*Hardrensis*?), and *Fenestellæ*; the sections on both headlands correspond with those so well shown at Woodabay, with which they are continuous along the precipitous north shore under Martinhoe. At Heddon's Mouth the slates strike seaward W. 20° N., and are lost under the waters of the Channel; thus at several points along the north coast we have the uppermost portion of the Lower or Lynton slates, and their junction with the succeeding red sandstone, well shown, notably so at Woodabay, Valley of Rocks, and Heddon's Mouth; the cleavage-planes at the latter dip north, at a very high angle; the fossils occur here, as at Lynton, in definite bands of impure limestone, which weather rusty; they are difficult to extract, owing to the indurated nature of the beds.

The beautiful and deep defile through which the river has cut its way, from Kinacot to the sea at Heddon's Mouth, is composed entirely of the red gritty sandstones of the Hangman, overlying the lower slates before mentioned (see fig. 8, p. 600), which at their upper part unite with the slates of the Middle or Ilfracombe group near Radley and Middleton Mill. Iron-ore occurs along the junction of these slates and grits at West Challacombe, and is nearly continuous with their strike. In the deep valley of Paracombe we are fairly in the Lower slates of the Ilfracombe group, which agree in every feature with those containing *Stringocephalus Burtini* and *Streptorhynchus umbraculum*, and which are exposed in the cliffs on the eastern side of Combe Martin Bay, at West Challacombe, under the Little Hangman. There is no evidence whatever of unconformity along this line between the red grits and the base of the grey Combe Martin or Challacombe slates; but the change of condition would seem to have been accompanied by a submarine outpouring of igneous matter, the true condition of which requires careful examination and seeking*. The undulating country between Paracombe and Westland Pound, through Lower and Higher Rowley, is occupied by the Lower or slaty and calcareous fossiliferous division of the Ilfracombe series, the rocks of which all dip to the south; and it may be assumed with but little hesitation that a line drawn from Lee Bay to Challacombe (north of Bratton Down), Eyeson Hill, and Treborough would nearly indicate the marked division that takes place between the lower group of slates, with its associated limestones and well-marked Middle Devonian fauna, and the higher pale-grey glossy unfossiliferous series, accompanied by the quartz veins that form so conspicuous a feature at Lee Bay, Bull Point, Rockham Bay, and Mortehoe, and which unmistakeably strike from the sea on the west to Wiveliscombe on the east, passing north of Bittadon, Arlington, Withypool, Winsford, the Exe Valley, and Exton Hill; this belt of country in the river-courses and valleys everywhere, where I examined it, showed the same physical features.

* On the south side of the Culm trough, from Padstow to Tintagel and Brocastle, there are numerous apparently contemporaneously bedded greenstones, and igneous rocks of various composition; and those of Padstow &c. may belong to about the same horizon, or be chronologically equivalent with the similar deposits associated with the lower part of the Ilfracombe group in North Devon.

On the latitude of Kentisbury and Lower Rowley, and between these two localities in the middle of the lower division of the Ilfracombe group, we again have clear evidence of contemporaneous igneous action, as exhibited in Lower Rowley quarry, where stratified thick-bedded white, grey, pale-brown, and green felstones(?) are worked, and used for road-material: a thickness of from 50 to 70 feet is exposed; but their upper face being covered by fissile slates, and the base not seen, their thickness is unknown. My attention was drawn to this remarkable rock by roadside-heaps, showing its hard porcelain-like character, differing from the Bittadon porphyry or any known rock in North Devon. In Lee Bay a greenstone dyke occurs, striking east, and in a direct line with Kentisbury and Rowley: but an intrusive dyke may take any bearing or direction; and therefore no hypothesis is justifiable to account for metamorphic action, so far away from what might otherwise cause this change. This Lee dyke and the one at Fremington Pill also, south of Barnstaple, I doubt not belong to the grand system of intrusive greenstones that intersect the slates and granite of Lundy Island, there being no less than 60 dykes, varying from 1 foot to 30 feet in width, that traverse that remarkable island from east to west in the space of $2\frac{1}{2}$ miles, affecting both granite and slates alike, all of which have been carefully examined and mapped by myself*.

Bands of limestone in red slates, containing *Cyathophyllum cespitosum* and casts of bivalve shells, succeed those at Higher Rowley, dipping south, and which, with those of Challacombe and Twichin, appear to be the highest known calcareous beds in this lower division of the Ilfracombe group. Then set in the Lee and Morte-hoe slates, which are traceable into the beautiful dale and ravine of Arlington, and immediately underlie the high land of Garmond Down, Eratton Down, Span Head, &c.,—portions of the upper and persistent zone of red sandstones and grits that stretch from Morte Bay to Wiveliscombe—in other words, the Pickwell Down series, stated by Professor Jukes to be the faulted or repeated series of the Foreland, ten miles to the north.

The junction of the Lee and Morte-hoe slate series, here, as at all other points along this north line, or outcrop of the red grits and sandstones, is complete, and, as at Woolacombe, Bittadon, and the Exe Valley &c., there is no evidence of unconformity, or disturbance, either obscuring or destroying local or general continuity; and the constructed and measured section in Morte Bay, still more to the west, to be yet described, will, I hope, not fail to show this. It is well known that at Bittadon, Smithia Park, and onwards to the east, there are local exhibitions of igneous rocks, doubtless continuous, if carefully traced; and notably stands out the Bittadon felstone-porphyry, at or near the junction of the Morte Slates and the base of the red sandstone of Swinham Down†. Road-sections to Sherwell Cross and those exposed in the river, to Youlston Old

* See also Williams (Rev D.), Quart. Journ. Geol. Soc. vol. ii. p. 68.

† The Viveham iron mines are a little south of this, and were once extensively worked.

Park, continuously expose the variegated Upper Old Red Sandstones dipping S. 30° to 45° , as along the whole strike from Venton, at the south part of Morte Bay, to Dulverton &c.

In this traverse, as in the one made down the Rivers Exe and Barle over the Dulverton area, and in two made between the Ilfracombe and the Muddiford Valley, *viâ* Bittadon, over and across the same beds, I failed to detect any evidence of either fault or anticlinal other than such as would be caused by slight rolling or undulations of the beds from north to south; and while *below*, in the Morte series, the slates were conformable to the Pickwell Down Grits, or Upper Old Red Sandstone, *above* they gradually passed into the pale-yellow and brown slaty and calcareo-siliceous Upper Devonian series of Baggy, Marwood, and Sloly &c.

2. *Little Hangman and West Challacombe to Ilfracombe; Ilfracombe to Baggy Point viâ Morte Bay.*—I now return to the junction of the red fine-grained grits of the Little Hangman with the fossiliferous slates of Combe Martin Bay. In West Challacombe Bay the lowest or Stringocephalus-slates of the Ilfracombe group may be examined in detail, where they repose upon the red, grey, and yellow mottled grits of the Little Hangman and Knap Down, further to the east; the junction is also traceable up the road from Combe Martin, leading to Knap Down Mine; and in the bay the passage takes place through a series of alternating or interstratified siliceous red grits and fossiliferous slates, which finally assume their persistent grey slaty character on the coast and in the valley; they dip S.E. 35° . There are numerous intermittent beds and masses of impure and subcrystalline limestones through the entire course of these lower slates; and the purer limestones of Combe Martin, Hagginton, Helesborough, and Ilfracombe, when carefully examined, form an important feature in the structure of the country; they strike west and east through North Devon and on into the Quantock Hills in West Somerset. The aggregate thickness of these lenticularly bedded and apparently disconnected (on the line of strike) masses of impure limestones is very great, equal to the more massed and definite series at Newton Bushel, Torquay, &c.; and to a large extent they contain the same fossils, and a large and well-marked Middle Devonian fauna illustrates this area; but, imperfect as the organic remains necessarily are, through cleavage and excessive induration of the harder rock-masses, I hope to show that they, together with those of the Lower Devonian of the Lynton area, belong to a group unmistakably and essentially identical with beds of the same age in Rhenish Prussia, Belgium, and the Bas Boulonnais in France. This question will be gone into in my remarks upon the palæontological value of the fossils of the Devonian group of rocks. The slates and grits of Combe Martin Bay require much and careful investigation, owing to disturbance and faulting. There is doubtless a rich fauna in the indurated siliceous sandstones that are interstratified with the slates on the eastern side of the Bay: it is here, and in these beds, that the large *Stringocephalus* (*S. Burtini*) occurs, apparently below which, in the

red grits, are the large and well-known *Myalinae* and *Naticae*, occurring as casts only; their position, however, at the Little Hangman and at Holstone in the same grits, fixes their place. At Sprecombe, near Oareford, Wishet, and the Red Deer, near Black Barrow Down, in the North Forest, the same shells, with casts of *Favosites cervicornis*, *Cucullaea*, *Sanguinolaria*, *Solen*?, *Macrocheilus brevis*, *Pleurotomaria*, and *Loxonema*, occur*. At Combe Martin, on crossing the river to the south, a marked change in the aspect of the country takes place; a ridge of elevated country richly wooded, stretching from Widmouth Head on the west to Kentisbury on the east, marks the outcrop of the Limestone series; but unlike the beds of the same age in South Devon, they are here intimately interstratified with the slates in irregular alternating thick- and thin-bedded lenticular calcareous masses, yet very continuous. In the first or lowest series, south-east of the village, the united thickness of the limestone beds is from 60 to 100 feet, and they are extensively burnt for lime. These calcareous beds are chiefly composed of the well-marked Devonian corals, *Cyathophyllum caespitosum*, *C. Hallii*, *Favosites cervicornis*, *Stromatopora concentrica*, and *Heliolites porosus*, with *Trimerocephalus levis* (casts) and *Atrypa reticularis*; many of these species are distributed through all the quarries, though sparingly. There appear to be two well-defined series of limestones, confined to about 1000 feet of vertical strata, and occupying the middle part of the lower division of the Ilfracombe group; it is these limestones that here, as in South Devon, so eminently characterize the Middle Devonian Rocks, and, as on the continent, contain that peculiar group of corals, totally unlike, and different from, those of the underlying Silurian rocks as well as, *without exception*, the succeeding Carboniferous; for of the *fifty* species of corals known in the Middle Devonian series of North and South Devon and Cornwall, one doubtful species only is said to occur in the Silurian rocks, viz. *Favosites fibrosa*, and only one is said to pass up into the Carboniferous series, viz. *Amplexus tortuosus*, of which, however, we have *no authentic evidence*. In the North Devon area, thirteen species occur, and with one exception are confined to it—one species only recurring in the beds south of Baggy, viz. *Petraia pleuriradialis*?; and yet, on comparison with the Eifel and Belgian Devonian strata, 20 species, or 40 per cent., are common to the Middle Devonian series of Devonshire and Europe. A similar relation and difference I hope to show in all the groups of organic remains that occur in this formation in Great Britain.

Crossing the calcareous group of slates from the Lee Quarries, east of Combe Martin, to the high ground of Berrydown, we again (near the cross roads) meet with the finer-grained, non-calcareous, unfossiliferous Mortehoe slates, which here occupy an elevated

* No one has more carefully studied the Ilfracombe group of rocks than R. Valpy, Esq.; and to him am I indebted for considerable information relative to fossil localities, permission to examine his rich Collection, and also his notes upon this part of the North Devon coast. He has himself catalogued and noted upwards of 50 species from the Ilfracombe group alone, a work of considerable time and labour.

undulating line of country to Huish Down, where they pass conformably under the red grits and sandstones of the often-mentioned Upper Old Red Sandstone, or Pickwell series, which continues on to Muddiford.

Returning to Combe Martin and the coast, I examined the slates and limestones along their strike to Newbery, Hagginton Mill, Watermouth, Widmouth, &c., and then in ascending order on their dip to Hagginton Beach and Hill, and Helesborough, and on to Ilfracombe, all of which may be taken as typical fossiliferous localities, and where Mr. Valpy has collected almost every species occurring in the district.

At Watermouth, which is in a direct line (on the strike) with the main mass of the shales, slates, and lower limestones of Combe Martin, many good sections occur, both in old quarries and on the coast. The shales, slates, and sandstones which alternate here are remarkable for their diversity of character, yet continuing with the same conditions repeated round Widmouth Head to Hagginton Beach. Quartz veins, with lead, I know nowhere else. At Sandaby, masses of siliceous rocks, containing *Stringocephalus Burtini*, Defr., occur; and Mr. Valpy has obtained *Trimericephalus lævis*, Münster., from mottled grey and red shaly rocks which overlie the *Stringocephalus* grits, associated with *Spirifera disjuncta*, Sow., *Atrypa reticularis*, Linn., and its variety *A. aspera*, Schloth., *Rhynchonella pleurodon*? *Fenestella*, &c. The Widmouth series at its lowest part consists of finely laminated thick-bedded sandstones, with *Tentaculites scalaris*, Schloth., and casts of other fossils. Above this Tentaculite-sandstone, succeeds a considerable series of red sandstones, in which no organic remains occur; an irregular mass of dark limestones with corals, especially *Favosites cervicornis*, Blainv., *Stromatopora*, and obscure masses of *Cyathophyllum cæspitosum*, Goldf., overlies the red grits.

Mr. Valpy informs me that on this limestone thin shales occur, which are studded with carbonaceous nodules and coprolites of fish*.

Succeeding the Widmouth rocks, and higher in the series are the Rillage and Hagginton beds. I examined the latter only; but a glance at them convinced me that patient and long study only could enable any one to make out the details of the complicated structure of the rock-masses of Hagginton Beach. The history of the Ilfracombe group is, indeed, written in the coast-series from Combe Martin Bay to Ilfracombe, but particularly so in the fine section of slates, sandstone, shaly limestone, and grits of Hagginton Beach and the Hill quarries, the impure clayey limestones and quartzose sandstones, &c., on the coast and Hagginton Hill Quarry, having yielded upwards of thirty species, twenty of which belong to the Brachiopoda.

* Mr. Valpy has obtained in many places along the coast good evidence of the existence of fish through the remains of bones and coprolites, but no teeth or scales so as to enable us to determine their genera. None but a local observer can do justice to the difficult and obscure structure of this coast; and no one has worked it out so patiently as, or with more detail than, Mr. Valpy.

In Mr. Valpy's collection (from these beds) are the following species:—Brachiopoda: *Spirifera disjuncta*, Sow.; *S. glabra*? *S. curvata*, Schloth.; *S. nuda*, Sow.; *S.*, sp.; *S. speciosa*, Schloth., and var.; *Merista plebeia*, Sow.; *Atrypa reticularis*, Linn.; *A. desquamata*, Sow.; *A. aspera*, Schloth.; *Athyris concentrica*, V. Buch; *Cyrtina heteroclyta*, DeFr.; *Orthis interlineata*, Sow.; *O. striatula*, Schloth.; *Rhynchonella pleurodon*. Gasteropoda: *Acroculia vetusta*, Sow.; *Euomphalus serpens*, Phill.; *E. radiatus*, Phill.; and *Natica*, sp., with *Tentaculites*, *Conulariæ*, *Fenestellæ*, and *Favosites cervicornis* (*polymorpha*), Blainv.

In the limestone quarry at Chambercombe, I observed *Cyathophyllum cæspitosum*, Goldf., *Favosites cervicornis*, Blainv., *Spirifera disjuncta*, Sow., casts of *Rhynchonella* like *R. pleurodon*, and *Fenestella antiqua*? The greater part of the slates and dark compact limestone is here fossiliferous, containing especially the ubiquitous coral, *Favosites polymorpha* or *cervicornis*, Polyzoa, and casts of Crinoidea. Mr. Valpy has obtained *Streptorhynchus crenistria*, Phill., *Euomphalus radiatus*, Phill., Encrinital remains, and Polyzoa in the beds across and through which the stream passes from Hele to Hagginton Beach, near the waterfall. The prevailing forms found are *Rhynchonella pleurodon*, Phill., fragments of *Spirifera disjuncta*, Sow., *Strophomena rhomboidalis*, Wahl., and two species of *Cypricardia*, Phill., with *Acroculia vetusta*, Sow., imperfect and small *Orthoceratites* and *Theca*?—a series of slates and impure limestones, finely laminated sandstones, blue calcareous sandstones, thick reddish quartzose beds with fish-remains, encrinite-stems, and fragments of *Phacops*, a shaly bed with *Phacops* and *Goniatites*, then shales and slates of some thickness, the weathered surfaces of which contain numerous *Tentaculites* (*T. scalaris*, Schloth., *T.*, sp.), *Euomphalus serpens*, Phill., Polyzoa, *Goniatites*, &c.; then 50 feet of slate to the sea-level, in which *Tentaculites scalaris*, *Euomphali*, *Natica*, and many Brachiopoda occur abundantly.

3. *Helesborough*.—This bold headland, which forms the eastern side of Ilfracombe harbour, I could not satisfactorily examine on shore, owing to the tides; but fossils in the slates and sandstones seemed much more rare here than in the series I have just mentioned, though the limestone bands appeared to contain a large assemblage of individuals, if not of species. Mr. Valpy, who has most carefully worked out the Helesborough beds, informs me that Corals, Crinoidea, Brachiopoda, Gasteropoda, and Cephalopoda are numerous, the limestone, as well as the shales, being full of these remains; he recognizes certain bands of whitish siliceous rocks full of Brachiopoda, and identifies the two well-known forms *Spirifera disjuncta*, Sow., and *Strophomena rhomboidalis*, Wahl., var. *analogæ*, Phill., and also on the eastern side of the headland a thin highly calciferous bed which is crowded with weathered-out examples of minute spiral Gasteropoda, *Murchisonia*, *Holopella*, &c., together with *Tentaculites* and defence-spines of fish; and, more eastward still, beds of the same character contain *Orthoceras cylindraceum*, Sow.

I have thus dwelt somewhat at length upon the general structure

of this group and area, from its important bearing upon the question at issue, and also for my purpose when I enter upon the palæontological value of the fossils in the several groups, and also because there has never been any satisfactory notice of the sequence and associated fossils of the Ilfracombe group. Apparently they have been much overlooked; and it is Mr. Valpy's collection that now supplies the mass of authenticated species, by which, with my own observations and the examination of his collection, I am enabled to make the somewhat complete accompanying list. Professor Phillips* names 37 species as occurring in the Ilfracombe group in North Devon; one Brachiopod, viz. *Stringocephalus Burtini*, seemed then to have been the only known form in that area. Through the labours of Mr. Valpy I am now enabled to add between 50 and 60 species to this Middle Devonian or Ilfracombe group alone, so that we have here (in North) as in South Devon, and the three typical areas in Europe, a Middle Devonian fauna of great and important value.

4. *Ilfracombe District*.—Although a traverse was made from Heddon's Mouth to Pilton, *via* Paracombe and Kentisbury, across all the series to the south, which I have described at pp. 601–604, I still desire to describe tersely the one made from the sea, at Ilfracombe, to the Muddiford valley, *via* Bittadon, to examine the igneous rocks of that place, it being here that the best known exposure of porphyritic felstone occurs, which so nearly resembles the Hestercombe granite—so called—on the Quantock Hills† both in character and stratigraphical position, occupying in both areas the upper part of the Morte slates, or base of the Upper Old Red Sandstone (Pickwell Sandstones), and recognized at places between these two points, and again at Morte Bay. The exposure at Bittadon, although small, is important, the rock being apparently a contemporaneously bedded, coarse-grained, stratified, felstone porphyry, the crystals of felspar being in a green felspathic paste.

The sections exposed in the slates up the steep and winding road leading from Ilfracombe to Two-Post Turnpike-gate are such as are known all through this lower portion of the Ilfracombe or Combe-Martin group—waved, undulating, contorted, and cleaved beds of slate with bands of impure limestone containing but few fossils. After passing the Chambercombe limestone we enter a tract of country almost void of calcareous matter, the meridian of Kentisbury, an exposure west of Ilfracombe being the highest known definitely marked limestone zone. South of this, the slates alter in colour and character, becoming indurated and more thickly bedded, assuming a brown or yellowish tint, and are quarried for building-purposes; roofing-slates are quarried at Woodscot &c.

The mean dip of the slates from the sea at Hagginton beach to Bittadon, over a space of eight miles, is about 40° S.S.W., with cleavage-planes to the south at high angles. It is along the meridian of Bittadon, West Down, Woolacombe, and Arlington &c. that Professor Jukes believes his concealed and hypothetical downthrow

* Pal. Foss. Cornwall and Devon, 1841.

† Leonard Horner.

fault to the north occurs, or a reversed anticlinal to the north, which, as before stated, would (according to his views) place the Lynton beds on the same *general* horizon with those of Baggy Point and Marwood, south of the Pickwell-Down Sandstone, although he admits that all appearances are to the contrary. There is no proof that the igneous rock at Bittadon is eruptive—nothing to prove that it is not a contemporaneously bedded porphyry, and the same as that occurring at Garmond Down and Smithia Park, before mentioned, though differing lithologically. It occurs immediately south of Bittadon, in a romantic dell west of Huish Down, immediately east of the main road from Ilfracombe to Pilton, and is at the top and near the junction of the grey Morte slates with the succeeding Upper Old Red Sandstone; a quarter of a mile north of Bittadon these slates dip 43° south, here 30° south; and immediately south, in the red sandstones at Swinham Down, the dip is south also. The road-sections show local undulations and reversed dips in the sandstones; there are scores of such undulations producing anticlinal and synclinal folds on both a large and a small scale across the whole of the Lower, Middle, and Upper Devonian slates and sandstones, from the north coast at Lynton to the Culm-measures on the south at Coddon Hill &c. Here, as at all points along the strike and junction of the Middle argillaceous group with the Upper Sandstone, there is no evidence whatever of reversion of dip, or fault, or anticlinal, in the sense in which it should be understood as existing along a line or axis of great and extended disturbance; and, moreover, on the question of identity or even similarity of the rock-masses of the two areas under discussion which this belt of sandstones divides, *i. e.* the Baggy, Croyde and Marwood area on the south, and the Ilfracombe and Lynton areas on the north, they are to me physically and palæontologically so different, both in great features and in detail, that it cannot be wondered that the older and able geologists who have examined the North Devon and West Somerset groups of rocks should have assigned to them the position, order, and succession they did, however difficult it might have been to have correlated them with the perhaps contemporaneous, or synchronously deposited, Lower, Middle, or Upper Old Red Sandstone of other areas: to me these red, green, white, and grey Upper Old Red Sandstones that stretch from the sea to the Quantock Hills are the natural physical and palæontological base of the well-defined and to them conformable fossiliferous Upper marine Devonian beds of Baggy, Marwood, and Croyde &c., which are in their turn succeeded by the Carboniferous Slates and Coomhola (?) Grits of Braunton, Barnstaple, &c., themselves covered by the equivalents of the Carboniferous Limestone at Ven, Swimbridge &c., and again by the higher Millstone-grit of Coddon Hill. The succession, position, structure, fossil character, &c., of the group of rocks in this traverse, between Ilfracombe and Pilton, showed and proved to me that the Middle and Upper Devonian series underlie conformably, without a break, the Lower Carboniferous or Carbonaceous beds to the south of Pilton and Barnstaple.

5. *Lee and Morte Bay*.—At Lee the lower calcareous fossiliferous member of the Ilfracombe group is succeeded by the upper or non-fossiliferous, grey, smooth, glossy slates of Morte, whose physical features are totally distinct from those to the north or south, and which nearly equal in thickness the Upper Old Red Sandstones overlying them, viz. from Woolacombe, Osborough, West Down, and Potter's Hill on the north side, to Vention and Pickwell on the south. From Bull Point, west of Lee Bay, through Rockham Bay, the smooth argillaceous slates dip south at a mean angle of 40° , with cleavage at an angle of from 60° to 70° south; a remarkable system of white amorphous quartz veins traverses these Rockham Bay slates, chiefly along their strike, from east to west, or obliquely to it; these veins are due probably to fracture and subsequent infiltration by segregation. The undulations and folding of the slates here are continuous, numerous, and traversed by cleavage; and this continues in various degrees to Morte Point, and south of Morte-hoe, where again a system of east and west white quartz veins, 2, 4, and 6 feet thick, traverses the vertical slates up the valley to Twitchim. Reefs also stretch out to sea, dipping at very high angles (varying from 70° to 80° S.W.), and with cleavage nearly coincident (60° to 70° *) with the bedding.

No one who has not examined this section between Lee, Rockham, Morte-hoe, and the rivulet that descends to the shore from Twitchim, can tell how difficult it is to work out either the dip or cleavage-system in these slates†. In the elevated ridge of ground about the hamlet of Yard, and continuous with Morte Point to the east, they are rolled and form an anticlinal; this ridge is the axis or watershed to the country north and south of it, all the streams taking their rise in this down and falling on either side to the sea. The total absence of this great series of slates to the south of Pickwell Down, with their attendant conditions and position above the calcareous group of Ilfracombe, is significant, when treating either of the supposed fault (against which they ought to abut, or their absence should be accounted for) or the anticlinal which, if either existed, should repeat them to the south, where, be it remembered, *no vestige* of them occurs. The Morte series gives proof of deep-sea accumulation and is unfossiliferous, whereas the Upper Devonian beds that rest upon the Upper Old Red Sandstones of Pickwell Down are crowded with organic remains, having been deposited under shallow-sea conditions, and having few species in common with the lower beds and those that live on or pass into the Carboniferous series as gradually as the physical changes oscillate also; and a greater contrast amongst

* This system of quartz veins traverses all North Devon (east and west), from Oakhampton quarries, near Wiveliscombe, to Morte Bay, occurring again at Lundy Island, where they traverse the same slates, and under the same conditions, intersecting like network the grey glossy slates of the "Rattles," "Lamatory," and Rat Island—at the southern end of that remarkable island, where trap dykes and quartz veins vie with each other in their ramifications, the former traversing the granite also, in all directions and at all angles.

† It is most difficult to distinguish cleavage-planes from bedding in these slates.

slaty masses can hardly be conceived, even on lithological grounds alone, than in the rock-masses of these two areas *when carefully examined*. I have now to show, if possible, that there is no unconformity in Morte Bay between the Morte-hoe and Woolacombe Slates and the Pickwell-Down Sandstones, and that they here insensibly, through lithological changes, graduate into the hard red grits and sandstones at Potter's Hill, Croscombe, and Pickwell Down, as they do at Wiveliscombe and intermediate points. Up to the village of Woolacombe, north of the stream, the slates are seen in places on the shore under Tracey and Potter's Hill dipping 60° and 70° S. The Woolacombe and Osborough valley was carefully searched; and nowhere down the stream, which here runs over and cuts through the strike of the beds, or to the east, at Dean Mill, where they are cut across by another rivulet, and dip 70° S., did I detect any inversion, notable disturbance, or alteration of dip; more than that, the gradation into the thicker beds of Potter's Hill and Higher Bullen is traced through a series of red gritty slates and fissile sandstones dipping 50° S., and resembling in all particulars the junction at and passage under Main Down, west of Wiveliscombe &c.; the small quarry on Potter's Hill showed the same lower thin-bedded red grits dipping 45° S.; on the strike of these beds, east, across the hill, and in a quarry at Higher Bullen, the same series dip 60° S. Descending to the shore under Potter's Hill, and at Tracey, we now take them in upward succession; the reefs of grey fissile slates, with rusty or decomposed bands, that crop out on the shore immediately west of the Kiln at Woolacombe, are the same that occur in the Tracey and Osborough valley, and are immediately succeeded by the Potter's Hill red group. On and along the shore between Woolacombe and Baggy Point twelve groups or reefs of red, claret, grey, and green micaceous sandstones crop up, and the recent marine sands of Morte Bay (Woolacombe Sands) cover up their inclined edges and continuous dip. Every bed visible along the shore, and composing this series of sandstones, was measured, the interspaces (covered by the sands) were paced, and careful notes made upon the whole magnificent section up to the overhanging abrupt northern face and escarpment of Baggy Point, where, without a trace of movement, break, or unconformity, the passage into the true fossiliferous Upper Devonians is complete*. It is both superfluous and unnecessary to describe the Morte section in detail; it speaks for itself; neither above or at the top of the Upper Old Red Sandstone at Vention and Pulsborough, nor at the base at Tracey or Osborough is there any evidence of dislocation, or any trace of a fault.

6. *Conclusions relative to the Middle Devonian or Ilfracombe Group of West Somerset and North Devon.*—(1) Whether the red grits and sandstones of the Hangman should be classed with the upper part of the Lower Devonian or Lynton group, or should constitute the natural base of the Ilfracombe slates, it may be difficult, if not impossible, to determine, no fossils occurring throughout the whole series until we reach the upper gritty beds of the Little Hangman,

* See Mr. Salter's valuable paper upon the Upper Old Red Sandstone of North Devon and South Wales, Quart. Journ. Geol. Soc. xix. 1863.

where casts of *Myalina*, *Favosites cervicornis*, *Cucullæa*, *Macrocheilus brevis*, *Sanguinolaria* &c., and *Natica* are found; these sandstones and their fossils, however, graduate insensibly into the red and grey slates with *Stringocephalus Burtini* in Combe Martin Bay. I therefore place them at the base of the Middle group as the Middle Red Sandstones, the marine Middle Devonian slates being conformable upon them.

(2) These red gritty sandstones constitute a great belt of country, three miles in width, from Trentishoe and West Challacombe on the west, to Croydon Hill in West Somerset, on the east, the beds at Timberscombe being lowest, and those of Ashwell the highest; few fossils are known to occur in these sandstones along this strike of thirty miles; they divide the lower or Lynton slates from the Middle or Ilfracombe; and the base and top are conformable to the Lower slates of Lynton on the one hand, and the Middle or Ilfracombe above on the other. Their thickness is from 1500 to 2000 feet.

(3) Resting upon this extensive series of red sandstones (Middle Old Red) and along the meridian of West Challacombe, Paracombe, Black Barrow Down, Ashwell, Luxborough, and Nettlecombe, as their northern base, are the argillaceous and calcareous slates of the Middle Devonian or Ilfracombe group, its lower half containing a fine and marked assemblage of fossils, its upper half being entirely unfossiliferous and ending at its junction with the Pickwell Down Sandstones, along a line from Woolacombe, at Morte Bay, to the north of Main Down near Wiveliscombe on the east, and almost parallel to the base-line above named; this series, although much rolled and contorted, chiefly with the dip, passes conformably or unfaulted (along the line described) under the Upper Old Red Sandstone of Pickwell, Favisham, and Garmond Downs, Span Head, and Heydon and Main Downs. This zone or series of slates, grits, and limestones together is at least 8000 feet thick.

(4) The upper half of the Middle or Ilfracombe series of slates is unfossiliferous. They are finely exposed at Lee Bay, Rockham Bay, and Morthoe, and stretch across the whole of North Down, from Morte Bay to the Oakhampton Quarries, north of Wiveliscombe; their physical characters are persistent throughout this strike; they everywhere underlie the upper zone of red sandstones, the "Old Red Sandstone" of Prof. Jukes, and are conformable to the base of it. Their thickness cannot be less than 3500 or 4000 feet*.

V. PALÆONTOLOGICAL VALUE OF THE ORGANIC REMAINS FOUND IN THE DEVONIAN GROUPS.

I have now to examine, estimate, and coordinate the values of the Devonian groups, separately and collectively, as one great system, both in Great Britain and Europe, especially in those areas where

* In this communication I do not enter into details relative to the Upper Devonian beds. This has been done for that group south of Pickwell Down by Mr. Salter. It would only be repeating his views in detail to do so. *Vide* Quart. Journ. Geol. Soc. vol. xix. 1863.

they are recognized as largely developed (both physically and palæontologically) and are well understood by the Rhenish, Belgian, and French geologists. I also propose to examine the palæontological relations between the Devonian and Carboniferous systems of North Devon in particular, where their relations to each other are clearly made out, and their succession and superposition complete. Again, I propose to examine them in relation to the Carboniferous generally, more especially to that part of the group called the Carboniferous Slates, Coomhola Grits, or Lower Limestone Shales of Ireland, to which Professor Jukes has assigned all the well-known and peculiar Devonian species, as well as the rocks of Devonshire.

The question as to which of the two conformable groups of rocks, viz. the Old Red Sandstone below, or the Carboniferous above, we are to assign the Devonian series, is one, it is to be admitted, of some difficulty; but if we find an assemblage of organic remains having a distinguished and peculiar fauna, characterized by species which are peculiar to it, and totally distinct from the Silurian below, and largely so from the Carboniferous above, as is the case with the Devonian species, then, other things being equal, there are grounds for assigning to the marine fossiliferous group of rocks under consideration an intermediate position, be their relation to the two what it may.

I take the whole of the Devonian series to be chronologically equivalent to the whole of the Old Red Sandstone, or synchronously deposited with that group, but under different mineral and life conditions, and in a *different geographical area*, not side by side, through its whole or entire series, or synchronous with the Carboniferous, as suggested by Prof. Jukes, the assemblage of organic remains nowhere justifying this proposition. Either we must admit that the Devonian series is a marine equivalent in time of the Old Red Sandstone as a whole, or it must be a distinct life-system, occupying an immense area, spreading over an enormous interval of time between the completion of the Old Red Sandstone as a whole, and the commencement of the succeeding and well-marked Carboniferous series, and represented by contemporaneous deposits over a definite and comparatively small area, in Europe (Russia, Germany, Belgium, and France), that area being governed or marked out, especially in England, by geographical and physical conditions now difficult to trace, owing to subsequent movements and denudation or through the accumulation of newer strata along and over the south and west of England. During this epoch, almost identical conditions seem to have existed over the European area where the sandstones, slates, and associated limestones were deposited, the rocks having peculiar and marked physical resemblance, as well as possessing an almost specifically identical fauna, notably so in the Rhenish provinces, from the Taunus to Düsseldorf, the Belgian area, and the Bas Boulonnais, in the North of France,—the stratigraphical position and the zoological grouping of the Devonian rocks being of marked similarity everywhere.

Whatever precise relation the three divisions of the Devonian may have in time to the three equally well-marked groupings of the

Old Red Sandstone of the adjoining districts of Gloucester, Hereford, and South Wales, as well as Scotland, it is certain that they are most intimately related to the European series in every particular; and if it were possible to reconstruct the old geographical area and coast-lines against which, and the areas over which, the marine equivalents of the Old Red Sandstone were deposited or accumulated, we should, I think, find that the northern boundary to the British marine type would be about the latitude of our Mendip Hills, ranging eastwards to Coblenz and the Hunsrück, and westward to the south-west of Ireland, and a region now covered by the Atlantic. The southern boundary may be the north coast of France, or even Asturias and the Pyrenees on the north of Spain, thus constituting an area of great extent*.

1. *Chronological Equivalents of the Old Red Sandstone of Hereford, Scotland, &c.*—The palæontological break between the Silurian rocks and the Old Red Sandstone was nearly complete; and although they are stratigraphically conformable (*in the typical Silurian area*), yet there are only 13 species known as common to the Old Red of the Silurian area and the Silurian rocks. Those species that occur are represented by the Fishes and Pœcilopod Crustacea, which are found through the passage-beds, at all times a doubtful horizon, especially so when no other zoological group exists for comparison, which is so markedly the case at the close of the Silurian and commencement of the Old-Red-Sandstone period. They are the following:—*Cephalaspis Murchisoni*, *C. ornatus*, *Auchenaspis Salteri*, *Onchus Murchisoni*, *Pteraspis Banksii*, *P. Lloydii*, and *P. truncatus*. One genus only of these (*Onchus*) is represented in the Carboniferous series. The Crustacea, which are on the confines also of the two, are:—*Eurypterus abbreviatus*, Salt., *E. acuminatus*, Salt., *E. pygmeus*, Salt., *Pterygotus anglicus*, Ag., *P. problematicus*, Salt., and *Stylonurus megalops*.

It must be remembered that there are nearly 1160 described species in the Silurian rocks, and 149 (113 of which are Fish) in the Old Red Sandstone (Table I.), and only the above 7 Fish and 6 Crustacea are known to occur as common to the two formations, and that strictly on their confines†.

The accompanying Table is constructed to show the census of the Palæozoic rocks as now known, the number of species in each class being numerically expressed. The fifth column shows the number of species (56) common to the marine Devonian and the Carboniferous rocks; it is here incorporated as being also of value in future parts of the paper.

* This area will be more definitely noticed hereafter.

† It is stated by Prof. Jukes (Quart. Journ. Geol. Soc. vol. xxii. 1866, p. 366) that a few species, such as *Strophomena rhomboidalis*, occur in both Silurian and Carboniferous: this must be an error; I know no one species common to these two great formations.

TABLE I.—*Showing the present census of species in the Palæozoic Rocks of Great Britain.*

Classes.	Silurian.	Old Red Sandstone.	Devonian.	Sp. com. to Dev. & Carb.	Carboniferous.	Permian.
Plantæ	10	12	4	2	308	20
Amorphozoa	19	...	9	...	...	5
Rhizopoda .....	...	...	...	...	...	6
Cœlenterata	93	...	53	1	119	5
Echinodermata	83	...	21	4	129	2
Annelida	37	1	2	...	19	6
Crustacea	267	21	13	...	59	20
Insecta .....	...	...	...	...	3	...
Polyzoa	79	1	13	6	55	6
Brachiopoda	208	...	99	15	157	20
Lamell. { Monomyaria...	30	...	22	3	140	6
{ Dimyaria	99	1	36	6	194	20
Gasteropoda	96	...	46	7	174	25
Nucleobranchiata	22	...	9	3	20	1
Pteropoda	27	...	1	...	1	...
Cephalopoda	77	...	52	9	145	2
Pisces	7	113	3	...	202	21
Reptilia .....	...	...	...	...	7	2
	1154	149	383	56	1741	167

The following complete Table (II.) has been constructed to show the *whole of the fauna and flora* of the Old Red Sandstone and Devonian rocks in the British islands; and it shows in a marked and satisfactory manner the palæontological values of the two terms. It is constructed so as to show the natural-history grouping of the classes and genera, with the number of species in each genus, and also general or extended, yet definite, geographical areas over which the Devonian rocks are clearly distributed. Other Tables are constructed out of this, and prepared for purposes of more detail. It is necessary to establish one base for reference, either as a typical general group, or a known and definite and received basis, by means of which the species of one group of rocks may be collated or coordinated with those of another, or for comparing the unknown with the known. Stratigraphical sequence demands that we accept the Old Red Sandstone here as our true base, as it is conformable to, and immediately succeeds in time, the Upper Silurian; but on palæontological grounds the Old Red Sandstone stands alone, and can be compared with no other but itself. These conditions in Britain are general; everywhere is it, as Old Red Sandstone, in its three divisions, a barren series for comparison,—two groups only, the class of fishes among the Vertebrata, and the Merostomata (Pœcilopoda) among the Crustacea, being of any value.

It will be found that there are only 149 known species in the Old Red Sandstone proper; and these are distributed through only four classes of the animal kingdom, but they include some plants. They

PLANTÆ.

COELENTERATA.

[illegible]

SPECIES.

[illegible]

[illegible]

[illegible]

[illegible]

TABLE II. (continued).—*Showing the entire Fauna and Flora of the Old Red Sandstone and Devonian Rocks of Great Britain, and their comparison with those of the Rhenish-Prussian, Belgian, and French series.*

[illegible]

LAMELLIBRANCHIATA (MONOMYARIA).

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[illegible]

LAMELLIBRANCHIATA (DIMYARIA) (continued).

[illegible]

[illegible]

[illegible]

CEPHALOPODA (continued).

Asterolepis Malcolmsii, <i>Ag.</i>	*	*
" minor, <i>Ag.</i>	*	*
Auchenaspis Salteri, <i>Egert.</i>	*	*
" ornatus, <i>Egert.</i>	*	*
Bothriolepis favosus, <i>Ag.</i>	*	*
" ornatus, <i>Eichw.</i>	*	*
Brachyacanthus scutiger, <i>Egert.</i>	*	*
Byssacanthus arcuatus, <i>Ag.</i>	*	*
Cephalaspis asterolepis, <i>Hact.</i>	*	*
" Lewisii, <i>Ag.</i>	*	*
" Lyellii, <i>Ag.</i>	*	*
" Murchisoni, <i>Ag.</i>	*	*
" Solwayi, <i>Egert.</i>	*	*
" ornatus, <i>Egert.</i>	*	*
Cheiracanthus grandispinus, <i>M^c Coy</i>	*	*
" latus, <i>Egert.</i>	*	*
" microlepidotus, <i>M^c Coy</i>	*	*
" minor, <i>Ag.</i>	*	*
" Murchisoni, <i>Ag.</i>	*	*
" pulverulentus, <i>M^c Coy</i>	*	*
Cheirolepis Cummingæ, <i>Ag.</i>	*	*
" Traillii, <i>Ag.</i>	*	*
" uragus, <i>Ag.</i>	*	*
" velox, <i>M^c Coy</i>	*	*
Climacius reticulatus, <i>Ag.</i>	*	*
" scutiger, <i>Egert.</i>	*	*
" uncinatus, <i>Egert.</i>	*	*
Coccosteus cuspidatus, <i>Ag.</i>	*	*
" decipiens, <i>Ag.</i>	*	*
" maximus, <i>Ag.</i>	*	*
" Milleri, <i>Egert.</i>	*	*
" oblongus, <i>Ag.</i>	*	*
" minor, <i>Mill.</i>	*	*
Conchodus osteiformis, <i>M^c Coy</i>	*	*
Cosmacanthus Malcolmsoni, <i>Ag.</i>	*	*
Ctenacanthus ornatus, <i>Ag.</i>	*	*
Ctenopelychius priscus, <i>Ag.</i>	*	*
Deudrodus incurvus, <i>Duff</i>	*	*
" latus, <i>Owen</i>	*	*

PIECES (continued).

<i>Holotychnus giganteus, Ag.</i>	.....	*
" <i>Murchisoni, Ag.</i>	.....	*
" " <i>nobilissimus, Ag.</i>	.....	*
" " <i>Sedgwickii, M. Coy</i>	.....	*
<i>Homothorax Flemingii, Ag.</i>	.....
<i>Ichuacanthus gracilis, Egerl.</i>	.....	*
<i>Lamnodus biporcatus, Owen</i>	.....	*
" " <i>Panderi, Ag.</i>	.....	*
" " <i>sulcatus, Ag.</i>	.....	*
<i>Onchus arcuatus, Ag.</i>	.....	*
" <i>semistriatus, Ag.</i>	.....	*
" " ? <i>Murchisoni</i> ?, <i>Ag.</i>	.....	*
<i>Osteolepis arenatus, Ag.</i>	.....	*
" " <i>brevis, M. Coy</i>	.....	*
" " <i>macrolepidotus, Ag.</i>	.....	*
" " <i>major, Ag.</i>	.....	*
<i>Panphractus Andersoni, Ag.</i>	.....	*
<i>Paraxus incurvus, Ag.</i>	.....	*
<i>Phaneropleuron Andersoni, Hux.</i>	.....	*
<i>Phyllolepis concentricus, Ag.</i>	.....	*
<i>Placothorax paradoxus, Ag.</i>	.....	*
<i>Platygnaethus Jamesoni, Ag.</i>	.....	*
" " <i>paucidens, Ag.</i>	.....	*
<i>Pterichthys cancriformis, Ag.</i>	.....	*
" " <i>cornutus, Ag.</i>	.....	*
" " <i>hydrophyllus, Ag.</i>	.....	*
" " <i>latus, Ag.</i>	.....	*
" " <i>major, Ag.</i>	.....	*
" " <i>Milleri, Ag.</i>	.....	*
" " <i>macrocephalus, Egerl.</i>	.....	*
" " <i>oblongus, Ag.</i>	.....	*
" " <i>productus, Ag.</i>	.....	*
" " <i>quadratus, Egerl.</i>	.....	*
" " <i>testudinarius, Ag.</i>	.....	*
<i>Pteraspis Banksii, Hux.</i>	.....	*
" " <i>Dunensis, Hux.</i>	.....	*
" " <i>Lloydii, Ag.</i>	.....	*
" " <i>rostratus, Ag.</i>	.....	*
" " <i>Mitchelli, Fowrie</i>	.....	*

TABLE II. (continued).—*Showing the entire Fauna and Flora of the Old Red Sandstone and Devonian Rocks of Great Britain, and their comparison with those of the Rhenish-Prussian, Belgian, and French series*

[illegible]

stand thus :—Plantæ 12 species, Annelida 1 sp., Crustacea 20 sp., Polyzoa 1, Pisces 113 ; whereas the Marine Devonian contains 12 classes, 125 genera, and 383 species, distributed through its Lower, Middle, and Upper members in the West Somerset, North and South Devonian, and Cornish areas, or in the typical Devonian region. With these Devonian species are compared those occurring in the Carboniferous Slate of Ireland, many of which pass from the *Upper* Devonian group beneath into the Carboniferous series, which in the North-Devon area reposes upon the Upper Devonian rocks at Barnstaple, and in the country to the south. The whole Devonian fauna is also compared with the Carboniferous generally ; and, to make my comparisons still more important and complete, I have endeavoured to compare the English types of the Devonian species and those of the Irish Carboniferous slate with those in the groups of rocks recognized as Lower, Middle, and Upper Devonian in the Rhenish provinces, Belgium and France (the Bas Boulonnais) ; by this means I have arrived at some data as to the distribution of the Devonian species in space and time, and their true relation to the Old Red Sandstone on the one hand, and the succeeding Carboniferous group above on the other ; it serves to show us also that the marine Devonian system, as a whole, stands alone, through its organic remains—5 species only being common to the Old Red Sandstone and Devonian, out of the 149 species known in the former, and 385 in the latter. Three of these are Plants, and the remaining two Fish ; the 113 species of fish, therefore, are almost the only witnesses of animal life in the vast thickness of the Old Red Sandstone. As we have, therefore, no standard by which to compare the Devonian, or the Carboniferous, except through the “Devonian,” there is no alternative but to accept the British species as types and data for comparison with the continental Devonian series and the Carboniferous ; and admitting, upon stratigraphical evidence, that the Devonian is beneath the Carboniferous everywhere in England and Europe where they have been examined, it of necessity follows that the species distributed through the Devonian rocks preceded the Carboniferous in time, and also that the few species that occur in both are, without exception, of Devonian types, occurring either in the British area, or in one or more of the three European areas named ; and this stratigraphical position and life-succession are clearly shown in North and South Devon and West Somerset. (See Table II., p. 616, and Table IV., p. 640).

I purpose comparing the British species occupying the two Devonian areas amongst themselves, and then entering upon their comparison with relation to their foreign equivalents in the Rhenish provinces, Belgium, and France, and finally comparing them with the succeeding Carboniferous series in this country and in Ireland.

2. *Lower Devonian species of West Somerset and North Devon.*—These lower gritty slates and associated bands of limestone contain a fauna almost peculiar to themselves ; and it is remarkable how many of the known species are common to North Devon and the Rhenish and Belgian areas, notwithstanding that they are so widely separated ;

and although there is poverty in the number of known forms, yet it is evident that similar conditions then occurred equally favourable to the laws of life, the zoological relations over this extended area during the deposition of these lower beds, like those of the higher members, being marked and important. 18 species are known to occur in this lower series of West Somerset and North Devon; and their distribution is given in the following Table, in which are compared those species occurring in beds of the same age in the Rhenish provinces, Belgium, and France. It is somewhat singular that in our own group we have not as yet a single known species of the class Cephalopoda, no Crustacean, and, as far as we yet know, no Fish-remains.

TABLE III.—*Species occurring in the Lower Devonian Slates, Grits, and Limestones of North Devon, and those found in the same group on the Rhine, in Belgium, and in France.*

Species.	British.						Foreign.		
	Lynton.	Valley of Rocks.	Watersmeet.	Woodabay.	Lee.	Heddon's Mouth.	Rhine.	Belgium.	France.
1. <i>Alveolites suborbicularis</i> , Lam.	*	*	*	*	
2. <i>Favosites cervicornis</i> , Blainv.	*	*	*	*		
3. <i>Petraia pluriradialis</i> , Phill.	*	*				
4. <i>Actinocrinus tenuistriatus</i> , Phill.	*	*							
5. <i>Fenestella antiqua</i> , Goldf.	*	*	*	*	*	*	*	...	*
6. <i>Chonetes sordida</i> , Sow., vel <i>Hardrensis</i> , <i>Phill.</i>	*	*	*	*	
7. <i>Orthis arcuata</i> , Phill.	*	*	*	*	*	*			
8. — <i>granulosa</i> , Phill.	*	*					
9. <i>Spirifera canalifera</i> , Valen.	*	*	*	*	*	*
10. — <i>hysterica</i> , Schloth.	*	*	*	*	*	*
11. — <i>lævicosta</i> , Valen.	*	*	*	*	*	
12. <i>Streptorhynchus crenistria</i> ? Phill.	*	*							
13. <i>Pterinea spinosa</i> , Phill.	*					
14. <i>Ctenodonta Krachtæ</i> , M'Coy	*								
15. <i>Pleurotomaria aspera</i> , Sow.	*	*							
16. <i>Bellerophon striatus</i> , Bronn.	*					
17. <i>Tentaculites</i> , sp.	*	*	*			
18. <i>Megalodon cucullatum</i> , Sow.	*				

We thus see that of the 18 British species 7 are common to the Lower Devonian of North Devon, and that of one or other of the three European areas given in the Table, viz. *Alveolites suborbicularis*, *Favosites cervicornis*, *Fenestella antiqua*, *Chonetes sordida* vel *Hardrensis*, *Spirifera canalifera*, *S. hysterica*, and *S. lævicosta*. The paucity of known species in our area may arise from want of search, and also the absence of workable limestone on the Lynton group. Some of these species, Nos. 1, 6, 8, 9, 10, 14, and 16, do not pass up to

the Middle or Upper Devonian, or the Carboniferous, and are therefore peculiar to the lower series of North Devon. But *Alveolites suborbicularis*, *Orthis granulosa*, *O. arcuata*, and *Spirifera levicosta* occur in the Middle Devonian beds of South Devon, and *S. hystérica* and *Pterinea spinosa* in rocks of the same age in Cornwall.

The full relations of species occurring in the Lynton group of West Somerset and North Devon cannot be clearly arrived at—so little, as yet, being known of the fossils of the lower gritty slates of the Quantock Hills, and of the lower beds that sweep round the Croydon Hill promontory, north of Luxborough and Treborough Wood &c., and also from the difficulty we still have in assigning the true position of the Cannington-Park limestone, though I have no doubt that it belongs to the lowest part of the *Middle Devonian Rocks*. The physical characters of this limestone more strongly resemble those of the Torquay and Plymouth limestones than any in the northern area; and the corals which occur in them are of the same species as those of the middle series in the Quantock Hills; but the crystalline structure of the rock seems to have obliterated nearly all traces of life.

If we compare the species that are known to be peculiar to the Lower or Lynton group of North Devon, with those of the lower in *South Devon*, as at Looe &c., and of that of Cornwall, only 1 species is found to occur as common, viz. *Leptæna laticosta*; whereas if we examine and compare those species which are found in the three areas occupied by the same rocks, a similar result takes place; for only two, and those corals, are known to occur in common to the three areas, viz. *Petraia Celtica* and *P. pluriadialis*, whatever this may be. This is doubtless due to our incomplete knowledge of the fauna of the three areas, and a proof how little we yet know of the distribution of life through these obscure rocks; they are facts, nevertheless, as based upon what is known. Be it remembered we have here only examined and compared the Lower Devonian species amongst themselves, not the relation of the Lower to the Middle or Upper, where very different results will be found, tending to connect them as one and a complete series in a very conclusive manner. Careful search, then, gives us but 18 known species in the Lower Devonian group of Rocks in North Devon; and 13 of these are found and will be noticed as occurring in the Middle Devonian of either North or South Devon.

Table III. is constructed to show the relation of the Lower Devonian species of Britain to those of Europe, irrespectively of the species passing into higher members of the Devonian series in any area. It is singular that in the British Lower Devonian series there is only 1 Gasteropod known in any area (viz. *Pleurotomaria aspera*), only 4 Lamellibranchs (*Pterinea spinosa*, *P. anisota*, *Ctenodonta Krachtæ*, and *Clidophorus ovatus*), one Cephalopod (*Orthoceras gracile*), and a solitary Nucleobranch (*Bellerophon bisulcatus*); and these are from the lower series in Cornwall, the species found being either deep-sea or pelagic forms, thus agreeing with the nature of the deposits which contain them.

It has been stated that 13 species are common to the *Lower Old Red Sandstone* and the preceding Silurian rocks; but our comparisons are confined to the group of Fishes contained in the passage-beds between the two formations, of which there are seven species; and, from the want of this group of vertebrata in our Lower Devonian slates, it is negative evidence only for the British area. I doubt not that both the Lower, or Lynton, and the Middle, or Ilfracombe, beds will yet yield many species of fish, remains of which, but with hardly determinable characters, are frequently found in the slates on the north coast; for we now have conclusive evidence of their presence from bones and coprolitic débris*.

The following Table contains those invertebrate species still retained by many as common to the Silurian and Devonian rocks; I place the mark of interrogation against those I would reject as being very doubtful:—

Species.	Silurian.	Low. Dev.	Mid. Dev.	Up. Dev.
<i>Favosites fibrosa?</i> Goldf.	*	*	*	
<i>Tentaculites annulatus?</i> Schloth.	*	...	*	
<i>Atrypa reticularis</i> , Linn.	*	*	*	
—, var. <i>aspera</i> , Schloth.	*	*	*	
<i>Ctenodonta</i> (<i>Clidophorus</i>) <i>ovata?</i> Sow.	*	*	*	
<i>Orthoceras imbricatum?</i> Wahl.	*	*

The 7 species of Fish-remains cannot be compared, as we are not dealing with the Old Red proper of the Silurian area.

With the exception, therefore, of the ubiquitous *Atrypa reticularis*, which is undoubtedly common to the Silurian and Devonian Rocks in England and Europe, I believe we have no reliable species connecting the two great life-periods, viz. the Silurian and Devonian.

Whilst comparing the relation of the Silurian to the Devonian fossils, it would be as well to name (before we discuss critically) those species which are said to occur as common to the Lower Devonian rocks of the Lynton area and the so-called Carboniferous Slate above or to the south, and to link the two areas together in North Devon, and which have been referred to as one of the reasons for relating them, though this has only been done through the apparent similarity of the rock-masses of the two areas, and from the general resemblance that the slates of North Devon bear to the Coomhola and Carboniferous Slates of the South of Ireland. Professor Jukes, in his paper †, states that at Lynton, in the Valley of Rocks, he “was again among rocks belonging to the Carboniferous Slate,” and that the fragments of Brachiopoda and all other fossils seemed to be the same as those of Ireland. To all outward appearance there is and may be *similarity*, as there is in most slaty regions; and the Croyde and Baggy Slates to the south in a few par-

* Mr. Valpy's collection supplies this evidence.

† Quart. Journ. Geol. Soc. vol. xxii. 1866, p. 350.

ticulars physically resemble those of Lynton; but their *identity* stratigraphically (or by position in time) is impossible; and the second assertion, as to complete identity of species or organic contents, is an error; the only species out of the 18 known in the Lower or Lynton series (in the Lynton area) and common to it and the Carboniferous Slate to the south, or in any area, are two—*Fenestella antiqua** and *Chonetes sordida* or *Hardrensis*, a species still doubted by Mr. Davidson—and this admitting that the Barnstaple fossils are Carboniferous. No other forms pass up from the Lower Devonian to the Carboniferous, and no others are common in the North Devon area; and we must in this case, when absolute identity of rock-masses is stated to exist, compare the species that occur in each. Succeeding Tables will show their relation, when all the known Carboniferous species of North Devon will be compared with the three groups of the Devonian in the same area. It was necessary to show the palæontological relations of the species in these Lower Devonian rocks to the Silurian below on the one hand, and to the Carboniferous above on the other, as one amongst other proofs or evidence of their intermediate position and distinct character, and of their having, as I have stated, only one species common to the two systems. The gradual addition to the known number of species in the Middle and Upper Devonian rocks will show a marked relation to the succeeding Carboniferous; for of the 495 known species in the Old Red and whole Devonian, 57 are also found in the Carboniferous; these 57 species will also be compared in their proper place when I treat of the relation of the two groups to each other.

I have thus endeavoured to draw some comparison between the community of species in the Lower Devonian and Silurian rocks, also of those in the Lower Devonian of the North Devon area with the fossils of the Lower or Spirifer-sandstones &c. of the Rhine; and also, preparatory to further analysis, I have stated the relation which the Lynton Group bears to those rocks above the Pickwell-Down and Baggy series, which have been asserted to be of the same age. I now purpose analyzing the species that occur in the Middle Devonian or Ilfracombe Group.

3. *Middle Devonian or Ilfracombe Group.*—In the slates and limestones, and occasionally the gritty beds, chiefly (in North Devon) at and near Combe Martin, Watermouth, Widmouth, Hagginton, and Ilfracombe, a large assemblage of Middle-Devonian species occurs; 73 known forms are distributed through the slaty and calcareous rocks of this group; and 35 of these occur in one or other of the three European areas selected for comparison. Thus nearly 46½ per cent. are common to the Middle Devonian strata of Britain and Europe. Doubtless a still closer relation will be found to exist when other groups of fossils have been as extensively studied and accurately worked out as the Brachiopoda and Cœlenterata; for of the

* One of the most doubtful species in the Devonian Rocks; in nine cases out of ten it occurs only in the form of moulds and casts; and the Polyzoa are, of all other groups, when required for the identification of beds, the most deceptive.

TABLE IV. (continued).

Species.	North Devon.						West Somerset.				
							Qantock Hills.		Croydon Area.		
	Holdstone.	Ilfracombe.	Hagginton.	Widmouth.	Watermouth.	Combe Martin.	Adcombe.	Asholt.	Buncombe.	Withycombe.	Nettlecombe.
<i>Atrypa aspera</i> , <i>Schloth.</i>	*								
<i>Cyrtina heteroclyta</i> , <i>Deffr.</i>	*	*							
<i>Merista plebeia</i> , <i>Sow.</i>	..	*	*	*							
<i>Orthis striatula</i> , <i>Schloth.</i>	..	*	*	*							
<i>Rensseleria stringiceps</i> , <i>Roem.</i>	..	*	*	*							
<i>Rhynchonella pleurodon</i> , <i>Phill.</i>	..	*	*	*							
— <i>pugnus</i> , <i>Martin</i>	..	*									
<i>Spirifera curvata</i> , <i>Schloth.</i>	..	*	*								
— <i>disjuncta</i> , <i>Sow.</i>	..	*	*	*							
— <i>nuda</i> , <i>Sow.</i>	..	*	*								
— <i>speciosa</i> , <i>Schloth.</i>	..	*	*								
— <i>glabra</i> ? <i>Martin</i>	..	*	*	*							
<i>Spiriferina cristata</i> , <i>Schloth.</i>	..	*	*								
<i>Stringocephalus Burtini</i> , <i>Deffr.</i>	..	*	*	*	...	*					
<i>Streptorhynchus crenistria</i> , <i>Phill.</i>	..	*	*	*							
— <i>umbraculum</i> , <i>Schloth.</i>	..	*	*								
<i>Strophomena rhomboidalis</i> , <i>Wahl.</i>	..	*	*	*							
<i>Cypriocardia</i> , <i>sp.</i>	..	*	*								
— <i>sp.</i>	..	*	*								
<i>Cucullæa</i> , <i>sp.</i>	..	*									
<i>Myalina</i> , <i>sp.</i>	..	*									
<i>Schizodon deltoideus</i> , <i>Phill.</i>	..	*									
<i>Sanguinolaria</i> , <i>sp.</i>	..	*	*								
<i>Solen</i> ?	..	*									
<i>Acroculia vetusta</i> , <i>Sow.</i>	..	*	*	*				
<i>Euomphalus serpens</i> , <i>Phill.</i>	..	*	*								
— <i>radiatus</i> , <i>Phill.</i>	..	*	*								
<i>Holopella</i> ?	..	*	*								
<i>Macrocheilus brevis</i> , <i>Sow.</i>	..	*	*								
<i>Pleurotomaria</i>	..	*									
<i>Lexonema</i>	..	*	*								
<i>Murchisonia</i>	..	*	*								
<i>Natica</i>	..	*	*								
<i>Conularia</i>	..	*	*								
<i>Orthoceras cylindraceum</i> , <i>Sow.</i>	..	*									
— <i>tentaculare</i> , <i>Phill.</i>	..	*	*								
— <i>sp.</i>	..	*	*								
<i>Cyrtoceras</i> , <i>sp.</i>	..	*	*								
— <i>sp.</i>	..	*	*								

In this Table an analysis is given of the occurrence and geographical distribution of the entire known fauna of the Middle
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Devonian Rocks of North Devon, to which are added the species that occur in the Quantock Hills and other localities in West Somerset, chiefly from the Limestones east and south of Croydon Hill. It may be largely added to by diligent search along the east side of the Quantocks at Adscombe, Stowey, &c. &c. This table will form the basis of my comparisons both with species that may range lower or higher in this area, and also with the European Devonian fossils as collated with our British types.

This Middle division or group of the Devonian rocks, both in North and South Devon, has received most attention, arising partly from circumstances peculiar to its geographical position on the one hand, and to the economical value of its limestones on the other; and this applies to Europe as well as Britain. It is the source of the lime used in the interior of North Devon; in quarrying, therefore, the amount of limestone removed is considerable; and it is to this circumstance alone that we owe our knowledge of the Cœlenterate fauna of the Middle Devonian of North and South Devon. In the south, at Torquay, Plymouth, &c., the excess of workable limestone over that of the north is so great that long ago extensive collections were made, the species carefully examined, and then justly referred by Lonsdale to an extensive formation existing between the Silurian and Carboniferous systems*—in other words, occupying the stratigraphical place of the Old Red Sandstones, whatever may be the exact relation of this marine Devonian group to that great and almost non-fossiliferous formation.

Having enumerated the entire fauna as known in North Devon, it will be important to compare the species that are known to occur in beds of the same age in South Devon to aid us in generalizing upon the value of the term Middle Devonian, as now used, applied to, and correlated with, the European groups.

4. *Species common to the Middle Devonian Rocks of North and South Devon.*—It will perhaps surprise many to find that there are 235 marine species known in the Middle (or Torquay, Newton, and Plymouth) group in South Devon, which are distributed through 11 classes of the animal kingdom. I briefly enumerate the 11, also the genera and species in each (Table V.)

* Proceedings Geol. Soc. 1840, vol. iii.; Trans. Geol. Soc. vol. v. p. 721, &c. &c.

TABLE V.—*Species occurring in the Middle Devonian Rocks of South Devon, compared with those of North Devon and Europe, and with the Carboniferous generally.*

Classes.	Species.	South Devon.	North Devon.	Foreign.	Carboniferous.
AMORPHOZOA	<i>Scyphia turbinata</i> , Goldf.	*			
	<i>Steganodictyum cornubicum</i> , M'Coy	*			
	<i>Sphaerospongia tessellata</i> , Phill.	*			
	<i>Stromatopora concentrica</i> , Goldf.	*	*	*	
	— <i>placenta</i> , Lonsd.	*			
COELENTERATA.....	— <i>polymorpha</i> , Goldf.....	*	...	*	
	— <i>ramosa</i> , Brass.	*			
	— <i>verticillata</i> , M'Coy	*			
	<i>Acercularia Battersbyi</i> , M.-Edw.	*			
	— <i>coronata</i> , M.-Edw.	*			
	— <i>Goldfussii</i> , De Vern.	*	*	*	
	— <i>intercellulosa</i> , Phill.	*			
	— <i>pentagona</i> , Goldf.	*	...	*	
	— <i>Rœmeri</i> , De Vern.	*			
	— <i>limitata</i> , M.-Edw.	*			
	<i>Alveolites Battersbyi</i> , M.-Edw.	*			
	— <i>compressa</i> , M.-Edw.	*			
	— <i>suborbicularis</i> , Lam.	*	*	*	
	— <i>vermicularis</i> , M'Coy	*			
	<i>Amplexus tortuosus</i> , Phill.	*	*	*	
	<i>Arachnophyllum Hennahii</i> , Lonsd.....	*	...	*	
	<i>Battersbyia inæqualis</i> , M.-Edw.	*	...	*	
	<i>Campophyllum flexuosum</i> , Goldf.	*	...	*	
	<i>Chonophyllum perfoliatum</i> , Goldf.	*			
	<i>Cyathophyllum æquiseptum</i> , M.-Edw. ...	*	*	*	
	— <i>Boloniense</i> , Blainv.	*	*	*	
	— <i>cæspitosum</i> , Goldf.	*	*		
	— <i>ceratites</i> , Goldf.	*			
	— <i>Damnoniense</i> , Lonsd.	*	*		
	— <i>helianthoides</i> , Goldf.	*	*		
	— <i>hexagonum</i> , Goldf.	*			
	— <i>Marmini</i> , M.-Edw.	*			
	— <i>obtortum</i> , M.-Edw.	*	*		
	— <i>Rœmeri</i> , M.-Edw.	*	...	*	
	— <i>Sedgwickii</i> , M.-Edw.	*			
	— <i>turbinatum</i> , Goldf.	*	...	*	
	<i>Cystiphyllum vesiculosum</i> , Goldf.	*	*	*	
	<i>Emmonsia hemisphærica</i> , M.-Edw.....	*			
	<i>Endophyllum abditum</i> , M.-Edw.	*	*		
	— <i>Bowerbanki</i> , M.-Edw.	*			
	<i>Favosites cervicornis</i> , Blainv.	*	*	*	
	— <i>dubia</i> , Blainv.	*	*	*	
	— <i>Goldfussii</i> , D'Orb.	*	...	*	
	— <i>reticulata</i> , Blainv.	*	...	*	
	— <i>fibrosa</i> , Goldf.	*	*		
	<i>Hallia Pengellyi</i> , M.-Edw.	*	*		
	<i>Heliolites porosa</i> , Goldf.	*	*	*	
	<i>Heliophyllum Halli</i> , M.-Edw.	*	*		
	<i>Metriophyllum Battersbyi</i> , M.-Edw.	*			

TABLE V. (*continued*).

Classes.	Species.	South Devon.	North Devon.	Foreign.	Carboniferous.
CELENTERATA.....	<i>Pachyphyllum Devonienne</i> , <i>M.-Edw.</i>	*	*		
	<i>Petraia Celtica</i> ?, <i>Lonsd.</i>	*	*	*	*
	— <i>gigas</i> , <i>M'Coy</i>	*	*		
	<i>Pleurodictyum problematicum</i> , <i>Goldf.</i>	*	...	*	
	<i>Smithia Pengellyi</i> , <i>M.-Edw.</i>	*			
	— <i>Bowerbankii</i> , <i>M.-Edw.</i>	*			
	— <i>Hennahii</i> , <i>Lonsd.</i>	*			
	<i>Spongiophyllum Sedgwickii</i> , <i>M.-Edw.</i>	*			
	<i>Strephodes gracilis</i> , <i>M'Coy</i>	*			
	<i>Syringophyllum cantabricum</i> , <i>De Vern.</i>	*			
ECHINODERMATA.....	<i>Platycrinus pentangularis</i> , <i>Mill.</i>	*	...	*	
	— <i>tuberculatus</i> , <i>Mill.</i>	*	...	*	
	<i>Actinocrinus tenuistriatus</i> , <i>Phill.</i>	*			
	— <i>triacontadactylus</i> , <i>Mill.</i>	*	...	*	
	<i>Cupressocrinus crassus</i> ?.....	*	...	*	
	<i>Cyathocrinus nodulosus</i> , <i>Phill.</i>	*			
	— <i>geometricus</i> , <i>Goldf.</i>	*			
	<i>Hexacrinus depressus</i> , <i>Aust.</i>	*			
	— <i>intercapularis</i> , <i>Phill.</i>	*			
	— <i>macrotatus</i> , <i>Aust.</i>	*			
ANNELIDA.....	—, <i>sp.</i>	*			
	<i>Tentaculites annulatus</i> , <i>Schloth.</i>	*	*		
CRUSTACEA.....	—, <i>sp.</i>	*			
	<i>Bronteus flabellifer</i> , <i>Goldf.</i>	*			
	<i>Cheirurus articulatus</i> , <i>Münst.</i>	*			
	<i>Harpes macrocephalus</i> , <i>Goldf.</i>	*	...	*	
	<i>Phacops granulatus</i> , <i>Münst.</i>	*	...	*	
	— <i>latifrons</i> , <i>Bronn</i>	*	...	*	
	— (<i>Chryphæus</i>) <i>punctatus</i> , <i>Stein.</i>	*	*	*	
	— <i>Latreillii</i>	*	...	*	
POLYZOA.....	— (<i>Trimericephalus</i>) <i>lævis</i> , <i>Münst.</i>	*	*		
	— <i>cryptophthalmus</i> , <i>Emmer.</i>	*			
	<i>Ceriopora similis</i> , <i>Phill.</i>	*	*	...	*
	<i>Fenestella antiqua</i> , <i>Goldf.</i>	*	*	*	*
	— <i>arthritica</i> , <i>Phill.</i>	*	*	*	
	— <i>prisca</i> , <i>Goldf.</i>	*			
	<i>Hemitrypa oculata</i> , <i>Phill.</i>	*	...	*	
	<i>Polypora laxa</i> , <i>Phill.</i>	*	...	*	*
BRACHIOPODA.....	<i>Ptylopora flustriformis</i> , <i>Phill.</i>	*	...	*	
	<i>Retepora repisteria</i> , <i>Goldf.</i>	*	*	*	
	<i>Athyris Bartonensis</i> , <i>Dav.</i>	*			
	— <i>concentrica</i> , <i>V. Buch</i>	*	*	*	
	— <i>lachryma</i> , <i>Sow.</i>	*	*	*	
	— <i>Newtonensis</i> , <i>Dav.</i>	*			
	— <i>phalæna</i> , <i>Phill.</i>	*	...	*	
	<i>Atrypa desquamata</i> , <i>Sow.</i>	*	*		
	— <i>flabellata</i> , <i>Goldf.</i>	*	...	*	
	— <i>lens</i> , <i>Phill.</i>	*	...	*	
	— <i>lepida</i> , <i>Goldf.</i>	*	...	*	
	— <i>reticularis</i> , <i>Linn.</i>	*	*	*	
	— <i>aspera</i> , <i>Schloth.</i>	*	*	*	
	<i>Calceola sandalina</i> , <i>Linn.</i>	*	...	*	

TABLE V. (continued).

Classes.	Species.	South Devon.	North Devon.	Foreign.	Carboniferous.
BRACHIOPODA	<i>Camarophoria rhomboidea</i> , <i>Phill.</i>	*	?	*	
	<i>Chonetes Hardrensis</i> , <i>Phill.</i>	*	*	*	
	— <i>minuta</i> , <i>Goldf.</i>	*	*	*	*
	<i>Cyrtina amblygona</i> , <i>Phill.</i>	*	*	*	
	— <i>Demarlii</i> , <i>V. Buch</i>	*	*	*	
	— <i>heteroclyta</i> , <i>Def.</i>	*	*	*	
	— <i>multiplicata</i> , <i>Dav.</i>	*	*	*	
	<i>Davidsonia Verneulii</i> , <i>V. Buch</i>	*	*	*	
	<i>Leptæna interstitialis</i> , <i>Phill.</i>	*	*	*	
	— <i>nobilis</i> , <i>M'Coy</i>	*	*	*	
	<i>Merista plebeia</i> , <i>Sow.</i>	*	*	*	
	<i>Orthis arcuata</i> , <i>Phill.</i>	*	*	*	
	— <i>granulosa</i> , <i>Phill.</i>	*	*	*	
	— <i>striatula</i> , <i>Schloth.</i>	*	*	*	
	<i>Pentamerus brevirostris</i> , <i>Phill.</i>	*	*	*	
	— <i>biplicatus</i> , <i>Schnur</i>	*	*	*	
	<i>Productus subaculeatus</i> , <i>Murch.</i>	*	*	*	
	<i>Rhynchonella acuminata</i> , <i>Mart.</i>	*	*	*	*
	— <i>angularis</i> , <i>Phill.</i>	*	*	*	
	— <i>bifora</i> , <i>Phill.</i>	*	*	*	
	— <i>cuboides</i> , <i>Sow.</i>	*	*	*	
	— <i>laticosta</i> , <i>Phill.</i>	*	*	*	
	— <i>Lumatoniensis</i> , <i>Dav.</i>	*	*	*	
	— <i>Ogwelliensis</i> , <i>Dav.</i>	*	*	*	
	— <i>pleurodon</i> , <i>Phill.</i>	*	*	*	*
	— <i>primipilaris</i> , <i>V. Buch</i>	*	*	*	*
	— <i>protracta</i> , <i>Sow.</i>	*	*	*	
	— <i>pugnus</i> , <i>Martin</i>	*	*	*	*
	— <i>reniformis</i> , <i>Sow.</i>	*	*	*	*
	— <i>triloba</i> , <i>Sow.</i>	*	*	*	
	— <i>implexa</i> , <i>Sow.</i>	*	*	*	
	<i>Retzia ferrita</i> , <i>V. Buch</i>	*	*	*	
	<i>Spirifera comprimata</i>	*	*	*	
	— <i>curvata</i> , <i>Schloth.</i>	*	*	*	
	— <i>disjuncta</i> , <i>Sow.</i>	*	*	*	
	— <i>lævicosta</i> , <i>Val.</i>	*	*	*	
	— <i>lineata</i> , <i>Mart.</i>	*	*	*	*
	— <i>Newtonensis</i> , <i>Dav.</i>	*	*	*	
	— <i>nuda</i> , <i>Sow.</i>	*	*	*	
	— <i>simplex</i> , <i>Phill.</i>	*	*	*	
	— <i>speciosa</i> , <i>Schloth.</i>	*	*	*	
	— <i>subcuspidata</i> , <i>Schnur</i>	*	*	*	
	— <i>undifera</i> , <i>Ræm.</i>	*	*	*	
	— —, var. <i>undulata</i> , <i>Ræm.</i>	*	*	*	
	— <i>Urii</i> , <i>Flemg.</i>	*	*	*	*
	<i>Spiriferina cristata</i> , <i>Schloth.</i>	*	*	*	*
	— <i>insculpta</i> , <i>Phill.</i>	*	*	*	
	<i>Stringocephalus Burtini</i> , <i>Def.</i>	*	*	*	
	<i>Streptorhynchus crenistria</i> , <i>Phill.</i>	*	*	*	*
	— <i>umbraculum</i> , <i>Schloth.</i>	*	*	*	
	<i>Strophalosia fragaria</i> , <i>Sow.</i>	*	*	*	
	<i>Strophomena rhomboidalis</i> , <i>Wahl.</i>	*	*	*	*

TABLE V. (*continued*).

Classes.	Species.	South Devon.	North Devon.	Foreign.	Carboniferous.
BRACHIOPODA	<i>Terebratula sacculus</i> , <i>Mart.</i>	*	...	*	
	— <i>juvenis</i> , <i>Sow.</i>	*			
LAMELLIBRANCHIATA	— <i>Newtonensis</i> , <i>Dav.</i>	*			
	<i>Uncites gryphus</i> , <i>Schloth.</i>	*	...	*	
	<i>Avicula subradiata</i> , <i>Sow.</i>	*			
	<i>Aviculopecten plicatus</i> , <i>Sow.</i>	*	...		*
	— <i>rugosus</i> , <i>Phill.</i>	*			
	<i>Pterinea radiata</i> , <i>Goldf.</i>	*			
	— <i>reticulata</i> , <i>Phill.</i>	*			
	— <i>texturata</i> , <i>Phill.</i>	*			
	<i>Clidophorus ovatus</i> , <i>Sow.</i>	*			
	<i>Conocardium aliforme</i> , <i>Sow.</i>	*	...	*	*
	— <i>minax</i> , <i>Phill.</i>	*	...	*	*
	<i>Corbula Hennahii</i> , <i>Sow.</i>	*			
	<i>Cucullæa amygdalina</i> , <i>Phill.</i>	*			
	<i>Ctenodonta lineata</i> , <i>Phill.</i>	*			
	<i>Megalodon carinatum</i> , <i>Phill.</i>	*			
GASTEROPODA	— <i>cucullatum</i> , <i>Sow.</i>	*	?*		
	<i>Modiola scalaris</i> , <i>Phill.</i>	*			
	<i>Mytilus Damnoniensis</i> , <i>Phill.</i>	*			
	<i>Sanguinolaria sulcata</i> , <i>Münst.</i>	*			
	<i>Aeroculia sigmoidalis</i> , <i>Phill.</i>	*			
	— <i>vetusta</i> , <i>Sow.</i>	*	*	*	*
	— <i>triloba</i> ?	*			
	<i>Euomphalus annulatus</i> , <i>Phill.</i>	*			
	— <i>circularis</i> , <i>Phill.</i>	*			
	— <i>radiatus</i> , <i>Phill.</i>	*	...	*	
	— <i>serpens</i> , <i>Phill.</i>	*	*		
	— <i>lævis</i>	*	...	*	
	— <i>planorbis</i> , <i>Vern.</i>	*	...	*	*
	<i>Helminthochiton</i> ?	*			
	<i>Loxonema Hennahiana</i> , <i>Phill.</i>	*			
	— <i>lincta</i> , <i>Phill.</i>	*			
	— <i>nexilis</i> , <i>Phill.</i>	*			
	— <i>præterita</i> , <i>Phill.</i>	*			
	— <i>reticulata</i> , <i>Phill.</i>	*	...	*	
	<i>Macrocheilus brevis</i> , <i>Sow.</i>	*			
	— <i>elongatus</i> , <i>Phill.</i>	*			
	— <i>harpula</i> , <i>Sow.</i>	*	*	*	
	— <i>imbricatus</i> , <i>Sow.</i>	*	...		*
	— <i>subcostatus</i> , <i>Schloth.</i>	*			
	— <i>ventricosus</i> , <i>Goldf.</i>	*	*	*	
	<i>Murchisonia bigranulosa</i> , <i>D'Arch.</i>	*	*	*	
	— <i>geminata</i> , <i>Phill.</i>	*	*	*	
	— <i>spinosa</i> , <i>Phill.</i>	*	*	*	*
	— <i>tricincta</i> , <i>Phill.</i>	*			
	<i>Nerita deformis</i> , <i>Sow.</i>	*			
	<i>Pleurotomaria aspera</i> , <i>Sow.</i>	*			
	— <i>cirriformis</i> , <i>Sow.</i>	*	...	*	
	— <i>impendens</i> , <i>Sow.</i>	*	*		
	— <i>monilifera</i> , <i>Phill.</i>	*	...	*	
	— <i>multispira</i>	*			

TABLE V. (*continued*).

Classes.	Species.	South Devon.	North Devon.	Foreign.	Carboniferous.
GASTEROPODA.....	<i>Scoliostoma texta</i> , <i>Phill.</i>	*	...	*	
	<i>Trochus Boueii</i> , <i>Stein.</i>	*	...	*	
	<i>Turbo cirriformis</i> , <i>Sow.</i>	*	...		
	— <i>subangulatus</i> , <i>Sow.</i>	*	...		
	<i>Vermetus antitorquatus</i> , <i>Phill.</i>	*	...	*	
NUCLEORANCHIATA ...	— <i>annulosus</i>	*	...		
	<i>Bellerophon striatus</i> , <i>Bronn</i>	*	...		
CEPHALOPODA.....	<i>Porcellia Woodwardii</i> , <i>Sow.</i>	*	...	*	
	<i>Clymenia levigata</i> , <i>Münst.</i>	*	...		
	— <i>undulata</i> , <i>Münst.</i>	*	...		
	<i>Cyrtoceras armatum</i> , <i>Phill.</i>	*	...		
	— <i>bdellatus</i> , <i>Phill.</i>	*	...		
	— <i>fimbriatum</i> , <i>Phill.</i>	*	...		
	— <i>marginale</i> , <i>Phill.</i>	*	...		
	— <i>nautiloideum</i> , <i>Phill.</i>	*	...		
	— <i>nodosum</i> , <i>Phill.</i>	*	...	*	
	— <i>obliquatum</i> , <i>Phill.</i>	*	...		
	— <i>ornatum</i> , <i>Goldf.</i>	*	...	*	
	— <i>quindecimale</i> , <i>Phill.</i>	*	...		
	— <i>reticulatum</i> , <i>Phill.</i>	*	...		
	— <i>subornatum</i> , <i>McCoy</i>	*	...		
	— <i>tridecimale</i> , <i>Phill.</i>	*	...	*	
	<i>Goniatites excavatus</i> , <i>Phill.</i> .....	*	...	...	*
	— <i>globosus</i> , <i>Münst.</i>	*	...		
	— <i>serpentinus</i> , <i>Phill.</i>	*	...		
	— <i>transitorius</i> , <i>Phill.</i>	*	...		
	<i>Nautilus germanus</i> , <i>Phill.</i>	*	...		
	<i>Orthoceras cinctum</i> , <i>Sow.</i> .....	*	...	...	*
	— <i>ellipsoideum</i> , <i>Phill.</i>	*	...		
	— <i>tubicinella</i> , <i>Sow.</i>	*	...	*	
	— <i>unctum</i>	*	...		
	— <i>undulatum</i> , <i>Sow.</i>	*	...		

In the above Table will be found all the known species:—*Amorphozoa*: 4 genera and 8 species, all, with one exception (*Stromatopora concentrica*), confined to the southern area. *Cœlenterea*: 23 genera and 50 species; 10 genera and 17 species of which are known in the Ilfracombe group in North Devon and West Somerset; the physical conditions of the rocks of the two areas, and the small amount of old sea-bottom opened in the north compared with that in the south, will readily account for the wide difference as to number of species, though individually they appear to be as abundant in North Devon, many of the limestones being crowded with corals, especially at Adscombe, on the *east flanks* of the Quantock Hills (West Somerset), and the Combe-Martin area. *Echinodermata*: 4 genera and 8 species; and, as far as I know, no species of this group occurs in the Middle Devonian of North Devon; and, such as they are, they appear confined to the

typical southern area. I must, however, state that no group in the whole Devonian series is so difficult of identification, or perhaps more erroneously determined; the Crinoidea and Asteroidea, in nine cases out of ten, occur only as casts and moulds; yet some of the Upper Devonian beds of Baggy, Marwood, Croyde, Braunton, &c. are literally composed of the rusty decomposed remains of the Echinodermata, especially the *Crinoidea*. The 20 known species in the whole Devonian rocks are irregularly distributed through them; though 8 certainly occur in the Middle South Devonian beds. *Annelida*: only one determined species occurs, *Tentaculites annulatus**, known in both North and South Devon. *Crustacea*: 5 genera and 13 species occur in the Middle series in South Devon, one of which only, *Trimercephalus lævis*, is known in the Ilfracombe series of North Devon, and was found by Mr. Valpy in the gritty shales of Watermouth near Ilfracombe; this is important as being another and important link in evidence of the same species of Crustacea occurring in the two areas. Mr. Jukes states that he found *Phacops latifrons* in the Lower Devonian slates of Lynton (Valley of Rocks); and on his or Mr. Baily's authority I insert it in my list; these two species of the family Phacopidæ give us some hope that *Homalonotus* and *Harpes* will ere long reward the labours of some patient geologist. *Polyzoa*: 6 genera, and 8 species out of the 12 known, occur in South Devon; we cannot, however, at all depend upon the specific characters of these generally badly preserved and minute organisms; and as such they possess little or no stratigraphical value. *Fenestella antiqua* is, according to every one, in everything, from the slates of Looe to the Coomhola grits &c. Prof. Phillips admits 4 varieties of this species, all having different geographical positions; each should be carefully examined and understood, if weight is to be attached to so ubiquitous a deep-sea form. Lonsdale even refers it to the Silurian rocks; the whole group of the palæozoic Polyzoa requires great and critical examination.

Brachiopoda.—This class, like the Actinozoa among the Cœlenterata, highly typify and characterize the Middle Devonian rocks of South and North Devon; 23 genera and 68 species have been accurately determined as coming from these beds in South Devon; 10 genera and 22 of these species are common to the slates and limestones of the middle group in North Devon; and by comparison with those of the Rhine, Belgium, and France, in beds of the same age, no less than 47 species are common to the two marine areas; 7 only of these, viz.—

Rhynchonella acuminata, *Martin*.
— *pleurodon*, *Phill*.
— *pugnus*, *Martin*.
— *reniformis*, *Sow*.

Spiriferina cristata, *Schloth*.
Streptorhynchus crenistria, *Phill*.
Strophomena rhomboidalis, *Wahl*.

pass up to the Lower Carboniferous, all of which, with the exception of *Rhynchonella acuminata*, form an important feature in the Upper Devonian slates and limestones of Baggy, Marwood, Sloly,

* There are perhaps two if not three species, though their remains are obscure.

and Pilton. The typical genera, not known in higher beds, such as *Calceola*, *Merista*, *Pentamerus*, *Rensseleria*, *Retzia*, *Davidsonia*, *Strin-gocephalus*, and *Uncites* (all peculiarly Devonian), appear to have died out prior to the deposition of the Carboniferous series, during those changes of conditions which are evidenced by the physical structure of the Devonian sedimentary rocks, where through North Devon we recognize at the base great accumulations of red sandstones, succeeded by the fine and coarse gritty slates and impure limestones of the Lynton or Lower Devonian group, and another great and succeeding deposit of red sandstones and grits almost void of organic remains (the Hangman Grits), and a second series (the Ilfracombe group) of fine-grained fissile slaty deposits with associated organic limestones, rich in corals and Brachiopoda, differing in the two British areas in the amount of limestone, but in nothing as regards life-contents. This Middle-Devonian period was one of continued depression, which must have gone on continuously, as is proved by the position of the thick, glossy, fine-grained, unfossiliferous slates of Lee, Mortehoe, and Rockham, that overlie the Ilfracombe fossiliferous series &c., which sequence, with identical conditions, can be detected in the South Devon area. These unfossiliferous Morte Slates were probably again brought within the influence of shallow water; and on them rest the now higher Upper Old Red Sandstone beds of Pickwell Down, and then succeeds the upper marine Devonian series of Baggy, Marwood, and Pilton &c., with their crowds of typical Upper-Devonian species*.

Similarly scarce are the remains of *Lamellibranchs* in this group of deposits; and the 12 genera and 17 species known are Laminarian and deep-water forms — *Avicula*, *Pterinea*, *Otenodonta*, *Corbula*, the dwarfed *Conocardia*, *Cucullæa*, &c.; and indisputably the marked assemblage of peculiar species of corals and Brachiopoda accompanying them indicate the same bathymetrical conditions. Two species only of the Lamellibranchiata, viz. *Aviculopecten plicatus* and *Cardium aliforme* lived on to Carboniferous times: and 2 British species only are as yet known to occur in the three European areas, as compared with the known South-Devon forms; and they are *Conocardium aliforme* and *C. minax*.

Gasteropoda.—Similar facts are obtained by an examination of the Gasteropoda of this Middle zone: 11 genera occur, many of them being represented by only one or two species, such as *Nerita*, *Scolio-stoma*, *Trochus*, *Turbo*, and *Vermetus*; 36 species are distributed amongst the 11 genera, only four of which, or proportionally less than half as many as the Lamellibranchs, lived on to the Carboniferous Limestone; they are, *Acroculia vetusta*, *Euomphalus laevis*, *Macrocheilus imbricatus*, and *Murchisonia spinosa*; whereas we know of 15 European species being common to our Devonian series of North and South Devon. They are enumerated in Table V.

* Consult the able paper by J. W. Salter, Esq., on the Upper Old Red Sandstone and Devonian rocks, Quart. Journ. Geol. Soc. vol. xix. for a complete description of these beds and their fossil contents, as well as of those of the Pembroke area.

Nucleobranchiata.—*Bellerophon* and *Porcellia*, with perhaps *Conularia*, are the only three genera known in the Middle Devonian rocks of South Devon; 3 species occur, and all are confined to that area, viz. *Bellerophon striatus*, *Porcellia Woodwardii*?, and *P. striata*.

Cephalopoda.—The species in this class are singularly distributed through the Devonian series, and seem to have here been localized in groups or colonies, the two genera *Clymenia* and *Cyrtoceras* especially so. The former (*Clymenia*), both in Europe and Britain, seems confined to the Upper Devonian, and notably to with us, at Petherwin and Landlake, the genus not occurring higher in the series; and, with one exception, the species are all localized, or confined to one area. Eleven species are found in the Upper Devonian beds, below the Marwood group, and south of the great Culm-trough. The species of the genus *Cyrtoceras* seem to have been equally locally colonized, 12 species being confined to the Middle Devonian of Newton Bushel in South Devon, *C. rusticum* being the only form recorded as coming from the upper series at Petherwin. However difficult it may be to account for this speciality and colonization of a definite area by a group of Mollusca pelagic in their habits, the evidence, as it is, must be received in both cases, viz. of the *Clymenia* in the Upper Devonian, and the *Cyrtoceras* in the Middle. The species typifying the *Goniatites*, *Orthoceratites*, and *Nautili* are, on the other hand, as widely scattered through the Devonian of North Cornwall, South Devon, and North Devon; 6 species of *Orthoceras* occur in the Middle Devonian of South Devon, and two species of each genus recur in the Carboniferous beds, viz. *Goniatites excavatus*, *G. serpentinus*, *Orthoceras cinctum*, and *O. undulatum*. This analysis of the 235 Middle or Eifelian species of South Devon will show a marked feature of close affinity with forms occurring in beds of the same age in Rhenish Prussia, the Eifel, and France, as a large percentage of the species common to each can be adjusted to, and collated with, our Devonian types.

TABLE VI.—Showing the species common to the Middle Devonian rocks of North Devon, South Devon, and West Somerset.

Species.	North Devon.	South Devon.	West Somerset.
<i>Stromatopora concentrica</i> , Goldf.	*	*	*
<i>Tentaculites annulatus</i> , Schloth.	*	*	*
<i>Amplexus tortuosus</i> , Phill.	*	*	*
<i>Cyathophyllum æquiseptum</i> , M.-Edw.	*	*	*
— <i>Boloniense</i> , Blainv.	*	*	*
— <i>cæspitosum</i> , Goldf.	*	*	*
— <i>Damnoniense</i> , Lonsd.	*	*	*
— <i>helianthoides</i> , Goldf.	*	*	*
— <i>obtortum</i> , M.-Edw.	*	*	*
<i>Cystiphyllum vesiculosum</i> , Goldf.	*	*	*
<i>Favosites cervicornis</i> , Blainv.	*	*	*
— <i>dubia</i> , Blainv.	*	*	*

Species.	North Devon.	South Devon.	West Somerset.
<i>Favosites fibrosa</i> , Goldf.	*	*	
<i>Hallia Pengellyi</i> , M.-Edw.	*	*	
<i>Heliophyllum Hallii</i> , M.-Edw.	*	*	*
<i>Heliolites porosus</i> , Goldf.	*	*	
<i>Pachyphyllum Devonienne</i> ?, M.-Edw.	*	*	
<i>Endophyllum abditum</i> , M.-Edw.	*	*	*
<i>Alveolites suborbicularis</i> , Lam.	*	*	*
— (<i>Favosites</i>) <i>reticulatus</i> , Blainv.	*	*	*
<i>Phacops</i> (<i>Trimeroccephalus</i>) <i>lævis</i> , Münst.	*	*	
<i>Ceriopora similis</i> , Phill.	*	*	
<i>Fenestella antiqua</i> , Goldf.	*	*	*
— <i>arthritica</i> , Phill.	*	*	
<i>Retepora repisteria</i> , Goldf.	*	*	
<i>Athyris concentrica</i> , V. Buch.	*	*	
— <i>lachryma</i> , Sow.	*	*	
<i>Atrypa desquamata</i> , Sow.	*	*	
— <i>reticularis</i> , Linn.	*	*	
— <i>aspera</i> , Schloth.	*	*	
<i>Cyrtina heteroclyta</i> , Def.	*	*	
<i>Merista plebeia</i> , Sow.	*	*	
<i>Orthis arcuata</i> , Phill.	*	*	
— <i>granulosa</i> , Phill.	*	*	
— <i>striatula</i> , Schloth.	*	*	
<i>Rensseleria stringiceps</i> , Rœm.	*	*	
<i>Rhynchonella cuboides</i> , Sow.	*	*	
— <i>pleurodon</i> , Phill.	*	*	
— <i>pugnus</i> , Martin.	*	*	
— <i>reniformis</i> , Sow.	*	*	
<i>Spirifera curvata</i> , Schloth.	*	*	
— <i>disjunata</i> , Sow.	*	*	
— <i>lævicosta</i> , Valen.	*	*	
— <i>nuda</i> , Sow.	*	*	
— <i>speciosa</i> , Schloth.	*	*	
<i>Steptorhynchus crenistria</i> , Phill.	*	*	
<i>Strophomena rhomboidalis</i> , Wahl.	*	*	
<i>Acroculia vetusta</i> , Sow.	*	*	
<i>Euomphalus serpens</i> , Phill.	*	*	

5. *Species common to the Middle Devonians of North Devon, South Devon, and West Somerset.*—We will now examine those species that are common to the Middle or Eifelian beds of South and North Devon (Table VI.) so as to show their identity, and, by the community of species, to endeavour to establish still more the relations of the group and the value of its middle position in North Devon. It will be found that in South Devon the position of this series can only be clearly determined by palæontological research, and by no other. In other words, the stratigraphical sequence in that area is so obscure through disturbance, that palæontology alone can decide or guide us; whereas, in the north, the physical sequence is clear and unmistakable, and, aided by the assemblage, condition, and identity of the fossil fauna of its slates and sandstones with that of South Devon and Western Europe, we can, I believe, firmly establish the true zoological position of the rocks under examination. Know-

ing, then, that 235 species occur in South Devon (Table V.), we will adopt them as our standard for comparison with the northern species in the middle zone. We find, in all, that 50 species of the known 235 are common to the two areas (*vide* Table VI.), which are related by a marked and peculiar facies, one distinctly characteristic of, and identical with, the Middle Devonian, or Eifelian and Stringocephalenkalk, of the Rhenish provinces &c., which is especially borne out by the Brachiopoda and Cœlenterata: 21 species of the *former*, out of 67 in South Devon, are common to the Middle Devonian of it and the North; and 17 of these occur in European areas.

This close approximation in the number of identical species is most significant of their synchronous deposit; and similarity of conditions is evidenced by the structure of the rock-masses in all the areas. Comparison among the corals shows different results, so far as numbers are concerned. Of the 50 species known in South Devon 18 are also common to it and the North; and of these 18, seven are found in the Western European Devonians, *no species living on to the Carboniferous period*. The grand development of limestone in South Devon will fully account for the greater number of known species of corals over that of the northern area, added to its being also more extensively worked for economical purposes; and the rocks of the southern area have been more industriously searched and examined by many able geologists*; and now, under the patient research of a few good observers†, the northern slates and limestones are abundantly yielding species identical with those of the south. One bivalve only occurs common to the two, *Megalodon cucullatum*; two univalves, *Acroculia vetusta* and *Euomphalus serpens*; the sponge *Stromatopora concentrica*, and four Polyzoa, with *Phacops (Trimerocephalus) levis*, and *Tentaculites annulatus*, complete the 50 common or connecting species; 8 of these 50, chiefly Brachiopoda, recur in the Carboniferous series. Want of more complete evidence prevents our comparing the Middle Devonian of Cornwall with either area; but of the known species only 4 occur as common, viz. *Athyris concentrica*, *Atrypa desquamata*, *Spirifera speciosa*, and *Favosites cervicornis*. In Table IV. p. 640, is given the whole *Middle Devonian* fauna of North Devon and West Somerset, in which 71 species are shown to be distributed through that area; to these 71 I now adjust and compare those known to occur in the Rhenish, Belgian, and French areas, so as to correlate them, through their fossils, with our North-Devon types, and to show their intimate relation, connexion, and identity; for most of them are cognate species.

In Table V. it is shown that 34 species are common to North Devon and Europe, and that chiefly as before, through the two classes, Actinozoa and Brachiopoda, 10 species of corals and 16 species of Brachiopoda occurring in our own and one or other of the European Devonian areas, whereas only one Lamellibranch, *Megalodon cucul-*

* Mr. Godwin-Austen (Geol. Trans.), Phillips, Pengelly, Sedgwick & Murchison, Lee, Vicary, &c. &c.

† Mr. Valpy, Mr. Hall, Rev. W. Mules, the Rev. H. H. Winwood, &c.

latus, one Gasteropod, *Acroculia vetusta*, and two Polyzoa, *Fenestella antiqua* and *Retepora repisteria*, help to unite them: the species of the typical genera, *Cyrtina*, *Merista*, *Rensseleria*, *Stringocephalus*, &c., all characteristic of the slates of North Devon, are of themselves weighty and good evidence of pre-Carboniferous times.

It is, however, singular, and will show how little we yet know of the original conditions and distribution of life over even this one area, that at present we are acquainted with only 3 species that are common to the lower, middle, and upper groups in North Devon and West Somerset; these are the questionable *Fenestella antiqua*, the ubiquitous *Chonetes Hardrensis*, and *Streptorhynchus crenistria*. These long-lived species all pass the confines of the Upper Devonian, and are abundant in the lower beds of the Carboniferous group.

This imperfect record can only arise from the very incomplete search which the rocks of this area have undergone, and the little we therefore know of their palæontological contents. No agreement with the Carboniferous strata can be deduced from the presence of these three forms, as no real value can be attached to them; it simply shows that the individuals of the species were abundant, widely diffused, and long-lived. It also shows, in the absence of other evidence, that the assemblage of forms which constitute the population of a given area is peculiar and almost definite. In the present case, 16 species are known to occur in the Lower Devonian 53 in the Middle, and 104 in the Upper Devonian; and yet, out of these, only the 3 species before named are common to the three divisions, or pass through all three; and these lived on to the Carboniferous slates. This, be it remembered, is in North Devon; these three species necessarily ally the lower or Lynton group with the Barnstaple beds (Carboniferous*) to which they pass; but these are all: it would therefore appear that, palæontologically, there is no evidence to identify, or hardly to connect, the beds *above* the Upper Old Red Sandstone of Pickwell Down with the underlying Lynton slates and grits, similarity in lithological conditions being no proof of identity or of synchronous deposition.

6. *Agreement of Foreign Devonian Species with our British Middle and Upper Series in North and South Devon.*—We know that 144 species are common to the Devonian rocks of England and the Continent, as expressed in the general Table II., p. 616. Taking them at percentage value, we have an agreement of 38 per cent. as being common to the British and European areas; or, of 3 species which occur in our typical beds, 1 is found in the Rhenish, Belgian, and French taken collectively,—a far closer agreement than that which is recognized as existing between our Devonian and the Carboniferous, which, according to the analysis given in the Table, as is 1 to 7, or only $14\frac{1}{2}$ per cent. occurring as common to the two formations. This relation and identity of species in two chief areas, so widely separated as are the three Continental from the two British, is to my mind a most valid reason for their contemporaneity and simul-

* That is, admitting that the Barnstaple beds may be of Carboniferous age.

taneous deposition, which took place in one general sea, over one definite, once connected, but now disunited area.

Having compared the Devonian species generally amongst themselves, in their respective areas in North and South Devon, and with those of the Rhenish, Belgian, and French areas, and partly with the Carboniferous, it now remains for me to analyze the particular groups of organic remains amongst themselves, in our North Devon district, and also to compare the species in that area with those of Ireland and the Continent: in no other way can we arrive at the relation which I believe exists amongst the fossil remains, and at the value of the term "Devonian" or "the Devonian System."

I propose, therefore, to examine and compare the British Devonian Coelenterata, Brachiopoda, and Cephalopoda amongst themselves, these groups being of chief value,—also their relation to the continental species of the same age, and to the Carboniferous of Devon, Ireland, and Britain generally.

TABLE VII.—Comparison of the British Devonian Coelenterata with those of the Rhine, Belgium, and France.

	British.			Foreign.								
	Lower Devonian.	Middle Devonian.	Upper Devonian.	Rhine.			Belgium.			France.		
				L.	M.	U.	L.	M.	U.	L.	M.	U.
<i>Acervularia pentagona</i> , Goldf.	*	*	*				
— <i>Goldfussii</i> , <i>De Vern.</i>	*	*	...	*	*				
— <i>Roemeri</i> , <i>De Vern.</i>	*	*	...	*	*				
<i>Alveolites suborbicularis</i> , <i>Lam.</i>	*	*	*	...	*	*				
<i>Amplexus tortuosus</i> , <i>Phill.</i>	*	*	...	*	...						
<i>Cyathophyllum caespitosum</i> , <i>Goldf.</i>	*	*	...	*	*		
— <i>Boloniense</i> , <i>Blainv.</i>	*	*	*	
— <i>ceratites</i> , <i>Goldf.</i>	*	*	...	*	*	*	
— <i>helianthoides</i> , <i>Goldf.</i>	*	*	...	*	*	*	
— <i>hexagonum</i> , <i>Goldf.</i>	*	*	...	*	*	*	
— <i>Roemeri</i> , <i>M.-Edw.</i>	*	*	...	*	*	*	
— <i>turbinatum</i> ? <i>Goldf.</i>	*	*	...	*	*	*	
<i>Cystiphyllum vesiculosum</i> , <i>Goldf.</i>	*	*	...	*	*	*	
<i>Favosites Goldfussii</i> , <i>D' Orb.</i>	*	*	...	*	*	*	
— <i>cervicornis</i> , <i>Blainv.</i>	*	*	*	...	*	...	*	*	*	
— <i>dubia</i> , <i>Blainv.</i>	*	*	...	*	*	*	
— <i>fibrosa</i> ? <i>Goldf.</i>	*	*	*	...	*	*	*	
— <i>reticulata</i> , <i>Blainv.</i>	*	*	...	*	*	*	
<i>Fistulipora cribrosa</i> , <i>Goldf.</i>	*	...	*	...						
<i>Heliolites porosa</i> , <i>Goldf.</i>	*	*	...						
<i>Petrolia Celtica</i> , <i>Lonsd.</i>	*	*	*	...	*	...						
<i>Pleurodictyum problematicum</i> , <i>Goldf.</i>	*	*	...	*	*	...	*	*	*	

Coelenterata (Corals).—There are 24 genera and 51 species of Corals known in the Devonian rocks of North and South Devon (*vide* Tables II. and V.); and there appear to be 2 forms, *Fistulipora* (*Manon*) *cribrosa*, Goldf., and *Michelinia antiqua*, M'Coy, on the confines of the two

systems (Devonian and Carboniferous), which can hardly be regarded in our calculations, much doubt existing as to their position; regarding them, however, as strictly passage-species and common to either group, we have 49 species belonging to this horizon. None are *peculiar* to the Lower Devonian of either North or South Devon; whereas 35 species are *not* known out of the Middle, and four are *common* to Lower and Middle, viz. *Alveolites suborbicularis*, Lam., *Favosites cervicornis*, Blainv., *Petraia celtica*, Phill., and *Pleurodictyum problematicum*, Goldf.* When we compare this important group of fossils with their equivalents in the Rhenish provinces, Belgium, and France, we find that 22 out of the 51, or 43 per cent., are identical species with those found in the three areas on the Continent, 17 are Rhenish, 14 are Belgian, 11 are common to both areas, and 11 occur in the Boulonnais.

The accompanying Table (VII.) shows the distribution of those species only that are known to be common to Britain and Europe in either the Lower, Middle, or Upper division: 35 are absolutely confined to the Middle Devonian series of South Devon; and 22 of these occur in Europe; see Table II., p. 616, and Table V., p. 643; so that the relation of an area to the species that occupy it, the entity of the Middle Devonian Corals amongst themselves, with other equally definite physical conditions, palæontological affinities, and results, in all the areas, give a marked and peculiar character to the Middle Devonian group: 3 species only of the 22 (Table VII.) occur in the Upper Devonian beds of North Devon, as we should expect from the nature of the sea-bottom; and two of these belong to the *Turbinoïæ*, or simple forms, whose habits are different from those of the compound species; they are *Amplexus tortuosus*, Phill., and *Petraia Celtica*, Phill., the remaining species being the dubious *Fistulipora (Manon) cribrosa*, Goldf.; and no single species of the known 51 passes up to the Carboniferous system. It cannot, then, be asserted that we have no true Devonian Corals, or that there "are or were local coral-banks in the Carboniferous sea," when no single form is known common to the two horizons, either *here or in any known area*: such reasoning would not and could not apply either to the great assemblage of Corals and Crinoidea in the Upper Silurian, or to the Corals of the Carboniferous Limestone, where the surrounding relations are the same; they, like the species in the limestones and slates of the Middle Devonian series, were a group peculiar to themselves, and to the seas in which they lived, and as definitely determine it. This class, like the Brachiopoda, which will claim our next attention, occupies and typifies one physically united area, dying out or changing when the conditions favourable to their existence no longer continued; and the continuous or fringing barrier-like reef of slaty coral and limestones which extends *from what is now Ilfracombe and Combe Martin to the Quantock Hills, in West Somerset, and farther east still, under the Secondary rocks, ceased to exist as the area they then occupied deepened, or became depressed, thus giving origin to the grey fine-grained sedimentary non-fossiliferous slates of Lee, Rockham, Mortehoe, Lundy, Winsford, and the southern flanks of the Exmore,*

* Always occurring in the slates.

indeed to all that underlie the zone of Upper Old Red Sandstone to the south*. All research, as far as I know, has failed to detect a single organism in these upper slates of the middle group; and, save on the strike of the older or lower slates and limestones, which I doubt not continue on to Belgium and the Rhine, we neither know nor again find a single cognate species.

7. *Analysis of the British and Foreign Devonian Brachiopoda*.—It is difficult, amidst the conflicting opinions of distinguished naturalists in this country, Europe, and America, to definitely arrive at their conclusions as to the strict nomenclature of a large number of either genera or species in this important class of Mollusca; but no group has played so important a part in the history of the past as the Brachiopoda, and particularly in Palæozoic times. Generically and specifically they are of high value in determining the age of the rocks in which they occur, and notably so when we endeavour to trace the history and succession of the series forming the Devonian system, especially as regards the overlying Carboniferous system which at its base is intimately connected with the Devonian. We have no fear of confounding the Silurian with the Old Red Sandstone or Devonian; for, except through the fishes†, one doubtful coral, viz. *Favosites fibrosa*, one Annelide (*Tentaculites annulatus?*), one Brachiopod (*Atrypa reticularis*, and its var. *aspera*), one Lamellibranch (*Otenodonta?*), with perhaps *Orthoceras Ludense* and *O. ibex* among the Cephalopoda (8 forms in all), there was a complete break between the two, and it is thus quite clear that the 1150 known species of the Silurian fauna in the British area entirely disappeared or changed before any of the Marine Devonian species had existence. The accompanying Table (Table VIII.) will enable us to understand the distribution and relations of the class Brachiopoda through the three groups of the Devonian series, both in our own areas and those of the Rhine, Belgium, and France; and as our standard of comparison must be taken from the species occupying the British area, I adjust the groups amongst themselves, and compare the European species with them and ultimately with the Carboniferous. There are 99 known Devonian species (see Table II. p. 616). These species are distributed through 26 genera, many of which are peculiar to the Devonian age. 21 genera and 52 species of the 99 are common to British and Foreign Devonian rocks, and are found in one or other of the three divisions, or in the Lower, Middle, and Upper Devonian; 2 species only are common to, or occur in, all three divisions in our two areas, viz. *Athyris concentrica* and *Chonetes Hardrensis* (*C. sordida*). 47 of the 52 species enumerated in the Table are found in our Middle Devonian; and out of the total of 52 enumerated, 6 pass up to our Lower Carboniferous system, viz. *Chonetes Hardrensis?* (*C. sordida*), *Rhynchonella acuminata*, *R. pugnus*, *Productus scabriculus*, *Streptorhynchus crenistria*, and *Strophomena rhomboidalis*. This is in accordance with what we should expect in the conformable and succeeding system, where no stratigraphical break is known to exist; none, however, of

* The Pickwell-Down Sandstones.

† The fishes on the confines of the Silurian and Old Red being chiefly confined to the Passage series, 4 genera and 7 species occurring.

the peculiar and typical Devonian genera are known in the Carboniferous rocks, either in our own two areas or in the European; the prominent and characteristic species recognized everywhere, viz. *Calceola sandalina*, Linn., *Davidsonia Verneuli*, V. Buch, *Merista plebeia*, Sow., *Rensseleria stringiceps*, Rœm., *Retzia ferita*, V. Buch, *Stringocephalus Burtini*, DeFr., *Cyrtina Demarlii*, V. Buch, and *Uncites gryphus*, Schloth., characterize the British as well as the Foreign Middle Devonians; but species of other well-known genera mark equally well the unity of the middle group over Europe and in England. Amongst the many strictly Lower-Devonian forms prominently stand out *Leptaena laticosta*, Conrad, *Orthis hipparionyx*, Vanux., and *Spirifera cultrijugata*, Rœm., which with us are confined to the Lynton group in North Devon and the equivalent Looe beds in South, and appear confined to the same stage in Europe. Thus, then, of the 99 known British Devonian species, 52, or 50 per cent., are known to occur in Europe, and are therefore common to both the great areas; and both are related to a higher or succeeding system (the Carboniferous) by only the 6 species above enumerated; we must not, however, fail to again notice the above 8 remarkable genera with their known single representatives, which so distinguish the Middle Devonian group.

It is now equally necessary to analyze and examine the British species of Devonian Brachiopoda with those of the Carboniferous, so far as they are known to be common to each other, and in each of the three Devonian groups separately, because it is asserted by Mr. Jukes that the rock-masses which are believed and acknowledged to be of Lower, Middle, and Upper Devonian age in North Devon, at Lynton, Ilfracombe, and Baggy &c. are, by community of fossils and by stratigraphical and physical relations, "part of the same group of rocks as those called Carboniferous Slates in Ireland;" and, more than this, it is asserted that the particular and so-called Upper Devonian series of Baggy and Marwood are "on the same general horizon with those of the Lower Devonian slates and grits of Lynton," &c. &c. These views are based on the similarity of the slaty and other rock-masses, in both these North Devonian areas, and by comparison of them with that area of the South of Ireland containing Carboniferous Slates and certain fossils.

I have endeavoured to prove that neither fault nor anticlinal exists in North Devon of a nature or magnitude to invert the order of, or to repeat, the beds of the two areas from south to north, and I will now endeavour to show through the Brachiopoda, as I have done through the Cœlenterata, that there are valid grounds for not receiving either the physical or the palæontological interpretation put upon them by Prof. Jukes; and these will be appealed to by a more complete analysis of all the known Devonian and Carboniferous fossils occurring in the Northern or disputed area.

TABLE VIII.—*Comparison between the British and Foreign Devonian Brachiopoda, showing also their range to the Carboniferous.*

Species.	British.			Foreign.									Carboniferous.	
	Lower.	Middle.	Upper.	Rhine.			Belgium.			France.				
				Lower.	Middle.	Upper.	Lower.	Middle.	Upper.	Lower.	Middle.	Upper.		
<i>Athyris concentrica</i> , <i>V. Buch</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>lachryna</i> ? <i>Sow.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>phalæna</i> , <i>Phill.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Atrypa flabellata</i> , <i>Goldf.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>lens</i> , <i>Phill.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>lepidæa</i> , <i>Goldf.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>reticularis</i> , <i>Linn.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>aspera</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Calceola sandalina</i> , <i>Linn.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Camarophoria rhomboidea</i> , <i>Phill.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Chonetes minuta</i> , <i>Goldf.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>sordida</i> , <i>Sow.</i> (<i>C. Hardrensis</i> , <i>Phill.</i>)	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Cyrtina Demarllii</i> , <i>V. Buch</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>heteroclyta</i> , <i>Def.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Davidsonia Verneuilii</i> , <i>V. Buch</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Leptæna interstitialis</i> , <i>Phill.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>laticosta</i> , <i>Conrad</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>nobilis</i> , <i>M. Coy.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Merista plebeia</i> , <i>Sow.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Orthis hipparionyx</i> , <i>Vanux.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>striatula</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Pentamerus brevirostris</i> , <i>Phill.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Productus subaculeatus</i> , <i>Murch.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>scabriculus</i> , <i>Mart.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Rensseleria stringiceps</i> , <i>Ræmer</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Rhynchonella acuminata</i> , <i>Mart.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>cuboides</i> , <i>Sow.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>primipilaris</i> , <i>V. Buch</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>pugnus</i> , <i>Martin</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Retzia ferrita</i> , <i>V. Buch</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Spirifera canalifera</i> , <i>Valen.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>comprimata</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>curvata</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>cultrijugata</i> , <i>Ræmer</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>disjuncta</i> , <i>Sow.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>hysterica</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>laevicosta</i> , <i>Valen.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>lineata</i> , <i>Mart.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>simplex</i> , <i>Phill.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>speciosa</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>subcuspidata</i> , <i>Schnur</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>undifera</i> , <i>Ræm.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>undulata</i> , <i>Ræm.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Stringocephalus Burtini</i> , <i>Defr.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Streptorhynchus crenistria</i> , <i>Phill.</i>	?	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>umbraculum</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Strophalosia fragaria</i> , <i>Sow.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>productoides</i> , <i>Murch.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Strophomena rhomboidalis</i> , <i>Wahl.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Terebratula sacculus</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
— <i>Newtonensis</i> , <i>David</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*
<i>Uncites gryphus</i> , <i>Schloth.</i>	*	*	*	...	*	*	...	*	*	...	*	*	*	*

8. *Devonian and Carboniferous Brachiopoda*.—It has been before stated that 99 species of this class are in the Devonian rocks of Britain. Table II. shows every species in North Devon, arranged in the order of time or succession. Those species occurring in South Devon and Cornwall are compared with them; in other words, every species in North Devon is collated with the same in Cornwall and South Devon. Of the 99 known forms, we have, then, in the Northern area 52 common; and of 26 genera known in British Devonian rocks 22 occur in North Devon, 5 only, viz. *Camarophoria*, *Davidsonia*, *Leptæna*, *Pentamerus*, and *Retzia*, being required to complete the generic equivalence of the two areas. This Table also shows that 27 of the 48 North-Devon species also occur in the foreign Continental rocks, and that 13 are common to the Carboniferous above; but these are related chiefly, as will be seen, through the passage-series (*vide* Table VIII. p. 658, and Table IX. p. 669).

We will now see how far the species occurring in the Lower Devonian (Lowest or Lynton) beds agree with those of the Upper and of the Carboniferous south of Pickwell Down at Baggy, Marwood, Sloly, and Pilton—the two groups of rocks which Mr. Jukes states are on the same geological and palæontological horizons, and that both are the “Carboniferous Slates” of Ireland. In this comparison I neglect all but the Brachiopoda. The mass of species in other classes and orders will be compared hereafter in their proper place. The species occurring in the Lynton Slates are the following:—

<i>Lynton.</i>	<i>South of Pickwell.</i>
<i>Athyris concentrica</i> , <i>V. Buch.</i>	<i>Chonetes Hardrensis</i> , <i>Phill.</i>
<i>Chonetes sordida</i> , <i>Sow.</i> (<i>vel C. Hardrensis?</i> , <i>Phill.</i>).	
<i>Spirifera canalifera</i> , <i>Valen.</i>	
— <i>hysterica</i> , <i>Schloth.</i>	
— <i>lævicosta</i> , <i>Valen.</i>	
<i>Orthis granulosa</i> , <i>Phill.</i>	
— <i>arcuata</i> , <i>Phill.</i>	
<i>Streptorhynchus umbraculum</i> , <i>Schloth.</i>	

The only species, therefore, believed to be common is the *Chonetes Hardrensis*; and there is much doubt still as to the Lynton, *C. (Lep.) sordida*, *Sow.*, being the Upper Devonian and Carboniferous *Chonetes Hardrensis* of Phillips. It is, however, *retained*. Should they on closer research prove to be distinct, we then have *no species* in this or any class common to the Lower Devonian slates of the Lynton area and the Upper Devonian, or to the Carboniferous Slates, or to the Lower Limestone shales, anywhere. Casts of *Crinoidea* cannot be received as of specific value; and the dubious *Fenestella antiqua*, said to be in every bed, has yet to be understood. However much, then, at a *casual glance*, the slates and grits of Lynton may be said to physically resemble the beds of Baggy, Marwood, Croyde, Brainton, and Pilton &c., on close inspection and zoological analysis, they bear scarceiy any resemblance. The physical conditions, structure, arrangement, and cleavage of the Lynton Slate group generally, altogether differ from the associated slates, brown sandy grits, and limestones in the Baggy and Croyde area—to say

nothing of what I believe to be the case, that hardly a single species will ever be found common to the two areas. The very band of Upper Old Red Sandstone which stretches (in place) across North Devon from Pickwell Down (Morte Bay) to Wiveliscombe and the Quantock Hills constitutes a natural base-line to the Upper Devonian rocks and species. The physical changes that accompanied and produced that great accumulation of red sandstone also seem to have modified the forms of life that succeeded it, now enabling us to draw both a physical and palæontological boundary-line between the well-marked Ilfracombe or Middle Devonian group below, and the Upper, or Baggy and Marwood, group above; and, more important still, the species comprising the Petherwin fauna to the south of the Culm-trough, which are older in time than those of the Baggy and Marwood beds, have to be interpolated and accounted for, although at present not yet recognized below the Baggy series on the north side of the Culm series. To still carry on our analysis as to the value of the Brachiopoda, and the relationship between the admitted Lower and Middle Devonian rocks of this area and the supposed Carboniferous Slates south of Vention and Morte Bay, we must state the evidence collected and given in Tables IX. and X. It is there seen that, of the 48 species of this class distributed through the Lower, Middle, and Upper Devonian slates and limestones, only 13 species of the whole are common to the two formations, namely the 9 following:—

<i>Athyris oblonga</i> , Sow.	<i>Rhynchonella reniformis</i> , Sow.
<i>Discina nitida</i> , Phill.	<i>Spirifera Urei</i> , Fleming.
<i>Lingula squamiformis</i> , Phill.	<i>Spiriferina insculpta</i> , Phill.
<i>Productus scabriculus</i> , Martin.	<i>Terebratulina sacculus</i> , Mart.
<i>Rhynchonella acuminata</i> , Martin.	

all of which are Upper-Devonian and Carboniferous forms, and not known in older beds north of the Pickwell or Morte-Bay Old Red Sandstones; and the remaining 4,

<i>Rhynchonella pleurodon</i> .	<i>Streptorhynchus crenistria</i> .
— <i>pugnus</i> .	<i>Strophomena rhomboidalis</i> .

are common to the Middle and Upper Devonian and Carboniferous rocks of North Devon; but if the remaining form, *Chonetes sordida*, Sow., of the Lower or Lynton Group, and the *Chonetes Hardrensis*, Phill., be one species, then we have only one shell that passes through the whole of the rocks of North Devon, or only one species connecting the Upper Devonian slates of Baggy and Marwood, &c. &c., with those of the Lower at Lynton and the Middle at Ilfracombe. The 9 Upper-Devonian forms before named have ever been regarded as passage-species, and subject to the caprice and views of those who would (all other evidence wanting) place them either at the base of the Carboniferous, or at the top of the Upper Devonian, although careful examination into their specific value would determine them (at least 3 of the 9) as having far greater affinity with Devonian types, and but a slight range into the Carboniferous series. The paucity of species, in all the other zoological groups that exist in common in the Devonian and Carboniferous,

is known and recognized by all palæontologists, this doubtless arising from the littoral and sublittoral habits of the Invertebrata, and their migration or change under different bathymetrical and other physical conditions as regards land and water. North and South Cornwall possess 22 species in common with the Middle and Upper Devonian of North Devon. They are placed in their respective positions in Table II. pp. 616–634, so as to complete the evidence; and it is only in the Upper Devonian beds of Petherwin, Tintagel, &c. that the species approach and have passage affinities; they are generally true Upper-Devonian forms, and have been well determined. It will also be seen that of the 27 species found in the Ilfracombe group only 4 are common to it and the beds south of Morte Bay as well as to the “Carboniferous slates.” These are stated above, and need no further comment.

I will embody in one Table (IX., p. 669 *et seqq.*) all the known species in the Lower, Middle, and Upper Devonian series of North Devon, and include also the Upper Devonian species of Petherwin in a separate column, and indicate those that pass up and occur in the passage-beds between the Devonian and Carboniferous of the same area, admitting that the Barnstaple beds, and all south of them to the latitude of Venn and Swinbridge &c., belong to the Carboniferous group, as determined by Sir R. Murchison and Prof. Sedgwick in the year 1836*. With these Devonian species I have collated those recognized as belonging to the Carboniferous Slate of Ireland and the Coomhola Grits which are associated with them, in other words recurrent forms†. This Table will go far to show us, if it does not prove, that these so-called Coomhola species of Ireland are chiefly, if not entirely, derived from the typical Upper-Devonian fauna—from that group which so conspicuously and conformably rests (in North Devon at least) upon the unfossiliferous Upper Old Red Sandstone of Morte Bay.

The assertion of Prof. Jukes, in his “Notes for a Comparison” &c.‡, that all the species occurring in the rocks above the Vention Old Red Sandstone are those of the Carboniferous Slate, with those of the Coomhola Grits in the lower parts, is based upon the fact that the Irish species are compared with those of North Devon, and referred to them as the types. The 97 species named in his “Fossils of the Carboniferous Slate,” page 22§, and referred to 8 localities (p. 17) in North Devon, and one locality (Petherwin) in North Cornwall are, without exception, well-known and recognized Devonian species, no one form occurring in the so-called Coomhola Grits or Carboniferous Slate of the typical Irish area. In this list there are 84 species catalogued as *belonging to* rocks of this age; yet not one occurs either in these lower members of the Carboniferous group, or in the Carboniferous Limestone of any area: it is simply

* These beds were called “Greywacke” by most writers up to the time of De la Beche, who also retained the title in his ‘Report on the Geology of Cornwall,’ &c.

† In the column headed “Carboniferous generally.”

‡ “Notes for a Comparison between the Rocks of the South-west of Ireland and those of North Devon and of Rhenish Prussia,” &c., Journ. Roy. Geol. Soc. Ireland, 1865.

§ *Ibid.*

an assertion, arising from or through similarity, not identity, in rock-masses, without any physical or palæontological proof whatever. When it is *proved, determined and admitted* that all the slates, grits, and limestones to the south of, and that rest upon, the Upper Old Red Sandstone of Pickwell Down, are of Carboniferous age, and not Upper Devonian, *then these 84 species may* occupy the place assigned to them, or be classed with the Irish Carboniferous Slates and their associated Grits. I have, however, good evidence to the contrary, and will not go to found either the two areas (North Devon and South Ireland) or the species occupying them*.

Whatever views may be entertained relative to the contemporaneity of the Carboniferous Slate, either with the Carboniferous Limestone or the Upper Devonian, it is quite evident that in the North Devon area the succession of the strata and of the groups of associated fossils is continuous and natural—being, in fact, one great physical and zoological group. It is only south of the Baggy, Marwood, and Croyde zones, in the order of succession, that we see anything approaching the physical and zoological conditions of the Carboniferous series. The assertion that these beds *are* Carboniferous Slate with Coomhola Grits, is not borne out by the lists of fossils intended to convey that impression in Professor Jukes's paper†; the Baggy and Croyde series conformably overlies the upper red sandstone of Venton, which constitutes the natural base to the Upper Devonian of North Devon, these being still succeeded at Barnstaple &c. by the Lower Carboniferous beds, which are of great thickness before they reach the Culm-measures to the south.

I have clearly shown in these Tables the relations that the Upper Devonian fossils of Baggy, Marwood, Sloly &c., have to the Carboniferous in this and other areas; and Mr. Jukes's list, *when divested of* the 84 species from the Upper Devonian of Petherwin and the above-named places, tells the same facts.

VI. STRATIGRAPHICAL VALUE OF THE SPECIES COMPRISING THE DEVONIAN FAUNA.

No one disputes either the intermediate position of the rock-masses comprising the so-called Devonian system, or that, accompanying them, there is also a fauna composed of genera and species at present not known either below, in the Silurian system, or above, to a very large extent, in the Carboniferous.

I propose to briefly discuss the evidence and value of this fauna, which will aid us in affixing a value to the whole system, and also enable us to distinguish it from the Carboniferous, which, although allied to, and containing many species (54) in common with the Devonian, is yet a totally distinct group; it is chiefly through its upper division, and at the close or passage into the Carboniferous, that the relation exists, which we should expect.

* Consult Table X. p. 674.

† Notes for a comparison between the rocks of the south-west of Ireland and those of North Devon and of Rhenish Prussia (Journ. Roy. Geol. Soc. Ireland, 1865).

It is well known that in the Continental areas where the Devonian system is well developed, and also in Britain, certain and peculiar genera occur which are represented by a limited number of species; yet the fauna of the Devonian period, so far as at present known, when compared with those of the two periods (the Silurian and Carboniferous), is comparatively poor*.

We may assume that eleven classes are represented in the fauna of the Devonian system, viz. the Amorphozoa, Cœlenterata, Echinodermata, Crustacea, Polyzoa, Brachiopoda, Lamellibranchiata, Nucleobranchiata, Gasteropoda, Cephalopoda, and Pisces,—the last but sparingly (as far as we know), but still of considerable importance as bearing upon the question of the synchronism of occurrence of certain forms of life in deposits believed to be of equal value, or equivalent in time, though accumulated under different conditions and in different areas. We know that 9 of the 11 classes do not occur in the true Old Red Sandstone, none of the marine Devonian Mollusca, Cœlenterata, and Echinodermata having any representative in the Scotch, Welsh, or English areas occupied by that group of rocks; but evidence of late tends to connect these two disconnected yet contemporaneous deposits through the group of Fishes, so that chronologically the difficulty of correlating them is partly overcome; for the Middle and Upper Old Red Sandstone of Russia contains a marine Molluscan fauna associated with the Fish; Scotland contains the same Fish, but no intermixture of associated and marine Invertebrata. This fact clearly identifies the Middle and Upper Old Red Sandstone of the northern or Scotch area with the slates and calcareous series of the Eifel, and with the Devonshire Devonians†; and now we have in South and North Devon conclusive evidence of the same fact, from the occurrence of *Phyllolepis concentricus* and Ichthyodorulites of *Onchi* in the Lower Devonian Slates of Looe Island in South Devon, and *Holoptychius* in the Lower and Upper Devonians.

No value is attached to the occurrence of many species of Fish that occur in common at the top of the Upper Silurian series and in the lower beds of the Old Red Sandstone; they are locally connecting species, in the passage-beds, and do not occur higher; and the want of absolute chronological and palæontological identity between the Lower Old Red Sandstone and Lower Devonian prevents our true correlation of the two series. *Auchenaspis Salteri*, *Cephalaspis Murchisoni*, *C. ornatus*, *Onchus Murchisoni*, *O. tenuistriatus*, *Plectrodus mirabilis*, *P. pleiopristis*, *Pteraspis Banksii*, and *P. truncatus* are all Upper-Silurian species, four of which, *A. Salteri*, *C. Murchisoni*, *C. ornatus*, and *Pteraspis Banksii*, are common to the Upper Silurian and Old Red Sandstone‡. The remaining 108 species of Fish are distributed through the Lower, Middle and Upper Scotch Old

* *Vide* numerical or census-table of the number of genera and species in the Silurian, Old Red Sandstone, Devonian, and Carboniferous strata, p. 615.

† Siluria, 3rd edit. pp. 382 &c.

‡ For much valuable information and tabular results see Pengelly, Brit. Assoc. Report, 1860, Oxford Meeting. Also Pengelly "On the Devonian Age of

Red Sandstone, three only being known in the Marine Devonian, viz. *Phyllolepis concentricus*, *Onchus*, and *Holoptychius* (vide Table II. p. 630–634, for distribution of all the species through the Old Red series).

1. *Amorphozoa*.—Four genera and nine species of this class occur in, and are here noticed as being peculiar to, the Lower and Middle Devonian rocks of Cornwall and South Devon; one species only, *Stromatopora concentrica*, Goldf., is known in North Devon and West Somerset. They likewise occur in the Rhenish beds of the same age. The singular and typical *Sphærospongia* (*Sphæronites*) *tessellata*, Phill., is strictly British, and at present is known only in, and confined to, the limestones of the Middle series at Launceston and Woolborough in South Devon. The abundance of *Steganodictyum* in the Lower Devonian slates of Polperro, Fowey and Looe, indeed all along the South Devon and South Cornish coast, from Mudstone bay to Brixham and Fowey, as well as on the north coast of Cornwall at Bedruthen, testifies to the widely spread distribution of this hitherto peculiar British species; and, confined, as it is, to the Lower division of the Devonian slates, careful search will, I believe, reveal one or both of the species in the Lynton area. No *Amorphozoa* are known either in the Upper Devonian rocks of any area, or in the Carboniferous group, unless we accept the doubtful genus *Tragos*, which is peculiar to the Carboniferous Limestone, and which may belong to this class. These nine Lower (and one Middle) Devonian *Amorphozoa*, amongst other fossils, must therefore be considered evidence of much value when associated with higher forms which are also strictly Devonian types.

2. *Coelenterata*.—The greatest significance must be attached to this class, when treating of the stratigraphical value of the Devonian fossils. They stand alone, and, side by side with certain genera of the Brachiopoda, serve especially to distinguish and characterize the Middle Devonian series. No less than 24 genera are known to occur in this Middle division alone, of which the following 15 are confined to it, viz. *Acervularia*, *Arachnophyllum*, *Battersbyia*, *Campophyllum*, *Chonophyllum*, *Emmonsia*, *Endophyllum*, *Hallia*, *Heliophyllum*, *Metriophyllum*, *Pachyphyllum*, *Pleurodictyum*, *Smithia*, *Spongiophyllum*, and *Strephodes*. These known 24 genera embrace 53 species, 52 of which are strictly Devonian, 45 being confined to and characterizing the Middle group alone (see Tables II. and V. for distribution). Analysis and comparison of the British species with those of the three European areas reveal and give the same results.

Table VIII. has been constructed to show the remarkable distribution of, and zoological agreement between, the British and Foreign species in space, and their distribution in time also.

We find that 10 genera and 22 species are identical and common to the four areas, and also to the received stratigraphical groupings

the World," the substance of six lectures delivered at the Royal Institution, 1861, Geologist, vol. iv. p. 332, 1861; and Pengelly "On the Geological and Chronological Distribution of the Devonian Fossils of Devon and Cornwall," Geologist, vol. v. p. 10, 1862,

in these four areas*. Four species of one genus are known also in the Russian Devonians, viz. the widely distributed and characteristic *Favosites Goldfussii*, *F. reticulata*, *F. fibrosa*, and *F. cervicornis* (*polymorpha*).

It is needless attempting any comparison of the British Devonian corals with the Carboniferous; for they stand alone, one species only, *Michelinia antiqua*, M'Coy, with much doubt being referred as common to the Upper Devonian series of North Devon and the Carboniferous beds of Hook &c. in the South of Ireland.

Comparisons made amongst the Devonian Cœlenterata (Tables II., V., & VII.) reveal to us the importance that must be attached to the intermediate grouping and stratigraphical place of the South and North Middle Devonian limestones and slates, the limestones of both areas yielding, as in all others, the chief mass of the species; but *Petraia celtica*, *P. gigas*, *P. pleuriradialis*, and *Pleurorodictyum problematicum* are abundant in the slates, and *Favosites cervicornis* is common to both, in North and South Devon.

The relation of the two allied and connected regions is shown from the fact that they contain 10 genera and 18 species of corals in common, an agreement singularly close to that borne by the three European areas to our own, where the same number of genera occur, and 22 species (see Tab. V.). This coincidence may not have any great value in itself, but it tends to show the persistency and distribution of species through a given time, and over a definite area. No species is known to be common to the Lower, Middle, and Upper series, and only one to the Lower and Middle, viz. *Favosites cervicornis*. No attempt need be made to individualize special genera or species, as the Devonian corals as a group are peculiar to the beds in which they occur, and distinctly mark the intermediate character of the Devonian series, as well as, being a zoological group, distinctly characterizing the Middle Devonian series, to which they are confined.

3. *Crustacea*.—This class, as a whole, is but feebly represented in the marine Devonian group, two orders only being known, viz. the Ostracoda and Trilobita. Our present means of comparison between the Old Red Sandstone proper and its believed equivalents, the Lower, Middle, and Upper Devonian of Cornwall and Devon, both on physical and palæontological grounds, do not enable us to affirm positively that they are identical; but it is not a little singular that two such opposite classes in the animal kingdom as the Crustacea and Fish should be so largely represented at the close of the Silurian and commencement of the Old Red Sandstone period, the former through the suborder Eurypterida (order Merostomata); the latter through the Ganoid and Placoid Fishes, both of which, and the species in which, equally represent the close of one period and the commencement of the other, the one (Merostomata) not again appearing in the Devonian rocks of any area, whilst the Fishes are only sparingly represented in the Middle Devonian of Livonia, in Russia, of the Eifel, in Rhenish Prussia, of Looe, in

* Devonshire, Rhenish provinces, Belgium, and France.

Cornwall, and of Baggy, in Devonshire. As before stated, we have no means of establishing any real comparison between the 43 genera and 113 species of Fish that are known to be in the true Lower, Middle, and Upper Old Red Sandstone of Scotland, England, and Wales &c.

The typical Upper Devonian beds of Petherwin yield *Cypridina serratostrata*, the only form of bivalve Crustacean (Ostracoda) known in the Marine Devonian beds. It is the Rhenish species, and occupies the same position in our English Upper Devonian of North Cornwall as in Nassau, Thuringia, and Franconia; its abundance and persistency, accompanied also by the genus *Clymenia*, affords a parallelism which cannot be overlooked, other conditions also coinciding.

The Trilobita, as contrasted with the Silurian species, afford no comparison; they, like the Corals, are a group of genera and species peculiar to the Devonian rocks which contain them. No genus or species occurs common to the Carboniferous and Devonian rocks. It should be noticed also that although the 6 genera, viz. *Bronteus*, *Cheirurus*, *Harpes*, *Homalonotus*, *Phacops*, and *Trimeroccephalus* are Silurian, yet their 11 species are all peculiar to Devonian strata; and although *Phacops granulatus*, *P. laciniatus*, and *P. latifrons* occur in the uppermost Devonian beds, they have, nevertheless, never been found in the Carboniferous series, unless it be admitted that the Barnstaple beds are positively of that age, and *P. latifrons* occurs in them. This affinity with the Silurian series through the Trilobites adds one other element to strengthen the view that difference of province, migration to new areas, nature of sea-bottom &c., or the remnant of an older and almost extinct fauna might have existed during the series of changes which took place, even over so small a geographical area as that occupied by the Silurian and succeeding Devonian seas, at, or contemporaneous with, the close of the Silurian period and the commencement of the Devonian. These genera and species of Trilobites died out at the close of the Devonian period, and were replaced by one family only (the Proctidæ), possessing three new generic types, which characterize the Carboniferous rocks, viz. *Phillipsia*, *Griffithides*, and *Brachymetopus*, which contain 15 known species; so that neither families, genera, nor species of this group passed from the Devonian to the Carboniferous sea*. The remaining seven genera in the orders Merostomata or Pœcillopoda, and their nineteen species, found in the Old Red Sandstone have no significance in our present inquiry and examination, arising from want of comparison and our not yet being able to satisfactorily correlate the group of the marine Devonians with the received divisions of the Old Red Sandstone.

4. *Cephalopoda*.—Comparisons amongst the chief Devonian genera and species themselves, or between them and those of the formations above or below them, would not be complete

* The distribution of this order, both stratigraphically and chronologically, is the same through and over the three European areas, the same results being observed in the Rhenish, Eifélien, and Boulonnais rocks.

without some notice of the class Cephalopoda, which, as a group, occupies a very prominent place in the fauna of the Devonian period, and one of marked significance. Five well-defined genera, all belonging to the order Tetrabranchiata, occur in the British Devonian rocks. Two of these, *Clymenia* and *Cyrtoceras*, have no such distinctive zoological parallel in any other British formation: they would appear to have constituted two colonies of very restricted range, both in time and space; and this remark applies to either genus at the time of its culmination, the one (*Cyrtoceras*) in the Middle Devonian of the South Devon area, at Newton &c., the other (*Clymenia*) in the Upper Devonian of North Cornwall, at Petherwin, Landlake, &c. Whether the upper portion of the Newton deposit, through synchrony or homotaxis, or both, be regarded as equivalent to that of Petherwin or not*, two more distinct zoological groups do not exist in any known area of the British islands. The species of the genus *Cyrtoceras* are, with one exception (*C. rusticum*), confined to the Middle Devonian series of Newton Bushel, where twelve species are known to occur, three of them (*C. nodosum*, *C. ornatum*, and *C. tridecimale*) being also found in the Rhenish and Eifel beds of the same age. No form is known in the Upper Devonian in any area; and only two, totally distinct, species occur in the Carboniferous Limestone of Ireland, Derbyshire, and Belgium, viz. *C. Gesneri*, Martin, and *C. Verneuillianum*, Koninck. The distribution of the genus *Clymenia*, which contains ten species, is yet more remarkable and definite as bearing upon that of the Devonian fauna in our own area, and clearly also identifies it with the true Upper Devonian (*Clymenia*-limestone and *Goniatite* limestone and shale) of the Rhenish provinces. Ten species colonize this one area, and appear to have been confined to it in Britain; but through *C. lævigata* and *C. striata* being found in the Eifel, and *C. undulata* in the French Devonian beds, we are enabled, aided by other characteristic fossils, to associate the Upper Devonian series of Petherwin with deposits of the same age on the continent.

These two colonies of Cephalopoda, singularly distinguished by two genera of the same order and numerous species in each, and occupying two geographical areas, may yet have been contemporaneous, and their remains synchronously deposited. Their zoological associations, however, are notably different, and would point to different conditions, dependent perhaps more upon *province or station* than time. The genus *Cyrtoceras*, with its thirteen species, is associated with a numerous assemblage of corals and Brachiopoda in the Middle Devonian of Newton Bushel; whereas the eleven species of *Clymenia* and three species of *Goniatites*, with one *Nautilus*, occupy a marked position in the true Upper Devonian slates and limestones of Petherwin and Landlake, not one of these species occurring in any higher beds; and of the whole 243 known species comprising the Middle Devonian fauna of South Devon, twenty-eight are common to it and the Petherwin beds; these added to the twenty-seven

* Mr. Salter believes, and with good reason, that the uppermost part of the Newton beds are of the same age as the Petherwin series of North Cornwall.

peculiar species of *Clymenia* and *Goniatites* (55 in all) constitute an assemblage of organic remains not known in the Carboniferous series anywhere.

5. *Brachiopoda*.—We cannot pass over this important class of Mollusca, which plays so important a part in the fauna of the marine Devonian rocks; and although in this group there is more community with the fossils of the Carboniferous series than any other, still it will be shown that it is chiefly through the Upper Devonian and passage-beds that the affinity exists. I restrict the term “Upper Devonian” to those beds that repose upon the highest member of the Upper Old Red Sandstone at Vention, George Ham, Marwood, High Bray, Dulverton, and Wiveliscombe—in other words, to that latitude occupied by the uppermost beds of the non-fossiliferous red sandstone that stretch from Morte Bay to Wiveliscombe. The labours of Mr. Davidson *, in his elaborate monographs upon the Devonian and Carboniferous Brachiopoda, have now determined and fixed the specific nomenclature of this class with such precision that we are enabled, through his valuable researches, to correctly estimate their numerical and specific values, as well as to collate them with the continental Devonian species. We find that twenty-five genera and ninety-nine species are known in the British Devonian rocks, and that thirteen of these are common to them and the Carboniferous in Britain or Ireland. Seven of these thirteen do not occur below the Upper Devonian—viz. *Athyris oblonga*, *Discina nitida*, *Lingula squamiformis*, *Productus scabriculus*, *Rhynchonella acuminata*, *Spirifera Urei*, and *Terebratula sacculus*; whereas the remaining 6 species, *Rhynchonella pleurodon*, *R. pugnus*, *R. reniformis*, *Spiriferina insculpta*, *Streptorhynchus crenistria*, *Strophomena rhomboidalis*, and *Terebratula sacculus* are common to both the Middle Devonian and Carboniferous, one species only, the doubtful *Chonetes Hardrensis*, being common to the Lower, Upper, and Carboniferous. The remaining eighty-six species are therefore strictly Devonian forms. (*Vide* Table II. p. 616.) Considerable weight must be attached to those genera which here as well as in continental Europe are not known above the Middle group, and equally characterize it both in our own two areas (viz. North and South Devon) and in those of the continent. The following eight genera and nine species are here given to show their value and relation:—

<i>Calceola sandalina</i> †.	<i>Rensseleria stringiceps</i> .
<i>Davidsonia Verneuilii</i> .	<i>Retzia ferrita</i> .
<i>Merista plebeia</i> .	<i>Stringocephalus Burtini</i> .
<i>Pentamerus biplicatus</i> .	<i>Uncites gryphus</i> .
„ <i>brevirostris</i> .	

Of the *ninety-nine* British species, *fifty-two* are represented in either the Rhenish, Belgian, or French areas, only six of which are known in, or are common to, the Carboniferous rocks. In Table VIII. p. 658, is shown the relation of our Devonian species to those of the three areas

* Monog. Brit. Dev. Brachiopoda, Pal. Soc. 1864–66.

† This form has not yet been satisfactorily determined in North Devon.

above mentioned, in which it is seen that 52 (*or more than 50 per cent.*) are common to the British and European Devonian rocks. Again, if we admit that the Barnstaple beds are of Carboniferous age, and take the whole of the North-Devon Brachiopoda, or compare those of the same area together (*i.e.* the north and south side of the supposed fault) and with those of *any* Carboniferous locality, the result is, that of the 48 species known in the North Devon Devonian series, thirteen are also Carboniferous, all of which are in the Upper division south of, or above, the red Pickwell sandstones, 5 occurring in the Middle division ranging north of Pickwell, and one (*Chonetes Hardrensis* or *C. sordida*) in the Lower or Lynton group; in fact, the relations and affinities of nearly the whole of the Devonian fossil fauna are through those species that comprise the Upper Devonian group south of and upon the Upper Old Red Sandstone of the line above mentioned. (See Tables VIII., IX., and X.)

TABLE IX.—*Species occurring in the Lower, Middle, and Upper Devonian Series of North Devon and Petherwin (in North Cornwall), showing those species that pass into the Carboniferous in any area.*

Species.	North Devon.			Petherwin.	Carboniferous generally.
	Lower Devonian.	Middle Devonian.	Upper Devonian.	Upper Devonian.	
<i>Knorria dichotoma</i> , <i>Houghton</i>			*	*
<i>Adiantites Hibernicus</i> , <i>Forbes</i>			*	*
<i>Bornia</i> (<i>Knorria</i>) <i>transitionis</i> , <i>Göpp.</i>			*		
<i>Stromatopora concentrica</i> , <i>Goldf.</i>		*			
<i>Alveolites suborbicularis</i> , <i>Lam.</i>	*				
<i>Amplexus tortuosus</i> , <i>Phill.</i>		*		*	
<i>Cyathophyllum aequiseptum</i> , <i>M.-Edw.</i>		*			
— <i>Boloniense</i> , <i>Blainv.</i>		*			
— <i>cæspitosum</i> , <i>Goldf.</i>		*		*	
— <i>helianthoides</i> , <i>Goldf.</i>		*			
— <i>obtusum</i> , <i>M.-Edw.</i>		*			
<i>Cystiphyllum vesiculosum</i> , <i>Goldf.</i>		*			
<i>Favosites cervicornis</i> , <i>Blainv.</i>	*	*			
— <i>dubia</i> , <i>Blainv.</i>		*			
— <i>fibrosa</i> ?, <i>Goldf.</i>		*			
<i>Fistulipora cribrifera</i> , <i>Goldf.</i>			*		
<i>Hallia Pengellii</i> , <i>M.-Edw.</i>		*			
<i>Heliolites porosus</i> , <i>Goldf.</i>		*			
<i>Heliophyllum Hallii</i> , <i>M.-Edw.</i>		*			
<i>Michelinia antiqua</i> , <i>M.-Coy</i>			*	*
<i>Petraia celtica</i> , <i>Lonsd.</i>	*		*		
— <i>pleuriradialis</i> ?, <i>Phill.</i>	*		*		
<i>Actinocrinus tennuistriatus</i> , <i>Phill.</i>	*	*	*		
— <i>triacontadactylus</i> , <i>Mill.</i>		*	*		*
<i>Adelocrinus hystrix</i> , <i>Phill.</i>		*	*		*
<i>Cyathocrinus distans</i> , <i>Phill.</i>		*	*		
— <i>ellipticus</i> , <i>Phill.</i>				*	

TABLE IX. (*continued*).

Species.	North Devon.			Petherwin.	Carboniferous generally.
	Lower Devonian.	Middle Devonian.	Upper Devonian.	Upper Devonian.	
<i>Cyathocrinus macrodactylus</i> , <i>Phill.</i>	*	*		
— <i>pinnatus</i> , <i>Goldf.</i>		*		*
— <i>variabilis</i> , <i>Phill.</i>	*	*	*	*
<i>Pentremites ovalis</i> , <i>Goldf.</i>	*	*		*
<i>Taxocrinus macrodactylus</i> , <i>Phil.</i>		*		
<i>Protaster</i> , <i>sp.</i>		*		
<i>Palæaster</i> , <i>sp.</i>	*			
<i>Tentaculites annulatus</i> , <i>Schloth.</i>	*			
— <i>scalaris</i> , <i>Schloth.</i>		*	*	
<i>Phacops granulatus</i> , <i>Münst.</i>		*	*	
— <i>laciniatus</i> , <i>Rœm.</i>			*	
— <i>latifrons</i> , <i>Bronn</i>		*	*	
— <i>Latreillii</i> , <i>Stein.</i>		*		
<i>Trimerocephalus lavis</i> , <i>Münst.</i>	*	*		
<i>Cypridina serrato-striata</i> , <i>Sandb.</i>			*	
<i>Ceriopora similis</i> , <i>Phill.</i>	*			
— <i>gracilis</i> , <i>Phill.</i>		*		
<i>Fenestella antiqua</i> , <i>Goldf.</i>	*	*	*	*	*
— <i>arthritica</i> , <i>Phill.</i>	*			
— <i>plebeia</i> , <i>M. Coy</i>	*	*	*	*
<i>Glauconome bipartita</i> , <i>Phill.</i>		*		*
<i>Polypora laxa</i> , <i>Phill.</i>		*	*	*
<i>Retepora repisteria</i> , <i>Goldf.</i>	*			
<i>Athyris concentrica</i> , <i>Von Buch</i>	*	*	*	*	
— <i>decussata</i> , <i>Sow.</i>		*	*	
— <i>indentata</i> , <i>Sow.</i>		*	*	
— <i>oblonga</i> , <i>Sow.</i>		*		*
<i>Atrypa desquamata</i> , <i>Sow.</i>	*	*	*	
— <i>reticularis</i> , <i>Linn.</i>	*		*	
— —, <i>var. aspera</i> , <i>Schloth.</i>	*		*	
<i>Chonetes sordida</i> , <i>Sow.</i> , <i>vel Hardrensis</i> , <i>Phill.</i> ...	*		*		*
<i>Cyrtina heteroclyta</i> , <i>Def.</i>	*			
<i>Discina nitida</i> , <i>Phill.</i>		*		*
<i>Merista plebeia</i> , <i>Sow.</i>	*			
<i>Lingula squamiformis</i> , <i>Phill.</i>		*		*
<i>Orthis arcuata</i> , <i>Phill.</i>	*				
— <i>granulosa</i> , <i>Phill.</i>	*				
— <i>interlineata</i> , <i>Sow.</i>	*	*	*	
— <i>striatula</i> , <i>Schloth.</i>	*	*	*	
<i>Productus longispinus</i> , <i>Dav.</i>		*		
— <i>prælongus</i> , <i>Sow.</i>		*		
— <i>scabriculus</i> , <i>Murch.</i>		*		*
<i>Rensseleria stringiceps</i> , <i>Ræmer</i>	*				
<i>Rhynchonella cuboides</i> , <i>Sow.</i>	*				
— <i>laticosta</i> , <i>Phill.</i>		*		
— <i>pleurodon</i> , <i>Phill.</i>	*	*	*	*	*
— <i>pugnus</i> , <i>Martin</i>	*	*	*	*	*
— <i>reniformis</i> , <i>Sow.</i>	*	*	*	*

TABLE IX. (*continued*).

Species.	North Devon.			Petherwin.	Carboniferous generally.
	Lower Devonian.	Middle Devonian.	Upper Devonian.	Upper Devonian.	
<i>Spirifera canalifera</i> , <i>Valen.</i>	*	*			
— <i>curvata</i> , <i>Schloth.</i>	*	*			
— <i>disjuncta</i> , <i>Sow.</i>		*	*	*	
— <i>glabra</i> ?, <i>Martin</i>		*			*
— <i>hysterica</i> , <i>Schloth.</i>	*				
— <i>lavicosta</i> , <i>Valen.</i>	*				
— <i>lineata</i> , <i>Martin</i>			*	*	
— <i>megaloba</i> , <i>Phill.</i>			*		
— <i>mesomala</i> , <i>Phill.</i>			*		
— <i>obliterata</i> , <i>Phill.</i>			*		
— <i>nuda</i> , <i>Sow.</i>		*			
— <i>rudis</i> , <i>Phill.</i>		*	*		
— <i>speciosa</i> , <i>Schloth.</i>		*			
— <i>Urei</i> , <i>Flem.</i>		*	*	*	*
<i>Spiriferina cristata</i> , <i>Schloth.</i>			*		*
<i>Stringocephalus Burtini</i> , <i>DeFr.</i>		*			
<i>Sreptorhynchus crenistria</i> , <i>Phill.</i>		*	*	*	*
— <i>plicatus</i> , <i>Sow.</i>			*		
— <i>semircularis</i> , <i>Phill.</i>			*		
— <i>umbraculum</i> , <i>Schloth.</i>	*?	*			
<i>Strophalosia productoides</i> , <i>Murch.</i>			*	*	
<i>Strophomena rhomboidalis</i> , <i>Wahlenb.</i>		*	*		*
<i>Terebratulula sacculus</i> , <i>Mart.</i>			*		*
<i>Avicula Damnoniensis</i> , <i>Sow.</i>			*		
— <i>exarata</i> , <i>Phill.</i>				*	
— <i>subradiata</i> , <i>Sow.</i>			*		
<i>Aviculopecten alternatus</i> , <i>Phill.</i>				*	
— <i>arachnoideus</i> , <i>Phill.</i>				*	
— <i>nexilis</i> , <i>Sow.</i>			*		*
— <i>granosus</i> , <i>Sow.</i>				*	
— <i>granulosus</i> , <i>Phill.</i>				*	
— <i>pectinoides</i> , <i>Sow.</i>			*		
— <i>polytrichus</i> , <i>Phill.</i>			*		
— <i>transversus</i> , <i>Phill.</i>			*	*	*
<i>Pterinea cancellata</i> , <i>Phill.</i>			*		
— <i>rudis</i> , <i>Phill.</i>			*		
— <i>spinosa</i> , <i>Phill.</i>	*			*	
— <i>ventricosa</i> , <i>Goldf.</i>				*	
<i>Cardiola retrostriata</i> , <i>V. Buch</i>				*	
<i>Cucullæa amygdalina</i> , <i>Phill.</i>					*
— <i>angusta</i> , <i>Sow.</i>			*		
— <i>complanata</i> , <i>Phill.</i>			*		
— <i>depressa</i> , <i>Phill.</i>			*		
— <i>Hardingii</i> , <i>Sow.</i>			*		*
— <i>trapezium</i> , <i>Sow.</i>			*		
— <i>unilateralis</i> , <i>Sow.</i>			*		*
— <i>sp.</i>		*			
<i>Ctenodota elliptica</i> , <i>Phill.</i>				*	

TABLE IX. (*continued*).

Species.	North Devon.			Pether- win.	Carboniferous generally.
	Lower Devonian.	Middle Devonian.	Upper Devonian.	Upper Devonian.	
<i>Ctenodonta Krachtæ</i> , <i>M'Coy</i>	*		*	*	
— <i>antiqua</i> , <i>Sow.</i>			*	*	
— <i>latissima</i> , <i>Phill.</i>			*	*	
— <i>lineata</i> , <i>Phill.</i>			*	*	
— <i>plicata</i> , <i>Phill.</i>			*	*	
— <i>pullastriformis</i> , <i>M'Coy</i>			*	*	
<i>Curtonotus rectus</i> , <i>Salt.</i>			*	*	
— <i>elegans</i> , <i>Salt.</i>			*	*	
<i>Cypricardia Phillipsii</i> , <i>D'Orb.</i>			*	*	
<i>Leptodomus constrictus</i> , <i>M'Coy</i>			*	*	
<i>Megalodon cucullatus</i> , <i>Sow.</i>	*	*			
<i>Modiola amygdalina</i> , <i>Phill.</i>			*	*	
<i>Sanguinolaria elliptica</i> , <i>Phill.</i>			*	*	
— <i>sulcata</i> , <i>Münst.</i>			*	*	
<i>Sanguinolites complanatus</i> , <i>Phill.</i>			*	*	
— <i>liratus</i> , <i>Phill.</i>			*	*	
<i>Schizodus deltoideus</i> , <i>Phill.</i>		*		*	
<i>Orthonota</i> , <i>sp.</i>				*	
<i>Myalina</i> , <i>sp.</i>		*			
<i>Solen</i> ?, <i>sp.</i>		*			
<i>Acroculia vetusta</i> , <i>Sow.</i>		*	*		*
<i>Euomphalus serpens</i> , <i>Phill.</i>		*	*	*	
— <i>radiatus</i> , <i>Phill.</i>		*			
<i>Loxonema rugifera</i> , <i>Phill.</i>			*		*
— <i>nexilis</i> , <i>Phill.</i>				*	
— <i>tumida</i> , <i>Phill.</i>				*	
— <i>sinuosa</i> , <i>Phill.</i>				*	
<i>Macrocheilus neglectus</i> , <i>Phill.</i>			*		
— <i>brevis</i> , <i>Sow.</i>		*			
<i>Holopella</i> ?		*			
<i>Murchisonia angulata</i> , <i>Phill.</i>			*	*	*
<i>Natica meridionalis</i> , <i>Phill.</i>			*		
— <i>nexicosta</i> , <i>Phill.</i>			*		
<i>Pleurotomaria aspera</i> , <i>Sow.</i>	*		*	*	
— <i>cancellata</i> , <i>Phill.</i>			*	*	
— <i>expansa</i> , <i>Phill.</i>			*		*
— <i>gracilis</i> , <i>Phill.</i>			*		
<i>Bellerophon bisulcatus</i> , <i>Röm.</i>		*	*		
— <i>striatus</i> , <i>Bronn</i>	*		*		*
— <i>subglobatus</i> , <i>M'Coy</i>			*		*
— <i>Urei</i> , <i>Flemg.</i>			*		*
<i>Porcellia Symondsii</i>			*		
<i>Conularia</i>		*			
<i>Cyrtoceras rusticum</i> , <i>Phill.</i>				*	
—, <i>sp.</i>		*			
<i>Goniatis biforus</i> , <i>Phill.</i>				*	
— <i>linearis</i> , <i>Münst.</i>				*	
— <i>spirorbis</i> , <i>Phill.</i>			*?		*

TABLE IX. (*continued*).

Species.	North Devon.			Pether- win.	Carboniferous generally.
	Lower Devonian.	Middle Devonian.	Upper Devonian.	Upper Devonian.	
<i>Goniatites subsulcatus</i>				*	
— <i>vinctus</i> , Sow.			*	*	
<i>Orthoceras cinctum</i> , Sow.				*	
— <i>cylindraceum</i> , Sow.			*		*
— <i>cylindricum</i> , Sow.		*	*		
— <i>ibex</i> , Sow.				*	
— <i>imbricatum</i> , Wahl.			*		
— <i>lineolatum</i> , Phill.			*		*
— <i>Ludense</i> ?, Sow.			*		
— <i>Phillipsii</i> , D'Orb.				*	
— <i>tentaculare</i> , Phill.		*	*		
— <i>striatulum</i> , Sow.				*	
— <i>striatum</i> , Sow.			*	*	*
— <i>undulatum</i> , Sow.				*	
<i>Nautilus megasipho</i> , Phill.				*	
<i>Clymenia</i> , sp.				*	
— <i>fasciata</i> , Phill.				*	
— <i>lævigata</i> , Münster.				*	
— <i>Münsteri</i> , M'Coy				*	
— <i>Pattisoni</i> , M'Coy				*	
— <i>pleurisepta</i> , Phill.				*	
— <i>quadrifora</i> , M'Coy				*	
— <i>sagittalis</i> , Phill.				*	
— <i>striata</i> , Münster.				*	
— <i>valida</i> , Phill.				*	
— <i>undulata</i> , Münster.				*	
<i>Poterioceras fusiforme</i> , Sow.				*	

6. *Other Groups*.—It is unnecessary to carry our analysis of the individual groups further, the paucity of the Lamellibranchiata and Gasteropoda affording no means for our rigidly collating them either with the continental species or even amongst themselves in the two Devonian areas; and those species, in these classes, said to be common to the Devonian and Carboniferous require yet much critical examination. I may, however, notice the genera *Cucullæa*, *Curtonotus*, and *Megalodon*, the latter as not being known out of the Middle Devonian of South and North Devon, and the two former as being important Upper-Devonian forms in the Marwood, Baggy, and Sloly beds.

The whole group, however, of Devonian Lamellibranchiata contains twenty genera and fifty-eight species, of which five genera and seven species only occur in the Carboniferous series, viz. *Avicula Damno-niensis*, *Aviculopecten plicatus*, *Conocardium aliforme*, *Cucullæa amygdalina*, *C. Hardingii*, *C. trapezium*, and *Curtonotus elegans*.

The same difference exists between the two formations through
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the Gasteropoda, which have been carefully compared. Twelve genera and forty-six species occur in the Devonian; and of these also five genera and seven species pass to the Carboniferous, viz. *Acroculia vetusta*, *Euomphalus planorbis*, *Loxonema rugifera*, *L. tumida*, *Murchisonia angulata*, *M. spinosa*, and *Pleurotomaria expansa*. Three or four of these I much doubt, but I give them as they are recorded by Prof. Phillips, although a comparison with his figures and descriptions causes me to interrogate them.

Much could be said relative to the Echinodermata. I, however, feel confident that great confusion exists respecting the whole of the Devonian species, and especially so with relation to those said to be common to the Carboniferous and the Lower and Middle Devonian; their badly preserved condition, usually only in a fragmentary state, scarcely justifies us in relying upon them as being of specific value.

7. *List of Species common to the Devonian and Carboniferous formations.*—Table X. is constructed to show at once the relation between those species said to be common to the Carboniferous and Devonian rocks, in which every known recognized form is given, and arranged zoologically, so that comparison may be made at once*.

TABLE X.—*List of Species that occur in the Lower, Middle, and Upper Devonian rocks of North Devon, and in the Carboniferous rocks generally.*

Classes.	Species.	DEVONIAN.			Carboniferous.
		Lower.	Middle.	Upper.	
PLANTÆ	<i>Knorria dichotoma</i> , <i>Hought.</i> .....	...	...	*	*
CELENTERATA	<i>Adiantites hibernicus</i> , <i>Forbes</i> .....	...	...	*	*
	<i>Michelinia antiqua</i> , <i>M. Coy</i> .....	...	...	*	*
	<i>Adelocrinus hystrix</i> , <i>Phill.</i> .....	...	...	*	*
ECHINODERMATA	<i>Cyathocrinus pinnatus</i> ?, <i>Goldf.</i>	*	...	*	*
	— <i>variabilis</i> ?, <i>Phill.</i> .....	...	*	*	*
	<i>Pentremites ovalis</i> .....	...	...	*	*
	<i>Ceriopora similis</i> .....	...	*	*	*
	— <i>gracilis</i> .....	...	...	*	*
POLYZOA	<i>Fenestella antiqua</i> ?, <i>Goldf.</i>	*	*	*	*
	— <i>plebeia</i> ?, <i>M. Coy</i> .....	...	*	*	*
	— <i>prisca</i> ?, <i>Goldf.</i> .....	...	*	...	*
	<i>Glauconome bipinnata</i> , <i>Phill.</i> .....	...	...	*	*
	<i>Polypora laxa</i> ?, <i>Phill.</i> .....	...	*	*	*
	<i>Athyris oblonga</i> , <i>Sow.</i> .....	...	...	*	*
	<i>Chonetes sordida</i> , <i>Sow.</i> (<i>C. Hardrensis</i> , <i>Phill.</i>)	*	*	*	*
	<i>Discina nitida</i> , <i>Phill.</i> .....	...	...	*	*

* Consult Table XI., giving generic and specific values between the Old Red Sandstone, the British marine and Foreign Devonian beds of Rhenish Prussia, Belgium, and France, and the number of species (fifty-six) common to the Carboniferous.

TABLE X. (*continued*).

Classes.	Species.	DEVONIAN.			Carboniferous.
		Lower.	Middle.	Upper.	
BRACHIOPODA ...	<i>Lingula squamiformis</i> , <i>Phill.</i> .....	...	...	*	*
	<i>Productus scabriculus</i> , <i>Mart.</i> .....	...	...	*	*
	<i>Rhynchonella acuminata</i> , <i>Mart.</i> ...	...	*	...	*
	— <i>pleurodon</i> , <i>Phill.</i> .....	...	*	*	*
	— <i>pugnus</i> , <i>Mart.</i> .....	...	*	*	*
	— <i>reniformis</i> , <i>Sow.</i> .....	...	*	*	*
	<i>Spirifera Urei</i> , <i>Flem.</i> .....	...	...	*	*
	<i>Spiriferina cristata</i> , <i>Schloth.</i> .....	...	*	*	*
	<i>Streptorhynchus crenistria</i> , <i>Phill.</i>...	...	*	*	*
	<i>Terebratula sacculus</i> , <i>Mart.</i> .....	...	*	*	*
	<i>Strophomena rhomboidalis</i> , <i>Wahl.</i> ...	...	*	*	*
	<i>Avicula Damnoniensis</i> , <i>Sow.</i> .....	...	...	*	*
LAMELLI- BRAN- CHIATA	<i>Aviculopecten nexilis</i> , <i>Sow.</i> .....	...	...	*	*
	— <i>plicatus</i> , <i>Sow.</i> .....	...	*	...	*
	— <i>transversus</i> , <i>Sow.</i> .....	...	*	*	*
	<i>Conocardium aliforme</i> , <i>Sow.</i> .....	...	*	...	*
	<i>Curtonotus unio</i> , <i>Salt.</i> (<i>elegans</i> <i>Salt.</i>) .....	...	...	*	*
	<i>Cucullæa amygdalina</i> , <i>Phill.</i> .....	...	*	*	*
	— <i>unilateralis</i> , <i>Sow.</i> .....	...	...	*	*
	<i>Acroculia vetusta</i> , <i>Sow.</i> .....	...	*	*	*
	<i>Euomphalus planorbis</i> , <i>Vern.</i> .....	...	*	...	*
	<i>Loxonema rugifera</i> , <i>Phill.</i> .....	...	*	*	*
	— <i>tumida</i> , <i>Phill.</i> .....	...	...	*	*
	<i>Macrocheilus imbricatus</i> , <i>Sow.</i> .....	...	*	...	*
GASTEROPODA...	<i>Murchisonia spinosa</i> , <i>Phill.</i> .....	...	*	...	*
	— <i>angulata</i> , <i>Phill.</i> .....	...	...	*	*
	<i>Pleurotomaria expansa</i> , <i>Phill.</i> .....	...	...	*	*
	<i>Bellerophon Urei</i> , <i>Flem.</i> .....	...	...	*	*
NUCLEOBRAN- CHIATA	— <i>hiuleus</i> , <i>Sow.</i> .....	...	...	*	*
	— <i>subglobatus</i> , <i>M'Coy</i> .....	...	...	*	*
	<i>Goniatites excavatus</i> , <i>Phill.</i> .....	...	*	...	*
	— <i>serpentinus</i> , <i>Phill.</i> .....	...	*	...	*
CEPHALOPODA ...	— <i>spirorbis</i> ?, <i>Phill.</i> .....	...	...	*	*
	<i>Orthoceras cinctum</i> , <i>Sow.</i> .....	...	*	*	*
	— <i>cylindraceum</i> , <i>Flem.</i> .....	...	...	*	*
	— <i>lineolatum</i> , <i>Phill.</i> .....	...	...	*	*
	— <i>undulatum</i> , <i>Sow.</i> .....	...	*	*	*
	— <i>striatum</i> , <i>Sow.</i> .....	...	...	*	*
	<i>Poterioceras fusiforme</i> , <i>Sow.</i> .....	...	...	*	*
		3	28	47	56

It will be well to analyze this Table, which expresses the entire value of specific agreement.

Planta.—Two species of the known thirteen are common to the two formations.

Cœlenterata.—Amongst the Corals, only one species (*Michelinia antiqua*) occurs common to the two systems, although twenty-four genera and fifty-three species are known in the Lower and Middle Devonian slates and limestones of North and South Devon. (*Vide* Tables II., V., VIII.) These, and the entire series of rocks which

contain the nineteen North-Devon species, are wholly unaccounted for in Mr. Jukes's paper, either upon the hypothesis of the fault or anticlinal. Neither the rocks nor the fossils occur to the south of the Pickwell range, or Upper Old Red Sandstone; and the great series of slates of Mortehoe, Lee, Ilfracombe, and Combe Martin, with the Hangman grits below, hold a distinctive and intermediate position, which his hypothesis cannot account for, even upon physical grounds; and the entire fauna of the Ilfracombe group has also to be accounted for, and correlated with that of Baggy and Marwood ere any relation can be proved to exist. There is not, however, the least doubt that the whole Middle group is a well-determined one, and exists below the Pickwell-Down or Upper Old Red Sandstone series in North Devon.

Echinodermata.—Of the ten known genera, three are common; and of the twenty-one species, only four occur in the Carboniferous, one of which, *Cyathocrinus pinnatus*, I much doubt.

Annelida.—No comparison.

Crustacea.—Six genera and thirteen species are known in, and are entirely confined to, the Devonian rocks of North and South Devon. As before mentioned, both families, genera, and species are peculiar to them in the British and the three Continental areas.

Polyzoa.—The eight genera and twelve species known show nearly 50 per cent. common, viz. four genera and seven species. I give them, because at present they occur in most lists; but I believe that, when carefully examined, this group will require entire reconstruction, both for the Devonian and Carboniferous rocks.

Brachiopoda.—We know of twenty-five genera and ninety-nine species in the British Devonian rocks; eleven of the genera and fourteen species pass up to the Carboniferous series through the Carboniferous Slate or Lower Limestone Shales. Except through the genus *Rhynchonella*, which has four species common, there is only *one representative species* in each of the remaining genera—a significant fact and to be noted in this prolific group, in which the species are usually so great numerically.

Lamellibranchiata.—Out of the twenty genera and fifty-seven Devonian species, eight species *only*, through the two groups (Monomyaria and Dimyaria) unite the two systems; through the *Curtonoti* and *Cucullææ* there may be two or three more. With relation to the Devonian series, however, we have much to learn in this class, which in the Carboniferous rocks numbers 330 species.

Gasteropoda.—Only twelve genera are known; but their specific value is numerically greater than that of the *Lamellibranchiata*, there being 46 species of them; only six of the former and eight of the latter are known above the Upper Devonian beds.

Cephalopoda.—This pelagic class is represented in the Devonian rocks by six genera (all Tetrabranchiata). I have previously noticed (p. 650) their singular local distribution through the large assemblage of species in the genera *Clymenia* and *Cyrtoceras*. We have in our British Middle and Upper Devonian beds fifty-four known forms, nine only of which are common to the succeeding Carboniferous, and

this through the three genera, *Goniatites*, *Orthoceras*, and *Poterioceras*. (See Tables IX. and X.).

Pisces.—The 113 described species in the three recognized divisions of the Old Red Sandstone of England, Wales, Scotland, and Ireland, until lately had no known or well-authenticated representatives in the British marine Devonians. We now know of three species:—*Phyllolepis concentricus**, from the Lower Devonian slates of Cornwall; *Holoptychius*, from the Upper beds of North Devon; and *Cœlacanthus*, from the Upper beds of the Old Red Sandstone of Ireland, associated with *Adiantites Hibernicus* and *Anodon Jukesii*.

We have, therefore, clearly shown in Table X. (in which are enumerated all the species known common to the two formations) that fifty-six species out of the 383 known Devonian forms are common to those rocks and the Carboniferous, and that forty-seven of the 383 are allied through the Upper Devonian beds only; i.e. they are not known to the north of the Pickwell-Down Old Red Sandstone (Upper Devonian); whereas twenty-eight others of the fifty-six (and of the 383 named in Tables I. and II.) occur in the Middle Devonian, and are found to the north of Pickwell Down or elsewhere, and also common to the Carboniferous; and three only of the fifty-six (or 383) pass through the whole Devonian series (or connect the Carboniferous and Lower Devonian). Two of these three I doubt; they are *Cyathocrinus pinnatus* and *Fenestella antiqua*; and if the *Chonetes sordida* of the Lower or Lynton beds be that species, and not the *C. Hardrensis* of the higher beds and also Carboniferous, we then have scarcely a single species in common between the Lower and Upper Devonian themselves, or between the Lower Devonian and the Carboniferous.

There are therefore fifty-six species common to the whole Devonian formation and to the Carboniferous; forty-seven of these fifty-six are species common to the Upper Devonian and Carboniferous; and twenty-eight of the fifty-six to the Middle and Carboniferous, and three (?) to the Lower Devonian and Carboniferous. *Vide* Table X., where the names and range of the above species are enumerated.

VII. STRATIGRAPHICAL CONSIDERATIONS ON THE DEVONIAN FOSSILS.

The many Tables which have been prepared, based upon the known species and their distribution through the Lower, Middle, and Upper Devonian rocks, will enable us to establish some conclusions by comparing them amongst themselves as local groups, and also by comparison with those of other localities.

The chief important question arising from a critical examination of a set of organic remains resolves itself into the determination of the horizon, age, or stratigraphical position to which they should be referred.

The rocks and their fossil contents in North Devon belong to two ages, the Devonian (so called) and the Carboniferous; and to one or the other, or both, we have to refer them.

* Pengelly, Report Roy. Geol. Soc. Cornwall, 1860-65.

TABLE XI.—*Showing the number of genera and species in the Old Red Sandstone and Devonian series of Great Britain, and the number of species in the Carboniferous rocks common to the two formations; also compared with the Devonian rocks of Rhemish Prussia, Belgium, and France.*

	Old Red Sandstone.		DEVONIAN.					Species common to the Carb. and Dev. Rocks.	FOREIGN.		
	Genera.	Species.	Genera.	Species.	CORN-WALL.	SOUTH DEVON.	NORTH DEVON.		Rhemish.	Belgian.	French.
Plante	12	13	4	4	..	..	3	2	2		
Amorphozoa .....	..	..	4	9	2	9	1	..	18	1	14
Ceclenterata .....	..	..	25	53	7	51	19	1	4	17	
Echinodermata .....	..	..	10	21	2	12	11	4	4	5	
Annulosa	1	1	2	2	..	1	2	..	1		
Crustacea	7	21	6	13	4	12	3	..	9	4	2
Polyzoa .....	..	..	8	13	4	8	8	7	4	2	2
Brachiopoda .....	..	..	25	99	31	67	48	14	41	44	28
Lamellibranch- { Monomyaria .....	..	..	3	22	9	9	10	4	3	2	
ista. { Dimyaria	1	1	18	36	8	11	22	4	5	4	3
Gasteropoda .....	..	..	12	46	9	37	10	8	13	11	
Nucleobranchiata .....	..	..	3	9	2	3	6	3	..	3	
Pteropoda .....	..	..	1	1	..	..	..	..	..	..
Cephalopoda .....	..	..	6	52	26	26	9	9	4	7	1
Pisces	43	113	3	3	3	..	1	9			
	64	149	130	383	107	246	153	56	104	100	50

In the present case the intermediate position of the Devonian series is assumed, although the Silurian is not seen or known in this area; but the upward succession into the Carboniferous is clear and conclusive; and upon this belief I base my premises as to the value of the species contained in the underlying conformable rocks called Devonian.

There are 383 species of fossils known to occur in these rocks in North and South Devon, which have no known or determinable stratigraphical base. The rocks they do repose upon are *probably* Silurian; whether Upper or Lower we know not, or whether conformable or not we cannot say.

The known British Silurian fauna consists of 1154 species*, only one of which (*Atrypa reticularis*), I believe, is common to the Devonian and the Silurian rocks. The seven species of fish that occur in the passage-beds, and on the confines of the Upper Silurian and the Lower Old Red Sandstone, in the typical Silurian area in Hereford and Worcestershire &c. have no value whatever here, and therefore cannot be compared; when it is absolutely proved by stratigraphical demonstration that the lowest Devonian is *truly* and *identically* equivalent to the Lower Old Red Sandstone, we may then say that there are 8 species known to be common to the Devonian and Silurian formations.

There are *no* marine forms in the Old Red Sandstone; but there are 383 in the Devonian rocks of the British Islands.

Now it is well known that many thousands of feet of strata consisting of red, grey, brown, and greenish slates, grits, and sandstones occupy a large tract of country in North Devon, from Lynton to Barnstaple, these marine fossiliferous beds overlying, in part at least, what we have hitherto believed to be the lowest Old Red Sandstone, the equivalents of the Lower Old Red of the Silurian frontier, which is totally void of fossils.

The 383 new forms or species, then (for *one only* seems to have migrated from a Silurian region), we must locate somewhere in time as well as space. In the absence of any physical evidence to show that the strata named "Devonian" in North Devon and elsewhere are or are not contemporaneous with the Old Red Sandstone, their stratigraphical position is assumed, aided by palæontological evidence, and from the circumstance that only 56 species out of the 383 are known in the Carboniferous rocks which overlie the beds containing them in North Devon (Tab. X.). Had the Carboniferous rocks, however, stratigraphically preceded this group, we should have placed them below the Devonian, and have referred the now Devonian species to the Carboniferous as types. We are also now better able to correlate, and to establish more direct contemporaneity between, the Devonian and the Old Red Sandstone, through Fish-remains found in the known Devonian strata both in England and Belgium,—*Phyllolepis concentricus* and *Onchus* having been found in the Lower Devonian slates of Looe and Meadsfoot, *Pteraspis* in the lowest Coblentzian rocks of Devon and Wassenbach on the Laa-

* *Vide* Table I. p. 615.

chersee, *Holoptychius* in the Upper Devonian of North Devon, and *Coccosteus* in the Middle Devonian of the Eifel, to say nothing of the association of numerous species of fish with marine Mollusca, Corals, &c. associated together in the same beds in the Valdai Hills &c., where *Cephalaspis* and eight or nine other genera occur, having species identical with our own Scottish Old Red Sandstone, and 16 species of shells common to our Devonian also*. Thus, then, we have some grounds for placing our marine Devonian rocks on the same horizon as, and contemporaneous with, the recognized divisions of the Old Red Sandstone in other localities; but the physical structure and succession, as exhibited in North Devon alone, is (and was years ago) enough to establish this.

To the Devonian series therefore we assign the 329 species peculiarly Devonian, after eliminating the 56 which are common to that formation and to the Carboniferous; and it is only through the *Upper Devonian* beds that a close agreement takes place between the species of the two groups of rocks, where 45 of the 56 (or 383) pass to the Carboniferous, 25 from the Middle to the Carboniferous, and only 3 species are common to the Lower or Lynton group and the Carboniferous beds†. (Table X.)

But I cannot admit (as stated), because I have failed to detect, that a single form occurs in common between the Silurian and Carboniferous, although they are said to be thus related through the species *Strophomena rhomboidalis*, by Professor Jukes, *loc. cit.*

We must in this case adhere to circumstances and facts as we find them, and receive the opinions and decision of experienced palæontologists until contradicted.

I have contended, aided by the stratigraphical position of the rocks, for the intermediate zoological grouping and value of the forms of life in the Devonian as related to the Silurian through the Trilobites, and notably and distinctly by the individuality of certain well-marked genera not known out of the Devonian series, either in Britain or over all Europe: nor are they known below in the Silurian rocks, or above in the Carboniferous in any area.

The Middle group, which holds so distinct a place in the series in North and South Devon, both by richness in special and peculiar genera, and in number of species, is paralleled in every particular in

* Mr. W. H. Baily, Palæontologist to the Geological Survey of Ireland, at the Bath Meeting of the British Association, 1865, communicated to the Geological Section the first notice of the occurrence of fish in the Old Red Sandstone of the Bristol area; these remains he obtained from the base of a conglomerate bed exposed in the cliff at Portishead, and also from red flaggy beds on the shore between high- and low-water mark. He identified the scales as those "of *Holoptychius nobilissimus* and *Glyptolepis elegans*," associated with plants and bones, and also what appeared to be "the fin-rays of a fish like *Glyptolepis*, or *Platygmathus*, in Yellow Sandstone." These beds would probably represent the upper part of the Old Red Sandstone. The paucity of fish-remains in any portion of the Old Red of this area enhances the importance of this communication, and may yet aid us in determining their position in the series of the Portishead rocks: a fragment of a scale ornamented like those of *Bothriolepis* or *Asterolepis* was also found.

† Two of which are doubtful, if not all.

the three continental areas, where, as with us, the upward stratigraphical succession into the overlying Carboniferous through the Upper Devonian (when represented) is complete. It is the genera of Brachiopoda (*Uncites*, *Merista*, *Davidsonia*, *Stringocephalus*, *Calceola*, *Pentamerus*, &c.), the whole of the Cœlenterata (51 species), with all the Amorphozoa (9 species, which are unquestionably Lower and Middle Devonian), the Cyrtoceratites (11 species, all Middle Devonian), added to the rich numerical assemblage of species (vide Tables II., V., VII., VIII., IX.) which do not occur in the succeeding Carboniferous, that establish a distinctness and give a reality to this Middle Devonian group, which nothing but conclusive proof of unconformity here or abroad can ever shake.

I cannot doubt, therefore, that in North Devon the geological age of the fossils is proved by the stratigraphical position of the beds containing them, and that as there is no physical break in the upward rock-succession from the Lynton and Ilfracombe group to the Baggy series through the Pickwell-Down sandstone, neither is there in the zoological continuity and persistency of species that gradually lived on, or passed up, to the Upper Devonian, or Upper Old Red Series of Baggy and Marwood, and to the Croyde beds to the south.

Comparison, then, can easily be made between those species that are common to the Middle and Upper Devonian and the Carboniferous Slate &c. of the same area, believing as I do that the rocks and assemblage of fossils south of Baggy, at Croyde, Braunton, and Barnstaple &c., are the Carboniferous Slates and Coomhola Grits of the south of Ireland, but that in the North-Devon area we have a well-marked Upper-Devonian fauna below that (the Baggy, Marwood, and Sloly series), which, if they did not precede the Irish forms in time, were deposited in a different area.

I maintain, therefore, that the peculiar Devonian genera and species have a most definite value, because we know their stratigraphical place with relation, at least, to the Carboniferous group above; and although no one locality can perhaps be pointed out where fully developed Upper Silurian rocks below, and fully developed Carboniferous Limestone above, with the Devonian slates and limestone can be seen in one section, it does not necessarily follow that, because we have not seen it in its completeness or totality, we should deny all experience, and reject the views of every competent observer, when so much separate evidence exists.

It may be asked what is the history of that great mass of so-called Old Red Sandstone in South Ireland? and why the unconformity amongst the Scotch Old Red Sandstones themselves? what caused that change from the marine Silurian to the barren or non-fossiliferous Old Red of the Silurian area?

The Table constructed by Professor Jukes at pp. 364-5* is anything but the right way to put the question of recurrence; it is simply comparing the Devonian species with each other in two different areas—comparing forms that lived on through the whole group, from the Lower portion to the Upper, which upon the law of continuity

* Notes for a comparison, &c., p. 578.

should be expected. Out of the 17 species therein given, there are but 8 known in any part of the Carboniferous rocks in any area; they are the following:—*Actinocrinus tenuistriatus*, *Cyathocrinus variabilis*, *Athyris concentrica*, *Rhynchonella pleurodon*, *R. pugnus*, *Spiriferina cristata*, *Strophomena rhomboidalis*, *Streptorhynchus crenistria*.

The 17 enumerated species, taking them as they stand, are known to most observers to occur in the North Devon Devonian rocks; but we have yet to learn that the fossils or rock-masses occupying the areas north and south of Pickwell Down are on the same general horizon, and are equally Carboniferous Slate; until this be the case, none of the 17 forms enumerated can be compared. Every name in the column marked South, except perhaps Barnstaple, and every species save the 8 given above, are recognized as Upper Devonian localities and species. Assigning to them therefore a north and south position and distribution geographically, by virtue of a so-called “central band” of Old Red Sandstone, whose position is neither central nor dubious in North Devon, shows upon paper a comparison that is not to be found in the physical structure of the country. Admit that all North Devon is Carboniferous Slate, and then the above 17 and all the other fossils are of that age; until then, 9 of them, viz. *Petraia pleuriradialis*, *Fenestella antiqua*, *Pleurotomaria aspera*, *Bellerophon globatus*, *Athyris concentrica*, *Orthis interlineata*, *O. striatula*, *Spirifera lævicosta*, and *Phacops latifrons*, will stand as Devonian species; and let me add that, of the whole 17 in the Table, the doubtful *Chonetes Hardrensis* is the only one common to the Lower or Lynton group and the Carboniferous Slate either of Devon or Ireland.

At p. 366 of same paper, it is stated that our choice is “now, however, limited to the period of the Old Red Sandstone and that of the Carboniferous Limestone, unless we assign to them [the fossils] a hitherto undefined period between those two, or suppose them to be older than those of the Old Red Sandstones” (the whole of that formation according to Prof. Jukes’s views, but which I would call Upper Devonian, or Upper Old Red Sandstone; therefore no one would suppose that the Carboniferous preceded the Devonian).

The fact that the Devonian fauna contained some species belonging to genera peculiar to or only previously known in the older Silurian rocks, such as *Phacops*, *Homalonotus*, *Bronteus*, *Cheirurus*, and *Harpes* among the Crustacea, the genus *Spirifera* and *Pentamerus* among the Brachiopoda, &c., but species of which do not occur in the Devonian or Carboniferous, tends to clearly establish passage and connexion at some unknown locality; and our one connecting species, *Atrypa reticularis* (numerically so great), which was so common in the whole of the Upper Silurian seas, would tend to show strong grounds for determining the Lower Devonian to be contemporaneous with the Lower Old Red Sandstone of the Silurian region, which is there conformable to the Silurian rocks, but totally distinct in life—remains a few feet above the passage-beds.

I have shown what species occur in common between the Devonian and Silurian, and what are common to the Lower Old Red,

accumulated probably under freshwater conditions, within the general area I have previously noticed, such being due to a series of geographical changes dependent on the relative position of masses of land and water, thus producing stratigraphical unconformity, and partial zoological breaks; yet, nevertheless, sufficient life-evidence is left to enable us, through the Fish, Silurian genera of Trilobites, and Brachiopoda, to link on and establish continuity, if not close affinity, or even contemporaneity, and also to lead us to the conclusion that the Devonian series as a group were deposited in a different geographical area, and that the physical and palæontological conditions were much the same here as over the region occupied by them in France, Belgium and Prussia, through the whole period of its accumulation; added to which the ichthyic evidence in the Lower, Middle, and Upper Devonian beds in the continental areas is marked and decided.

Professor Jukes states, p. 368, that “*by the hypothesis I now propose, the place of these marine Devonian beds will be fixed stratigraphically between the top of the Old Red Sandstone and the base of the Coal-measures, in North Devon as in Ireland.*” From this assumption, or proposition, and the way in which it is put, I entirely dissent on eight grounds.

1st. Because it is assumed that all the known Devonian species of North Devon occur south of, or above, the Upper Old Red Sandstone of Pickwell Down, his *Old Red Sandstone*; whereas 60 known Devonian species, and thousands of feet of strata in regular sequence are *below this line*.

2ndly. By this view we are led to believe that no older or lower beds whatever, containing fossils, exist to the north of the line assumed; we are, however, enabled to divide the whole group below into a Lower and a Middle series, the latter of which rests upon a set of red sandstones and grits as marked, definite, and important as those that overlie the Pickwell Sandstones, these are the Hangman grits.

3rdly. That the Lower or Lynton slates (Lower Devonian) nearly 1500 feet thick, and themselves divisible into three series, in their turn rest upon the arched red sandstones of the Lynn valley and the Foreland rocks.

4thly. This hypothesis only accounts for the already well-known position and group of the Upper Devonian series, which here in North Devon (south of Pickwell Down) overlie, as they do in the south of Ireland, a series of red, green, and yellow sandstones &c. (the Upper Old Red Sandstones), *all that are there known*.

5thly. It is assumed that an extensive fault, or concealed anticlinal (before noticed), traverses the country from west to east, somewhere along the latitude of Pickwell Down, thereby causing the beds properly called Upper Devonian to be repeated to the north, which are therefore stated to be the same beds as those south of Morte Bay, thus attempting to make the Lower or Lynton, and Middle or Ilfracombe series of the same age and to hold the same stratigraphical position as the Upper Devonian at Baggy &c.

6thly. We could find no trace of either fault or anticlinal; and the structure of the country, together with the palæontological evidence, is diametrically opposed to this hypothesis, *the interposition or interpolation of the great Middle group of slates and limestones with their definite fauna being fatal to this hypothesis*; it cannot be accounted for either on the ground of the fault or anticlinal, yet must be if it be even allowed. This series in North Devon possesses 13 genera peculiar to it, and not known in any higher group.

7thly. I conceive it to have been an error to compare the British Devonian with the Irish types in the Carboniferous Slate, where only one-third of the species are known to exist, the fauna of *that* area either being derived from the typical Devonshire, or being a remnant of the same that once existed there. The lower part of the Irish Old Red Sandstone, the base of which has nowhere been seen, may not impossibly represent in time the Middle and Lower Devonian (Middle and Lower Old Red Sandstone) of North Devon, where beds of red sandstone of no inconsiderable thickness (void of life) exist, both at the base of the Middle or Ilfracombe beds (Hangman grits) and the base of the Lower or Lynton slates (Foreland sandstones &c.).

8thly. The true Old Red Sandstone, as a whole, in one or other of its three members (neither of which contains marine fossils), may be the conformable base to the great Carboniferous series in some or many areas; but that it is so to the exclusion of the marine group called the Devonian can only be believed by admitting that the two series were synchronously deposited over every known area where they both occur. This hypothesis would perhaps answer for very widely separated geographical areas, where one or the other rested upon the Old Red Sandstone as its base, or where either the one or the other was not represented either in time geologically, or space chronologically; but we can scarcely receive and apply that doctrine to an area (our own) where the base of the Carboniferous itself rests conformably upon the Upper Devonian series, acknowledged to be the marine representative of the Upper Old Red Sandstone of our own and other areas, itself resting (as in Ireland and North Devon) upon the non-fossiliferous Upper Old Red. Such views cannot be applied to any geographical area of so limited an extent as that now occupied by the two groups (the Carboniferous and Devonian) in the British Islands, the zoological differences being so great in one and all, where they occur and are tested on biological grounds. The doctrine of synchrony and difference of nature of sea-bottom must be stretched to the utmost to establish a province or provinces of organic remains within a few miles of each other, and that laterally, that would account for differences of such magnitude as those which exist in the physical conditions and the fauna of the two united systems.

In Britain and Ireland alone, and chiefly in the very area we are discussing, there are 383 species of Devonian fossils (as compared with 1748 species of Carboniferous); and of these 383, only 56 are common to the two systems (*vide* Tables II., IX., X., XI.); and this ratio

holds good for Europe, so far as we know. Had such difference existed over a vastly wider area, then the difference in the fossils of the Carboniferous and Devonian groups might be accounted for upon the hypothesis that they were accumulated under very different conditions physically and chronologically, and in a totally different area or province; but that the Upper Devonian series of North Devon, and those of South Ireland, South Wales, and France (the Boulonnais), as well, perhaps, as the lower part of the Carboniferous (call them what we will), were deposited synchronously, making what reasonable allowance we please for locality, province, and difference of nature of sea-bottom, there cannot, I think, be any reasonable doubt; but we cannot parallel the *Lower and Middle groups* of the Devonians here and on the continent with the Carboniferous under any hypothesis.

I by no means pretend to decipher, or to propose any different or new theory relative to, the life-break that took place between the Upper Silurian and Old Red Sandstone, where in Shropshire, Herefordshire, &c. there is no unconformity or sudden break, their physical passage being uniform and complete, but accompanied by a total extinction of the Silurian marine species, dependent, perhaps, upon the relative positions of masses of land and water, causing the marine condition of that area to become one of fresh water: all that we can say amounts to this, that we cannot account for that complete change, except through unconformity, of which we have no actual evidence. The succeeding Old Red must have been deposited in a rising and circumscribed area of greatly broken condition, occupying a vast duration of time, sufficient to allow of the introduction of a new marine fauna to the south and east, either through the agency of depression along a given line, east and west, about the latitude of the Mendip Hills and the south of Ireland; or a barrier existed along the same line, against which the marine deposits of the Devonian series were deposited, and that with an extensive southern expansion. In no other way can we, I believe, account for the physical change and zoological conditions of the marine Devonian rocks.

Professor Jukes has shown a physical break between the two members of the Old Red Sandstone in Ireland,—the lower, of great thickness, being conformable to the Ludlow group, whilst the upper division, of some 4000 feet, rests unconformably on the Lower, passing up and being conformable to the Carboniferous. We are not yet certain what these may be the equivalents of in the South-Welsh or, perhaps, North-Devon area.

Mr. Geikie has shown the same for the Pentland and Lammermuir Hills, where, he states, the base of the Old Red Sandstone is conformable to the Upper Silurian (Ludlow beds); a break occurs between them in the red and yellow sandstones and associated igneous rocks of the Middle, and then upon these another unconformity of the Upper Old Red Sandstone, which at the top gradually passes into the Carboniferous. There is, in fact, no division of the British strata where the geological sequence or succession is

so remarkably broken and incomplete as the Old Red and Devonian series, illustrating lapses of unrepresented time, which are proved either by the great and complete change in, or total absence of, life-remains.

I have endeavoured, however, to show that it is possible to parallel the division of the Old Red proper with its chronological equivalents, the marine Devonian series, which were deposited in a different, although contiguous, geographical area.

I contend therefore that the Devonian system, as a group of strata, both physically and palæontologically, may be (as long ago proposed) naturally and conveniently divided into a Lower, a Middle, and an Upper series, and that there is valid reason for believing that this system equalled in time the whole of the deposits of the Old Red Sandstone proper; but we have no real means of establishing arbitrary lines of agreement, or of strictly correlating the received division of the one to that of the other, for the want of clear palæontological agreement and evidence; all that can be said is, that, in the sequence of rock-masses, the Old Red Sandstone and marine Devonian, be they absolutely equivalent or contemporaneous or not, occupy a place above the Silurian on the one hand and below the Carboniferous on the other. The evidence of succession is clear in Wales, Hereford, and Shropshire as regards the Old Red Sandstone; in the Devon area, on the other hand, it must be assumed, as we have no visible base-line uniting the Lower Devonian with the Silurian, though, for aught we know to the contrary, they may overlie Silurian rocks in the Lynton area, in North Devon; but the testimony of palæontological research has established beyond any doubt that in Devonshire and Western Europe there exist three natural groups, which stratigraphically and zoologically succeed each other, viz.:—a Lower or Lynton, equalling in time and position the Lower Old Red Sandstone of the Silurian area; a Middle series, the Ilfracombe beds of North Devon and their equivalents (the Newton Bushel and Torquay slates and limestones) in South Devon, which probably equal the Middle Old Red Sandstone of Herefordshire, Gloucestershire, and Glamorganshire; and a true Upper Devonian series, resting in North Devon upon the Morte-Bay Upper Old Red Sandstones (of Pickwell Down, Dulverton and Wiveliscombe), which also is equivalent to the Upper Old Red of the Pembroke area in South Wales; and it is upon these Pickwell-Down red sandstones that the slates, grits, and arenaceous flaggy beds of Baggy, Marwood, Sloly, and Croyde conformably rest, which contain the marked assemblage of Upper-Devonian forms. They are three distinctly marked physical and palæontological groups, true as to rock-succession, and equally well characterized by organic remains, especially the Middle or Ilfracombe group, with its *Cœlenterate* and *Mollusca* fauna; that this order of succession exists is incontestably proved by the clear interpolation of the middle fossiliferous slates and limestones, and the extensively developed series of unfossiliferous slates of Lee, Rockham Bay, Mortehoe, and Woolacombe, and it is also strengthened by the non-faulted range of Pickwell Down. No fault or

anticlinal along the line delineated by Professor Jukes can account for the total absence of the Lynton and Ilfracombe groups to the south of the Pickwell-Down range, which area is now occupied by the well-defined Upper Devonian series *in situ* upon it.

No fault can account for the absolute contrast that exists between the fossiliferous sandy grits and slates that are in position on the south side of Pickwell, and the barren glossy slates of Morte-hoe &c. that underlie the red grits and sandstones of Pickwell Down at Potters Hill, and also the still thicker slates and associated continuous bands of organic limestones of Ilfracombe and Combe Martin, which strike continuously on to Croydon Hill, in West Somerset; these ought to be accounted for (although they are not) by such hypotheses, as for thirty miles they strike and hold their place and position without inversion, although disturbed by extensive undulations.

On zoological grounds the evidence is equally strong and conclusive. No single coral out of the *nineteen* species in this area is known out of this Middle group in higher beds; and only *ten* out of the twenty-five species of Brachiopoda pass up to the Upper Devonian strata south of Pickwell, and *four* to the Carboniferous; whether these facts have any parallel in the South-west of Ireland or not, they are yielded by the structure and condition of North Devon. There is yet another thick group of sandstones underlying the Ilfracombe and West-Somerset Middle slates and limestones—the Hangman Grits, from 1800 to 2000 feet thick; they have no equivalent whatever to the south of the Upper Old Red Sandstones, and certainly are not the Pickwell group repeated, with the Middle series troughed in through undulation. These ought also to be accounted for to the south of the supposed fault. Again, if the Lower or Lynton beds are the same (or upon the same general horizon) as those of Baggy, Marwood, and Croyde &c. &c., to the south, no system of faults can account for or do away with the well-marked intermediate position of the Middle Devonian group; and no anticlinal situated so far to the south of the great mass of the country as Pickwell could divide the series without accounting for the Carboniferous series of Venn, Swinbridge, &c., which should become evident to the north at Lynton, or trough in between, which they do not.

Professor Jukes, again, in his paper, "Notes for Comparison between the Rocks of the South-west of Ireland and those of Devon," &c. &c., pp. 10 and 11, would infer, or lead those to believe who had not seen the country, that the rolled or undulating beds along the north coast, at Morte Bay &c., are confined to the *lowest groups*, which, he says, are "probably the Morte Slates and beds below them." These quartzose Morte slates are not the lowest, they are the highest of the Middle group, and overlie the fossiliferous Ilfracombe series proper, and hold their place all across North Devon into West Somerset. The whole of the fossiliferous slates and limestones of Ilfracombe and Lynton are below these and the red sandstones of Pickwell; neither will the rolling therein mentioned do away with the fossil evidence tending to disprove that "the

beds of Lynton, Combe Martin, and Ilfracombe may belong to the Carboniferous Slate rolled to the north by contortions, and somewhat differing lithologically from those further south." No rolling has destroyed the value of the *intermediate fossiliferous Middle* or Ilfracombe and Combe-Martin group; for of the seventy species found in these beds, six only recur in the Carboniferous series of any area, viz. *Cyathocrinus variabilis*, *Fenestella antiqua*, *Rhynchonella pleurodon*, *R. pugnus*, *Streptorhynchus crenistria*, and *Avicula vetusta*. All these are also in the intermediate Upper Devonian series in North Devon. Thus, then, these beds on the north coast, *which are below* the red beds of Morte Bay, do "disclose facts which have no parallel in the south-west of Ireland;" but there is no doubt as to their stratigraphical place, or the zoological value assigned to them.

If we admit the physical succession of the North-Devon rocks to be established, and that they constitute three well-defined groups, this of necessity destroys the views of Professor Jukes, who believes that the uppermost bed of the Old Red Sandstone was in existence before any of the beds containing marine Devonian fossils were deposited; and his Old Red Sandstone is the non-fossiliferous red series which strikes from Morte Bay through Garmon Down, Span Head, Dulverton Common, to Haddon and Main Down (Wiveliscombe), which red sandstones, according to the hypothetical fault, are the Foreland beds to the north repeated, caused by the supposed great downthrow existing between these two points; consequently, upon this hypothesis, the Foreland grits and sandstones and the Lynton slates, with the overlying fossiliferous Ilfracombe group, and the non-fossiliferous Morte-hoe slates, are, or should be, above his Old Red Sandstone, both being the same by virtue of the fault: this, I maintain, is not borne out either on physical or zoological grounds. I doubt not for one moment that the red sandstones in question may be the equivalents of the Welsh and Irish Upper Old Red Sandstone with the fossiliferous Upper Devonian series resting upon them and the surrounding or associated Carboniferous Slates and Coomhola Grits also; but I do not admit the existence of the fault, and I endeavour to prove that we have in North Devon a complete succession of the three groups, determined physically and palæontologically.

The relation that the Upper red sandstones of Pickwell &c. have to the overlying fossiliferous Upper Devonian slates, sandstones, and grits is the same relatively that the thick Middle group of sandstones of the Hangman, Trentishoe, Martinhoe, &c. have to the Middle Devonian or fossiliferous calcareous slates of Ilfracombe and Combe Martin above them; and on equally good grounds we are enabled to establish a base for the Lynton slates and gritty lime-stones upon the non-fossiliferous red sandstones of the Foreland.

This order of succession is not only a true one, but it is in accordance with the reading of the succession in Europe; it is based both upon the position of the rock-masses of North Devon, and upon their associated groups of fossils. The physical conditions coinciding with the zoological evidence, it is that group, as a

whole, to which must be collated or equated the succeeding Carboniferous species, to which by succession they are allied, constituting one life-system, up to the close of the Permian period. It is impossible to examine the distinctive fauna of the South and North Devon Devonian rocks, taken collectively and compared with their equivalents in Rhenish Prussia, Belgium, and France, and not to perceive that it is in the North Devon area, where the sequence is clear, that the question of life-succession must ultimately be determined; for in South Devon we have as yet no known Upper-Devonian fauna, which series was so conclusively established in this northern area, at Baggy, Marwood, and Croyde &c. above the Pickwell sandstones, and at Petherwin, Landlake, &c. in North Cornwall, by Mr. Salter, in the year 1863*.

Upon examination of Table IX., where every known species in the Northern area (including Petherwin) is given, the importance of the *Upper-Devonian fauna* will be at once perceived, and its relation to the Carboniferous appreciated. This Table shows the occurrence of 194 species in the Lower, Middle, and Upper Devonian series of North Devon and Petherwin; and in the Upper-Devonian column 110 are given, of which 40 of all classes pass up to and connect the Carboniferous; and, taking or assuming the Barnstaple or passage-series in North Devon to represent the lower part of the Carboniferous, we have in *this area* 30 species in common between the two, and 40 in all as compared with the Carboniferous generally in *any area*.

Having, I trust, clearly demonstrated the succession and value of the Lower and Middle Devonian Rocks, and added some little to what was previously known of their conditions, I am compelled to notice, in support of the views advocated, the relations which the fossiliferous Upper Devonian series bear to the so-called Upper Old Red Sandstone of Pickwell Down &c., because it is asserted by Professor Jukes that the uppermost bed of this range was in existence before any of the beds containing marine Devonian fossils were deposited. No one can doubt the fact that, resting upon the upper beds of the Red Sandstones of Pickwell Down at Venton and George Ham, (at the southern part of Morte Bay), we have the lowest members of the Upper Devonian group conformably succeeding the green, red, and grey micaceous Upper Old Red Sandstones above named; but it must not be believed that these are the *lowest marine* Devonian beds. I have endeavoured to show, as others have done before (and, I be-

* The carefully prepared paper by Mr. Salter (Quart. Journ. Geol. Soc. vol. xix. 1863) upon this series south of Baggy, in which the whole question is discussed, and its correlation with the South-Wales beds given, with also special reference to the Irish group, prevents my entering upon them in any form: all the species known in the Upper Devonian series are given in the Tables II. and IX., and their relation to the Carboniferous series of North Devon, or the Carboniferous Limestones of any area, is also given. I have appended a note upon the passage-beds between the Old Red Sandstone and Lower Limestone Shales of the Avon section, where I am disposed to believe the Upper Devonian series is represented by about 1000 feet of grits, shales, and impure limestones, and many species which occur in the Marwood group in North Devon, but which do not range higher into the Carboniferous series above, in the Bristol section.

lieve, successfully), that thousands of feet of fossiliferous slates and limestones occur, in regular sequence through all North Devon from north to south, or from the Foreland to Barnstaple. Had Professor Jukes stated that upon the uppermost beds of the Upper Old Red Sandstone at Pickwell Down rested those containing the Upper-Devonian marine fossils, or in part the equivalent of his Carboniferous slate and Coomhola grits, he would have read the real structure of the country; now we are asked to believe, through the agency of an unknown and supposititious fault with a northern downthrow, or an anticlinal running east and west from Morte Bay to Wiveliscombe, that these Upper Devonian beds (his Carboniferous slates) are repeated in the Lynton area, being rolled, undulated, or faulted to the north.

Upon this hypothesis, therefore, there is no such group as Devonian in North Devon, the whole Lower and Middle series with their characteristic fossils and clearly defined stratigraphical place being swept away, and substituted by the Carboniferous Slate, but *only* through similarity of aspect, and not identity, as based either upon physical or palæontological grounds. On the other hand, there may be grounds for endeavouring to establish contemporaneity between the Upper Devonian series of North Devon and the Carboniferous Slates of the south of Ireland upon the principle of geographical rather than chronological distinction; and the aspect of the beds both in North Devon and Ireland, and their zoological relations one to the other through certain classes, especially the Brachiopoda (*vide* Tables IX. and X.), is clear, and to be expected when we know that the Devonian preceded the Carboniferous in time. And it is admitted that the Petherwin, Baggy, Marwood, Sloy and Croyde beds are older than the Carboniferous Slates, and not clearly represented in the south of Ireland (*vide* Tables IX. and X., and Professor Jukes's "Notes for a comparison" &c. &c., pp. 17, 22, 27). I am disposed, therefore, from careful examination of the Upper Devonian fauna in North Cornwall and North Devon, and of that of the Boulonnais and Belgium, to collate the species in the Irish Carboniferous slate and Coomhola series with the English types rather than adapt the latter to the Irish.

There are in the Upper Devonian rocks of North Devon south of Pickwell Down, including Petherwin, 136 species*, representing 57 genera: 30 of these 136 species, in this area, may be Carboniferous, assuming that the Barnstaple beds are of that age; but no more than 40 are known to pass up to the Carboniferous Slate and Carboniferous Limestone in any area; the remaining 96 are exclusively Upper-Devonian species that lived earlier in time than the Carboniferous†, and underlie the Coomhola Grits and Carboniferous Slate, so

* Omitting the Petherwin, there are 110 true North-Devon forms; the additional Petherwin species occur only in that area amongst Carboniferous-slate and Carboniferous-limestone species.

† Professor Jukes gives a list of 84 species at pp. 22-27, but places them in the Carboniferous Slate on the *assumption* only that they are so; a Roman letter indicates (as stated at p. 17) the Old-Red-Sandstone localities, but *not yet* Carboniferous-slate localities. My Table IX. and that list will correct each other.

far as we know at present, everywhere. The value of Mr. Salter's paper is lost if we reject his careful determinations relative to the Upper Old Red and Devonian; if they be controverted, then we will convert the term Upper Devonian into Carboniferous Slate; but upon the nomenclature as it now stands, Mr. Salter's observations and my own go far to suggest, if not to prove, that the *Coomhola* species may yet be Upper Devonian; and this is supported by the fact that *Cyrtina heteroclyta* and *Spirifera disjuncta* occur in the gritty beds of Reenydonegan Point, Bantry Bay, one a strictly Middle Devonian form, and the other neither known in the Carboniferous Slate nor above the Upper Devonian in England or in any part of Europe. There may be confusion yet in the Irish series; and the comparison made between the thick Carboniferous slates of Cork, and the equally thick sandy slates and limestones of the Upper Devonian series of Baggy and Croyde in North Devon, may yet require considerable revision; that these Irish and North-Devon Upper Devonian beds are intermediate between and connect the Upper Old Red Sandstone and the Carboniferous rocks, there can be no doubt; and although the *Coomhola* grits appear stratigraphically to belong to the Carboniferous rocks of Ireland, yet it is found that they contain many Devonian species; and notably we find close resemblance between the two, both in structure and associated fossils, especially so in the Baggy, Marwood, and Pilton group; and they may readily be mistaken; but, taken as a whole, there cannot be any doubt as to the distinctness of the faunæ of the two, although connected by gradual passage. The species, then, of the Upper Devonian of North Devon may be on the "same general horizon" as those of the *Coomhola* series in Ireland; but that our lowest beds of this group, or the Petherwin and Landlake limestones and slates &c., are chronologically below the Baggy group and the Irish grits, there cannot be any doubt. We may yet expect to find a true Upper-Devonian fauna in the slates and grits that overlie the Upper Old Red Sandstone of the south of Ireland; and it will have to be collated to the English type; for that we have a large assemblage of well-marked forms in our Upper Devonian beds not yet accounted for in the Irish series is certain; and that we have a definite Middle- and Lower-Devonian fauna in North Devon, distinct from the Upper- and not known in Ireland, whatever may be the cause, is equally certain.

It has been questioned whether or not the "*Stringocephalus*-limestones of either North or South Devon can be shown to exist below anything that can be identified as Old Red Sandstone." No doubt can exist as to the stratigraphical position of the slates and grits that contain this and associated shells abundantly in North Devon; its position here, as in Rhenish Prussia, the Eifel, and as the *Calceola*-slates of the Boulonnais, is in the heart of the Middle or Ilfracombe group; it is abundant in places, especially so in Combe-Martin Bay, Hagginton, &c.; and when it is proved that the intermediate mass of slates &c. of the Ilfracombe series are *Carboniferous Slate*, then will *Stringocephalus Burtini*, *Uncites gryphus*, *Calceola sandalina*,

Davidsonia Verneuilii, and many other equally characteristic species cease to be typical continental and British Middle-Devonian shells. The limestones and gritty slates of Combe Martin occupy in North Devon the same subordinate place in that series (being near the base), as they do at Ecaussines, in Brabant, and they are unquestionably the equivalents in this country of the Paffrath and Münster-Eifel beds in the Rhenish provinces.

I have endeavoured to show reasons why these beds reposing upon the Hangman grits occupy a place far below the so-called Old Red Sandstone of Pickwell Down*.

In South Devon we have no Upper Devonian rocks yet known, and consequently no fossils referable to them.

It has also been asked if "the rocks of South Devon are not a mere expansion of the [so-called] *Carboniferous Slates of North Devon*, with a change in the fauna depending upon difference of province." No one who has examined the fossils or the rock-masses of the two areas north and south of the granitic mass of the Dartmoor can doubt their identity in time, either through organic remains, or through similarity of physical structure, the chief and only difference being the greater development of the organic limestones in the south over that of those in the northern area. There is no change or difference in the fauna of the two regions; and of the 238 species known in the Middle Devonian of South Devon 53 occur in the same series in North Devon, and that chiefly through the corals and Brachiopoda; and 21† of these 238 are known in

* It is still an open question whether the Upper Devonian beds are represented in the Avon section or not. There is a series of grey shaly marls and impure limestones beneath the Bone-bed which exists at the base of the Lower Limestone Shales; in one of these shaly beds are found *Modiola Macadami*, *Avicula Damnoniensis*, *Cucullæa trapezium*, *C. Hardingii*, *Filicites dichotoma*, *Knorrria dichotoma*, *Naticopsis plicistria*, and other forms recognized in the Upper Devonian beds of the Marwood series in North Devon. Underlying the bed containing the above, there occurs 100 feet of alternating limestones, shales, and marls, including about 30 feet of passage-beds into the Old Red Sandstone, which is recognizable by quartzose conglomerates. None of the above forms occur higher, in the Carboniferous Limestone, not even in the intermediate and immediately succeeding argillaceous Lower Limestone Shales; but true Carboniferous species are associated with them, such as *Spirifera bisulcata*, *Streptorhynchus crenistria*, *Rhynchonella pleurodon*, *Orthoceras gregarium*, *Lingula mytiloides*. All the above facts were carefully noted and described by W. W. Stoddart, Esq., F.G.S., in a communication read at the Bath Meeting of the British Association, 1865, Trans. of Sections, p. 71. I have since examined and measured the entire section underlying the red crystalline limestone, band which forms so conspicuous a feature below the Fish- or Bone-bed; and whatever these impure limestones, grits, and shales may be, they are a very distinct group from either the red conglomerates and marls below, or the overlying argillaceous limestones, which constitute the well-defined so-called Lower Limestone Shales, which are 500 feet thick: this passage-series may, and probably does, represent the greatly developed Upper Devonian beds of Baggy and Marwood above the Upper Old Red Sandstone of Pickwell Down; before the chief mass of thick-bedded flaggy Old Red Sandstone and marls are reached, the ground is occupied by a highly siliceous variegated marly series, measuring 1000 feet, which is indicated by the valley east of the railway-tunnel.

† 3 Polyzoa, 8 Brachiopoda, 3 Lamellibranchiata, 4 Gasteropoda, and 3 Cephalopoda.

or pass up to the Carboniferous generally. But the relationship between the fossils of the southern area and those of the continental Middle Devonian is more remarkable; for of the 238 species in England 90 are common to the two, almost every species of coral being the same, and the majority of the Brachiopoda also. Rather, then, should we expect to find that the species in the Carboniferous Slate are expansions of the Middle Devonian, the change in the fauna, when complete, being due to a difference of province or area as well as of time. We therefore look to the Devonian for the types with which to compare our Carboniferous fauna, and they will be found in North and South Devon.

If I am right in substantiating the succession in North Devon, it is impossible that the Devonian slates and limestones of South Devon can be an expansion or extension requiring nearly contemporaneous deposition—a condition to be perhaps readily accounted for in the case of the Carboniferous Slate and Carboniferous Limestone, which were doubtless formed under very different local conditions, and in one area. Such an hypothesis can scarcely be applied to the prior existing, lower, older, and conformable Middle Devonian slates and limestones of either North or South Devon, with an almost totally different fauna; the parallel hypothesis may be drawn and applied with relation to the Upper Devonian beds of Baggy and Marwood &c. and the Coomhola group. They perhaps were deposited on the same general horizon in time, under different geographical conditions, and now rest upon (in the Irish and English areas) a set of sandstones which constitute the base of the Upper marine Devonian series, let them be called by what name we please. It is their position as well as their palæontological value I contend for, both of which, if rightly viewed, give not only a natural but a true solution to the upward succession of the North Devon rocks. There is nothing in Ireland below our Upper fossiliferous marine Devonian series (Irish Carboniferous slate); and in endeavouring to make that the base of the whole of the Old Red Sandstone I believe that Professor Jukes has committed an error, and also in endeavouring to establish for Ireland a fossiliferous base for the Old Red Sandstone. Our fossiliferous Lynton and Ilfracombe series may, and probably do, represent in time the thick Irish series of red sandstones, gritstones, and clay slates, the base of which it is admitted has never been seen, and on the top of which repose their Carboniferous Slates, Coomhola Grits, and our Upper Devonian in part.

I believe, therefore, that we have in North Devon, and in the Lynton and Ilfracombe series only, the fossiliferous representative of these barren Irish Lower Old Red Sandstones, deposited under different conditions in a different area, although apparently allied geographically, accounted for upon the same principle that Professor Jukes advances relative to the lowest Carboniferous groups, and dependent upon chronological and geographical distribution, agreement, or distinction.

I therefore still ask whether the fossiliferous slates, sandstones,

and grits that repose upon the Upper Old Red Sandstone of Ireland under the names of Carboniferous Slate, Glengariff Grits, &c. are not, or may not prove to be an expansion of, the well-known well-marked typical English fossiliferous Upper Devonian series that occurs on the southern flanks of Pickwell Downs &c., which no one doubts passes insensibly, conformably, and inseparably into the Carboniferous (Carbonaceous) beds above in that area, where they overlie and are conformable to the so-called Old Red Sandstone*, which occupies the same position in South Wales and Ireland, but which at its base graduates down (in North Devon) through the conformable and underlying Morte slates into the well-marked Ilfracombe and Combe-Martin series, the Hangman grits, and the Lynton beds below them, all through which a life-succession and physical aspect are determinable, distinct, and readily separable from the beds called Upper Devonian and Carboniferous above.

When physical facts and fossil evidence can be put forward that will tend to show that the Ilfracombe and Lynton series are not below the Upper Old Red Sandstone of Pickwell Down, and are not the Lower and Middle Devonian, by an assemblage and facies of recognized organic remains as zoologically distinct as the Carboniferous are from the Permian which succeed them, and not till then, can any new reading be proposed for the physical structure of North Devon.

After very careful investigation into the physical structure of North Devon, as well as a critical examination of the organic remains contained in its diversified rock-masses, I can come to no other conclusion than that the series of sandstones, slates, and limestones ranging from the Foreland and Lynton on the north to Pilton and Barnstaple on the south are one great and well-defined system, and equally well divisible into three groups, a Lower, Middle, and Upper Devonian series, each equally well characterized by a fauna, the zoological facies of which are sufficiently distinct to determine them one from the other. Let this Devonian system be equated to what it may, it is nevertheless a great life-group—a system based upon clear stratigraphical succession of strata and an associated and well-marked marine fauna. This is borne out and testified by its extended and equivalent groups in Europe, where in Nassau, Rhenish Prussia, and Belgium the Lower and Middle series are precisely the same as our own in North and South Devon.

In Great Britain, the *North-Devon* and *West-Somerset* rocks must be regarded as the types with which we must compare those of South Devon and the Continent; for here only can the succession be satisfactorily determined; and although the preservation of the fossil fauna is more obscure than in the south, still every day adds to its comparative completeness, and to the identity of the two areas.

In North Devon and West Somerset only do we get the lowest known beds; and although these are much obscured by the Lynton anticlinal, and perhaps an extensive fault affecting the Foreland sandstones, it is clear that no fossil-bearing slates or limestones underlie

* Not the *whole*, but the "Upper."

these red grits and sandstones. I consider the Devonian deposits as a whole to be equivalent in time with, or chronologically the same as, the Old Red Sandstone as a whole—and that as it is convenient to divide the series composing the mass of the latter into Lower, Middle, and Upper Old Red by stratigraphical sequence and the fossil fishes which characterize the groupings, so it is also equally convenient and natural to make a threefold division of the marine Devonian Rocks as characterized by the assemblage of organic remains in, and by the physical characters of, each, and especially so through the middle or intermediate group and its great limestone coral-bearing series, this holding good for Europe as well as Britain.

I believe we may yet be able to demonstrate that the marine Devonian series of West Somerset and North Devon was deposited in a different area, a different province of life, from that of the Old Red Sandstone; it is a great marine system totally distinct from the Silurian below, and even from its contemporaneous, or synchronously deposited Old Red Sandstone, and that, through its upper members, when or where developed, it gradually passed into the succeeding Carboniferous group—which is incontestably seen and proved to be the case in the North-Devon area.

We have yet to learn what were the conditions and what the physical changes that took place at the close of the marine Silurian epoch and the commencement of the Old Red Sandstone proper, by which so complete a change took place that almost every species and vestige of invertebrate life changed or passed away, or is not preserved to us, through the whole of that interval of time which witnessed the deposition of the normal Old Red Sandstone series. I believe we can come to no other conclusion than that in the typical Old-Red area the marine Silurian sea was slowly and gradually changed, or was succeeded by long-continued and slow elevations and oscillations of the land, thus converting the old marine area into one of freshwater conditions of great extent. The contour of the area over which the Old Red Sandstone of England and Wales extended would favour and lend considerable weight to this view. The oval basin-shaped region or tract occupied by this formation extended from Much-Wenlock on the north to Haverford West and Milford Haven in South Wales, along the junction of the Silurian and Old Red strata at its western boundary, and thence in an easterly direction or strike to Pembroke, Caldy, Worms-Head and across the Channel to the Mendip Hills, and thence again deflected north, along the eastern margin of the Bristol Coal-field, where the still older Palæozoic rocks and Old Red Sandstone, as well as the Carboniferous series, all dip west, this condition being continuous along the strike of the Malvern and Abberley Palæozoic series and onwards to Bridgenorth. This extensive area, the only one in England occupied by the true normal Old Red Sandstone, though not so extensive as that originally occupied by the Wealden when produced across the English Channel into the Boulonnais, may have been, and indeed very probably was, during a long interval of time, subject to freshwater conditions, either estuarine or lacustrine, with slow but continuous

elevation of the land over the district traced out. There is nothing in the physical structure of the country to forbid this supposition, and on palæontological grounds nothing to disprove it. No form of invertebrate life can be pointed out, over this great area, that lived on beyond the deposition of the passage-beds on the confines of the two systems. The fishes and Pœcilopod Crustacea (both of which are allied to fresh water forms) are not known beyond the old margin; and those species of fish that do occur are sparingly found in the cornstones of Hereford and South Wales.

Either, I believe, we must admit that the total extinction of the Silurian species at the commencement of the deposition of the Old Red Sandstone was due to those conditions I have endeavoured to trace, or that the marine Devonian series must have been deposited and accumulated in an area having little or no community with the previously existing Silurian sea, but went on synchronously with the Old Red Sandstone, though in a different province, and under marine conditions; and we have not, I think, any great difficulty in approximately determining the position and probable extent of that area. I am disposed to believe that these marine Devonian strata were accumulated in a definite region, defined by a barrier which may have existed south of the Mendip Hills, and continuous or parallel with that range towards France and Belgium and the Rhenish provinces. Physicists may yet determine this; but it is south, or along the course of the Bristol Channel north, of the Foreland, that, I believe it may be determined, the equivalent strata in time, the marine Devonian rocks, were deposited. In other words, the southern British equivalents of the Old Red Sandstone (the Devonians) were deposited in a different and marine area, whilst the typical Old Red Sandstones were being accumulated in an area to the north of the prescribed barrier, and are of purely freshwater origin, the contour of that area being governed by the previously existing and older Palæozoic Rocks: the base of the one is seen in the Silurian area; and its upper members under many aspects may be examined in Wales, Somersetshire, and Gloucestershire, and under a different condition still in North Devon and Ireland.

It is from the remarkable contrast and difference that exists in the lithological and physical characters of the rock-masses of the typical Old Red Sandstone in its various localities as compared with what we believe to be its representative and equivalent in time, viz. the Devonian in North and South Devon and in the European areas, that we are led to examine into the causes for so complete a discrepancy; and looking at the exact bearing and well-defined strike of this westerly remnant of the North-Devon Devonian rocks under the waters of the St. George's Channel, or Atlantic Ocean, I am led to believe that an extensive coast-line or barrier existed to the north of what is now the coast of West Somerset and North Devon, at Lynton, Porlock, and Minehead, and thus construct a different geographical area or province of deposition and accumulation for the fossiliferous marine Devonian series. This sea and area would appear to have been extensive, if we correlate and connect our beds with their equivalents

in Belgium, and to the north, in the latitude of Düsseldorf and Arnberg, [in the north of Rhenish Prussia,] and on the east to the Taunus and Hunsrück ranges over the Coblentian area, thence south to Luxembourg, Mezières, and the Ardennes &c., and continuously on, with interruptions, to the Boulonnais, under the Paris basin, joining the narrow strip that reposes near Angers, Vannes, and Quimper, in Brittany, upon the Silurian series. Patches of Devonian rocks on the extreme north coast of Brittany would help us to construct this southern boundary to the Mid-European Devonian deposits or area.

It is not improbable that the Devonian rocks of the Pyrenees and of the Asturias, which strike east and west parallel to the British series, may have formed also a still more southerly extension of the same. They occupy an immense area in the north of Spain and south of France. On palæontological grounds also the British, Irish, Belgian, Prussian, South French, Pyrenean, and Asturian series may have formed, and probably did form or constitute, a connected and contemporaneous series of marine deposits—one definite hydrographical area; for the facies of the fauna in all the districts is the same.

Somewhere, then, at no great distance south of the Mendip Hills, I would suggest that an extensive barrier or ridge existed at the time of the deposition of the Lower Old Red Sandstone, perhaps an axis of depression synchronous with movements of elevation to the north, in the Silurian area, which governed the conditions of the deposition of the Old Red Sandstone, and destroyed the marine fauna at the close of the Silurian period. To the south of this barrier, which severed the groups and cut off communication with the northern area, were deposited the marine equivalents of the Old Red Sandstone (the Lower and Middle Devonian slates and limestones); in other words, this barrier, let it have been what it may, would produce two hydrographical areas—one marine, to the south, the other freshwater, to the north, or in the Silurian area (Wales, Herefordshire, Shropshire, Gloucestershire, &c.). A total change took place in the marine fauna through its passage-series to the succeeding and conformable Lower Old Red Sandstone, when the few Fish and Crustacea in common to the two series almost, if not entirely, disappeared; and the vast accumulation of sandstones marks an epoch and an area in one sense apparently lifeless; for we have only two or three species, and these land and freshwater, and found only in the upper part of the Old Red.

The structure of North Devon does not aid us in one desired point, there not being, as in the typical district, a recognizable base to the Lower Devonian slates of Lynton,—the Silurian, if there, being deeply seated and beneath the Foreland sandstones. We cannot, however, have any doubt, or hesitate to come to the conclusion, that the red, grey, and variegated sandstones and grits that constitute the structure of the country from the Foreland to Porlock, Minehead and Dunster, and the western side of the Quantocks belong in *time* to this lower part of the Old Red Sandstone; neither can we

fail to clearly determine that south and south-west of Lynmouth, after passing the anticlinal, an entirely new marine fauna sets in, accompanied by an equally new set of physical conditions, the species comprising the fauna in this North Devon area having but one form in common with all the Silurian species, viz. *Atrypa reticularis*. We are therefore, I believe, from our knowledge of the structure of the country, justified in assuming that along its now northern borders, washed by the waters of the Bristol Channel, and somewhere south of the Mendip Hills, an axis of movement or a barrier of some kind existed, stretching under what are now the secondary rocks of Somerset, Dorset, Hampshire, Sussex, and Kent, on to the French, Belgian, and Rhenish areas, over which we have one and the same kind of physical conditions, one and the same fauna, one and the same recognizable and adapted general succession.

The accompanying Table of equivalent strata in different areas has been drawn up with the view of endeavouring to coordinate the groups one to the other, taking their physical structure, and the distribution of the fossils of North and South Devon as the types of the Devonian system, adapting the European and Irish series to them as the type. It is still a matter of great doubt as to whether the true Old Red Sandstone series of England, Wales, and Scotland can in any way be really coordinated with the marine Devonian of Devonshire. All that can be said is, that they both occupy a place above the Silurian and below the Carboniferous, and that they are not found together in any area. The barren Foreland sandstones at the base of the Lynton slates I have, as before stated, placed as Lower Devonian sandstone. The red grits and sandstones which succeed these (the Hangman grits), and on which repose the Combe-Martin and Ilfracombe slates, I have placed at the base of, and classified with, the Middle Devonian series as Middle Devonian sandstone, and the equally well-defined and (to these) conformable red sandstones of Pickwell Down I have placed at the base of the Upper Devonian strata as Upper Devonian sandstone, which is the whole of the Old Red Sandstone of Prof. Jukes*. The groupings of the Rhenish Prussian, Belgian, and French series are correlated with our Devonshire beds, the whole of which I believe belong to and were deposited in and over one general area, and contemporaneously.

* Neither of these three Sandstones contains any organic remains, except the uppermost beds of the Hangman Grits near Combe Martin, in which occur *Mya'ina* and *Natica*, &c., as before stated.

TABLE XII.—Showing the Groupings of the Palæozoic Rocks of North Devon, and their equivalents in South Devon, Cornwall, South Wales, Scotland, South Ireland, and the three European areas.

	NORTH DEVON.	SOUTH DEVON.	CORNWALL.	SOUTH WALES.	SCOTLAND.	SOUTH IRELAND.	RHENISH PRUSSIA.	BELGIUM.	FRANCE.
CARBONIFEROUS SERIES.	Barnstaple beds (part). Carboniferous series of Sedgwick and Murchison.	Carboniferous beds.	Carboniferous series, Boscastle &c.	Carboniferous, Tenby &c.	Carboniferous series.	Carboniferous limestones, Carboniferous slates.	.....	.....	.....
UPPER DEVONIAN, OR UPPER OLD RED SANDSTONE.	Pilton, Braunton, Croyde, Marwood, Sloly, and Baggy beds, with the Pickwell-Down Sandstones at the base (Morte-Bay series).	No representative?*	Petherwin limestones and slates, Tintagel and De la Bole slates.	Pembroke section, part, Yellow sandstones, &c., and Upper Old Red Sandstone.	Yellow and Red Sandstones, Dura-Den beds, <i>Holoptychius</i> &c., Lammermuir Hills, Fifeshire sandstones.	Coomhola grits, yellow sandstones, &c., Upper Old Red Sandstone of the Cork area, with plant-remains, <i>Anodon</i> , and Fish &c.	Verneuillii-Schiefer, Clymenia-Kalk and Goniatite limestones and shales (Buch), Cypridina-Schiefer (Sandberger), Krammenzelstein (Dunker).	Syst. Condrusien (Dumont) inférieur.	Psammites de Condros, Slates of Famienné, Boulonnais beds.
CENTRAL OR MIDDLE DEVONIAN. MIDDLE OLD RED SANDSTONE.	Mortehoe, Woolacombe, Rockham, and Lee Slates. Ilfracombe and Combe-Martin Slates, Grits, Sandstones, and Limestones. The Hangman Grits at the base.	Dartmouth slates, Dartington, Oggwell, Torquay, Newton, and Plymouth Limestones, Lummaton and Ramsleigh &c.	Padstow, Looe grits (= Hangman beds), Polperro.	Old Red Sandstone (in part).	Caithness flagstones &c., Elgin and Findhorn Rivers with <i>Asterolepis</i> , <i>Cheirolepis</i> , <i>Dipterus</i> , <i>Osteolepis</i> , <i>Coccosteus</i> , <i>Pterichthys</i> , &c.	The great mass of unfossiliferous grits and sandstone of Dingle. Dingle beds (Kerry), base not seen.	Eifel limestone (Römer), Agger- and Lenne-Schiefer (Dunker) = Calceola-Schiefer, Rhenish Gramovelle (Römer).	Système Eifélien.	Givet limestone, Calceola-slates.
LOWER DEVONIAN, OR LOWER OLD RED SANDSTONE.	Heddon's-Mouth, Woodabay, Lee, Valley-of-Rocks, Watersmeet, Lynton, and Lynmouth Slates, &c. The Red Grits and Sandstones of the Foreland, Countisbury, Glenthorn, &c. &c., at the base.	Meadsfoot slates with <i>Phyllolepis concentricus</i> , Yealmp-ton-Creek and Black-Hill &c. &c. slates, Looe Island.	St.-Veep, Polruan, Polperro, and Fowey grits and slates.	Lower part of Cornstones &c., Old Red Sandstone.	Forfarshire flagstones &c. (Ross and N.E. Highlands), <i>Onchus</i> , <i>Cephalaspis</i> , <i>Pteraspis</i> , &c.	Glengariff grits, Killarney, Dingle, no fossils.	Ardennes-Schiefer, Coblenz-Schiefer, Wissenbach slates, Spirifer-Sandstein (Sandb.), Aeltere Rheinische Grauwacke (Römer), Système Coblentzien et Syst. Ahrien (Dumont).	Syst. Ahrien, Syst. Coblentzien.	Système Rhénan.

* Beds of Upper Devonian age probably occur near Newton Bushel.