compared; in the London slab they measure 2·5 cm. and 2·9 cm.; in the Berlin slab 1·7 and 2·8, but the longest Berlin digit is 4·3 cm.; so that notwithstanding its smaller size the Berlin animal appears to have had digits as long as the London specimen. The Berlin scapula measures 4 cm. and may be imperfect; the London scapula is 4·2 cm. The London ilium is 4·3 cm. long, in the Berlin slab it does not appear to exceed 3 cm. The ribs appear to be longer in the Berlin slab, some measuring 4·8 cm., while the longest in the London slab is 3·7 cm.

The Berlin tail measures 16·5 cm., and appears to include 21 vertebræ; the London tail measures 20·8 cm., and appears to include 23 vertebræ, of which the first 9 have transverse processes. The London animal probably had 5 sacral and 8 dorsal vertebræ, with a length of 8·5 cm., though number and length are uncertain. In the Berlin animal the length of this region is 8·5 cm. Vogt counts 10 in the back. The neck is imperfect in the London slab, the vertebræ lie in curve, five at least are preserved; a centrum measures 1 cm. In the Berlin slab the neck measures about 6·8 cm. Vogt estimates 8 vertebræ, but there are probably more. The head of the London animal as preserved measures 4 cm. in length; the Berlin head to the occipital articulation is 4·7 cm., and to the limit of the occipital crest about 6·1 cm. These differences are supported by details in the forms of the bones, which also prove the species to be distinct.

NOTICES OF MEMOIRS.

I.—British Association for the Advancement of Science, Fifty-First Meeting, 31st August, 1881.

[Sir John Lubbock, Bart., M.P., D.C.L., LL.D., F.R.S., etc., *President.*]

1.—Titles of Papers Read in Section C. (Geology).

President: Professor A. C. Ramsay, LL.D., F.R.S., etc.

Address by the President. (See p. 459.)

Prof. E. Hull, LL.D., F.R.S.—On the Laurentian Beds of Donegal and of other parts of Ireland.

G. H. Kinahan, M.R.I.A.—On the Laurentian Rocks of Ireland.[1]

C. Moore, F.G.S.—Life in Irish and other Laurentian Rocks.

A. R. Hunt, M.A., F.G.S.—On the Occurrence of Granite *in situ* about 20 miles S.W. of the Eddystone.

Professor J. Prestwich, M.A., F.R.S.—Some observations on the causes of Volcanic Action.

Professor W. J. Sollas, M.A., F.G.S.—The connexion between the Intrusion of Volcanic Rocks and Volcanic Eruptions.

Baldwin Latham, M. Inst. C.E., F.G.S.—On the Influence of Barometric Pressure on the Discharge of Water from Springs.

J. E. Clark, B.Sc.—Glacial Sections at York.

G. W. Lamplugh.—On the Bridlington and Dimlington Glacial Shell Bed.

J. R. Mortimer.—On Sections of the Drift obtained by the new drainage works of Driffield.

[1] See Geol. Mag. Sept. p. 427.

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A. G. Cameron.—On Subsidences over the Permian Limestone between Hartlepool and Ripon.

J. D. Kendall.—The Glacial Deposits of West Cumberland.

Professor H. G. Seeley, F.R.S.—On *Simosaurus pusillus* (Fraas), and the evolution of Plesiosaurus.

Professor H. G. Seeley, F.R.S.—On a restoration of *Archæopteryx*, with remarks on differences between the two specimens. (See p. 454.)

Professor P. M. Duncan, F.R.S.—On *Asterosmilia Readi*, a new Species of Coral from the Oligocene of Brockenhurst.

Professor J. Prestwich, M.A., F.R.S.—On the strata between the Chillesford Beds and the Lower Boulder Clay—"The Mundesley and Westleton Beds."

Professor J. Prestwich, M.A., F.R.S.—On the Extension into Essex, Middlesex, and other inland counties of the Mundesley and Westleton Beds, in relation to the Age of certain Hill Gravels, and of some of the Valleys of the South of England. (See p. 466.)

E. B. Poulton, M.A.—A Preliminary Report of the working (now in progress) of Dowkerbottom Cave, in Craven.

C. E. De Rance.—Report on the Circulation of Underground Waters.

W. H. Baily.—Report on the Tertiary Flora of the Basalt of the North of Ireland.

E. Wethered.—On the Formation of Coal. (See p. 469.)

Professor W. C. Williamson, F.R.S.—Preliminary Remarks on the Microscopic Structure of Coal.

W. Cash.—Some Remarks on the Halifax Hard Seam.

Jas. Spencer.—Researches in Fossil Botany.

Jas. Spencer.—Notes on *Astromyelon* and its root.

W. A. E. Ussher.—On the Palæozoic Rocks of North Devon and West Somerset. (See p. 441.)

Professor E. Hull, F.R.S.—The Devono-Silurian Formation.

Rev. E. Hill, M.A.—On Evaporation and Eccentricity as Cofactors in the causes of Glacial Periods.

A. Strahan.—On the Discovery of Coal-measures under New Red Sandstone, and on the so-called Permian Rocks of St. Helen's, Lancashire. (See p. 433.)

E. B. Tawney, M.A.—On the Upper Bagshot Sands of Hordwell Cliffs, Hampshire.

Rev. H. W. Crosskey.—Report on the Erratic Blocks of England, Wales, and Ireland.

G. R. Vine.—Report on Fossil Polyzoa. (See p. 471.)

J. R. Dakyns, M.A.—On "Flots."

P. H. Carpenter, M.A.—Remarks on the Structure and Classification of the Blastoidea. (See p. 464.)

P. H. Carpenter, M.A.—On the Characters of the Lansdowne Encrinite, *Millericrinus Prattii*, Gray. (See p. 466.)

A. Strahan, M.A.—On the Lower Keuper Sandstone of Cheshire.[1]

E. Wilson.—On a Discovery of Fossil Fishes in the New Red Sandstone of Nottingham.

[1] See Geol. Mag. September, p. 396.

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E. Wilson.—On the Rhætics of Nottinghamshire. (See p. 464.)
W. T. Blanford, F.R.S.—The Great Plain of Northern India not an Old Sea Basin.
W. King, B.A.—On Gold in Southern India, and the Quartz Outcrops.
R. Russell.—On the Geology of the Island of Cyprus.
Professor E. Hull, LL.D., F.R.S.—Observations on the two types of Cambrian Beds in the British Isles (the Caledonian and the Hiberno-Cambrian), and the conditions under which they were respectively deposited.
Professor T. McK. Hughes, M.A. — On the Lower Cambrian of Anglesea.
Professor T. McK. Hughes, M.A.—On the Gnarled Series of Holyhead and Amlwch in Anglesea.
Professor W. J. Sollas, M.A.—The Subject-matter of Geology and its Classification.
J. W. Davis.—An Account of the Exploration of the Raygill Fissure in Lothersdale, Yorkshire.
J. W. Davis.—On *Diodontopsodus*, a new genus of Fossil Fishes from the Mountain Limestone of Yorkshire.
J. W. Davis.—On the Zoological Position of the genus *Petalorhynchus*, Agass., Fossil Fishes from the Mountain Limestone.
Professor John Milne.—Report on the Earthquakes of Japan.
Professor John Milne and Thomas Gray, B.Sc.—A Contribution to Seismology.
Professor A. S. Herschel, M.A., and Professor G. A. Lebour, M.A.—Report on the Thermal Conductivities of certain Rocks, showing especially the Geological Aspects of the Investigation. (Read also before Section A.)
W. Topley.—On an International Scheme of Colours for Geological Maps.
J. A. Phillips, F.R.S.—The Origin of Desert Sandstone.
W. Keeping, M.A.—On the Glacial Geology of Central Wales.
J. Hopkinson.—On some points in the Morphology of the *Rhabdophora*, or true Graptolites. (See p. 448.)
H. Stopes.—On some Ores and Minerals from Laurium, Greece.
C. E. De Rance.—Notes on the Cheshire Salt Field.
J. E. Marr.—On some Sections in the Lower Palæozoic Rocks in the Craven District.

2.—Titles of Papers, Bearing upon Geology, read in other Sections.

Section A.—Physical Science.

Dr. S. Haughton.—On the Effects of Gulf Streams upon Climates.
Professor Schuster.—Report of Committee on Meteoric Dust.
J. N. Shoolbred.—Report of Committee on Tidal Observations in the English Channel and the North Sea.
Professor Everett.—Report of Committee on Underground Temperature.
T. Fairley.—On the Blowing Wells at Northallerton. (Read also before Section B.)

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Sir Wm. Thomson.—On the Thermodynamic Acceleration of the Earth's Rotation.

Section B.—Chemical Science.

I. Lowthian Bell, F.R.S.—On the Occlusion of Gaseous Matter by Fused Silicates at high temperatures, and its possible connexion with Volcanic Agencies.

W. Lant Carpenter, B.A., B.Sc.—On the Siliceous and other Hot Springs in the Volcanic Districts of the North Island of New Zealand.

V. H. Veley, B.A.—The Oxides of Manganese.

J. Y. Buchanan.—On Manganese Nodules and their Occurrence on the Sea Bottom.

E. Divers, M.D.—Note on the Sodium Alum of Japan.

E. Divers, M.D.—Note on the Occurrence of Selenium and Tellurium in Japan.

E. Divers, M.D.—Note on the Chrome Iron Ore of Japan.

J. A. Wanklyn.—Note on the Phosphates of Lime and Ammonia.

W. Galloway.—On Colliery Explosions.

C. F. Cross, B.Sc., and E. J. Bevan.—Cellulose and Coal.

J. L. Phipson.—On the New Metal Actinium.

Section D.—Biology.

R. J. Ussher.—Report on the Caves and Kitchen-middens at Cappagh, Co. Waterford.

Professor O. C. Marsh.—Jurassic Birds and their Allies.

General Pitt-Rivers, F.R.S.—On the Discovery of Flint Implements in Stratified Gravel in the Valley of the Nile, near Thebes.

Thomas Hicks and W. Cash.—On a Fossil Stem from the Halifax Coal-measures.

H. Stopes.—Traces of Man in the Crag.

Professor T. McK. Hughes and A. Williams Wynn.—On the Age of the Deposits in the Caves of Cefn, near St. Asaph, with special reference to the date of Man's First Appearance in them.

Henry Seaton Harland.—On Prehistoric Flints, etc., lately found whilst excavating on the New Line of Railway from Pickering to Scarborough.

Section E.—Geography.

W. Lant Carpenter, B.A., B.Sc.—On the Hot-Lake District, and the Glaciers and Fjords of New Zealand.

Commander V. L. Cameron, R.N.—Recent Visit to the Gold Mines of the West Coast of Africa.

Section G.—Mechanical Science.

Joseph Lucas.—On an Organization for the Systematic Gauging of the Wells, Springs, and Rivers of Great Britain.

II.—British Association for the Advancement of Science. Jubilee Meeting, York. Address to the Geological Section by the President, A. C. Ramsay, LL.D., F.R.S., etc., Director-General of the Geolgical Survey, September 1st, 1881.

On the Origin, Progress, and Present State of British Geology, especially since the First Meeting of the British Association at York in 1331.

In the year 1788, Hutton published his first sketch of his "Theory of the Earth," afterwards extended and explained by Playfair in a manner more popular and perspicuous than is done in Hutton's own writings. In this grand work, Hutton clearly explains that the oldest known strata, like their successors, are derivative, and that as far as *observation* can discover, in all geological time, "we find no vestige of a beginning, and no sign of an end." The complement to this far-seeing observation was at length brought about by William Smith, in his original "Geological Map of the Strata of England and Wales" in 1815, followed, in 1816, by his "Strata Identified by Organized Fossils." This great discovery, for such it was, threw a new light on the history of the earth, proving what had before been unknown, that all the "Secondary" formations at least, from the Lias to the Chalk inclusive, contained each a set of distinctive fossils by which it could be recognized. A law was thus provided for the identification of formations which geographically are often widely separated from each other, not only in England in the case of minor outliers, but also easily applicable to great areas on the neighbouring continent of Europe.

In 1811, the first volume of the "Transactions" of the Geological Society was published, and in 1826–27, there appeared the first volume of the "Proceedings," the object being to communicate to the Fellows as promptly as possible the proceedings of the Society "during the intervals between the appearance of the several parts of the Transactions." The last volume of the "Transactions" contains memoirs read between the years 1845–1856, and only four volumes of the "Proceedings" appeared between the years 1826 and 1845 inclusive, after which the title of the annual volume was changed to that of the "Quarterly Journal of the Geological Society." The Geological Society, to which the science owes so much, was therefore in full action when the British Association was founded in 1831, and the memoirs read before the Society from 1831 to this date may be said to show generally the state of British geology during the last fifty years. To this must be added the powerful influence of the first (1830) and later editions of Lyell's "Principles of Geology," a work which helped to lay the foundations of those researches in Physical Geology which both in earlier and later years have attracted so much attention.

Fifty years ago in this city, Viscount Milton was President of the first meeting of "The British Association for the Advancement of Science," which he explained had for its chief object "to give a stronger impulse and more systematic direction to scientific inquiry."

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In his address, he pointed out the numbers of Philosophical Societies which by degrees sprung up in all parts of the kingdom; and the practicability, through the means of the Association, "including all the scientific strength of Great Britain," "to point out the lines in which the direction of science should move."

In that year, 1831, Professor Sedgwick was president of the Geological Society, and the Geological and Geographical Committee of the British Association recommended that geologists should examine the truth of that part of the theory of Elie de Beaumont, in its application to England, Scotland, and Ireland, which asserts that *the lines of disturbance of the strata assignable to the same age are parallel;* that Professor Phillips be requested to draw up *a systematic catalogue of all the organized fossils of Great Britain and Ireland;* and that Mr. Robert Stevenson, Civil Engineer, be requested to prepare a report upon *the waste and extension of the land on the east coast of Britain, and the question of the permanence of the relative level of the sea and land.*

In 1881 it seems strange to us that, in 1831, with William Smith's map of "The Strata of England and Wales, with part Scotland," before them, it should have been considered necessary to institute an inquiry as to the truth of the general parallelism of disturbed strata, which, in a limited area like England, had suffered upheaval at different successive epochs; and we may fancy the internal smile with which Phillips, the nephew of Smith, regarded the needless proposal. The masterpiece of the old land surveyor and civil engineer remains to this day the foundation of all subsequent geological maps of England and Wales; and *as an unaided effort of practical genius*—for such it was—it seems impossible that it should be surpassed, in spite of all the accuracy and detail which happily modern science has introduced into modern geological maps.

The first paper read at York, in the year 1831, was by Professor Sedgwick, "On the general structure of the Mountains of the North of England." This was followed by "Supplementary Observations on the Structure of the Austrian and Bavarian Alps," by the Secretary of the Society, Mr. Murchison, a memoir at that time of the highest value, and still valuable, both in a stratigraphical point of view, and also for the light which it threw on the nature of the disturbances that originated the Alpine mountains, and their relations in point of date to the far more ancient mountains of Bohemia. In his elaborate address in the same year, on his retiring from the President's chair, he largely expatiates on the parallelism of many of the great lines of disturbance of what were then distinguished as the more ancient *schistose* and *greywacké* mountains, and quotes the authority of Elie de Beaumont for the statement, "that mountain chains elevated at the same period of time, have a general parallelism in the bearing of their component strata." On a great scale this undoubtedly holds true, as, for example, in the case of the Scandinavian chain, and the more ancient Palæozoic rocks north of Scotland, Cumberland, and even of great part of Wales. The same holds good with regard to the parallelism of the much more recent

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mountain ranges of the Apennines, the Alps, the Caucasus, the Atlas, and the Himalaya, all of which strike more or less east and west, and are to a great extent of Post-Eocene, and even partly of Post-Miocene age. The same, however, is not precisely the case with the Appalachian chain, and the Rocky Mountains of North America, the first of which trends N.N.W., and the latter N.N.E. The remarkable chain of the Ural Mountains trends nearly true north and south, and is parallel to no other chain that I know of, unless it be the Andes and the mountains of Japan. It is worthy of notice that the chain of the Ural is of Pre-Permian age according to Murchison, while Darwin has shown that the chief upheaval of the Andes took place in Post-Cretaceous times.

The Appalachian chain is chiefly of Post-Carboniferous date, and the Rocky Mountains have been re-disturbed and re-elevated as late as Post-Miocene times.

In the same address Professor Sedgwick entered an eloquent protest against the broad uniformitarian views so powerfully advocated in the first edition of Lyell's "Principles of Geology" in 1830, in which, throwing aside all discussion concerning cosmogony, he took the world as he found it, and, agreeing with Hutton, that geology is in no way concerned with, and not sufficiently advanced to deal "with questions as to the origin of things," he saw that a great body of new data were required such as engaged the attention of the Geological Society (founded in 1807), and which along with other foreign societies and private work has at length brought geological science to its present high position.

And what is that position? With great and consistent labour many men gifted with a knowledge of stratigraphical and palæontological geology, have, so to speak, more or less dissected all the regions of Europe and great part of North America, India, and of our colonies, and in vast areas, sometimes nearly adjoining, and sometimes far distant from each other, the various formations, by help of the fossils they contain, have been correlated in time, often in spite of great differences in their lithological characters. It is easy, for example, to correlate the various formations in countries so near as Great Britain and Ireland, or of the Secondary and Lower Tertiary formations of England and France; and what is more remarkable, it is easy to correlate the Palæozoic formations of Britain and the eastern half of the United States and Canada, even in many of the comparatively minute stratigraphical and lithological subdivisions of the Silurian, Devonian, and Carboniferous formations. The same may be said with regard to some of the Palæozoic formations of India, China, Africa, and Australia, and many of the Secondary and Tertiary deposits have in like manner been identified as having their equivalents in Europe. It is not to be inferred from these coincidences that such deposits were all formed *precisely* at the same time, but taken in connection with their palæontological contents, viewed in the light which Darwin has shown with regard to the life of the globe when considered in their relation to masses of stratified formations, no modern geologist who gives his mind to

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such subjects would be likely to state, for example, that in any part of the globe Silurian rocks may be equivalents in time to any of our Upper Palæozoic, Mesozoic, or Tertiary formations.

For all the latest details of genera and species found in the British Palæozoic rocks, from those of St. Davids, so well worked out by Dr. Hicks, to the Carboniferous series inclusive, I must refer to the elaborate address of Mr. Etheridge, President of the Geological Society, which he delivered at the last anniversary meeting of that Society. It is a work of enormous labour and skill, which could not have been produced by any one who had not a thorough personal knowledge of all the formations of Britain and of their fossil contents.[1]

In connection with such subjects I will not in any way deal with the tempting and important subject of cosmological geology, which in my opinion must go back to times far anterior to the date of the deposition, as common sediments, of the very oldest known metamorphic strata. Cosmological speculations perhaps may be sound enough with regard to refrigeration, and the first consolidation of the crust of the earth, but all the known tangible rocky formations in the world have no immediate relation to them, and in my opinion the oldest Laurentian rocks were deposited long after the beginning and end of lost and unknown epochs, during which stratified rocks were formed by watery agents in the same way that the Laurentian rocks were deposited, and in which modern formations are being deposited now, and the gneissose structure of the most ancient formations was the result of an action which has at intervals characterized all geological time as late as the Eocene formations in the Alps and elsewhere.

The same kind of chronological reasoning is often applicable to igneous rocks. It was generally the custom, many years ago, to recognize two kinds of igneous rocks, viz. Volcanic and Plutonic, and this classification somewhat modified in details is still applicable, the Plutonic consisting chiefly of granitic rocks and their allies, and which, though they have often altered and thrust veins into the adjoining strata, have never, as far as I know, overflowed in the manner of the lavas of modern and ancient volcanoes. Indeed, as far as I recollect, the first quoted examples of ancient volcanoes are those of Miocene age in the districts of Auvergne, the Velais, and the Eifel, and the fact that signs of ordinary volcanic phenomena are found in almost all the larger groups of strata was scarcely suspected. Now, however, we know them to be associated with strata of all or almost all geological ages, from Lower Silurian times down to the present day, if we take the whole world into account. Amongst them, those of Miocene date hold a very prominent place, greatly owing, doubtless, to the comparative perfection of their forms, as, for example, those of the South of France and of the Eifel. Their conical shapes, and numerous extinct craters, afford testimony so plain, that he who runs may read their history.

[1] I must also, with much pleasure, advert to Prof. Prestwich's inaugural lecture when installed in the Chair of Geology at Oxford in 1875, the subject of which is "The Past and Future of Geology."

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The time when they became extinct would doubtless amaze us by its magnitude, if it could be stated in years, but yet it is comparatively so recent that not all the undying forces of atmospheric degradation have heen able to obliterate their individual origin.

It is, however, generally very different with respect to volcanoes of Mesozoic age, for, though Lyell stated with doubt, that volcanic products of Jurassic date are found in the Morea, and in the Apennines; and Medlicott and Blanford consider that probably the igneous rocks of Rajmahal may be of that age, we must, perhaps, wait for further information before the question may be considered as finally settled. Of Jurassic age no actual craters remain. Darwin also has stated, on good grounds, that in the Andes a line of volcanic eruptions has been at work from before the deposition of the Cretaceo-Oolitic formation down to the present day.

In the British Islands we have a remarkable series of true volcanic rocks, the chronology of which has been definitely determined. The oldest of these belongs to the Lower Silurian epoch, as shown, for example, on a large scale in Pembrokeshire, at Builth in Radnorshire, in the Longmynd country west of the Stiper stones in Shropshire, and on a far greater scale in North Wales and Cumbria. Of later date we find volcanic lavas and ashes in the Devonian rocks of Devon, and in the Old Red Sandstone of Scotland. The third series is plentiful among the Carboniferous rocks of Scotland, and in a smaller way interstratified with the Coal-measures of South Staffordshire, Warwickshire, and the Clee Hills. The fourth series chronologically is associated with the Permian strata in Scotland, and the fifth and last consists of the Miocene basaltic rocks of the Inner Hebrides and the mainland of the West of Scotland.

In the British Islands the art of geological surveying has, I believe, been carried out in a more detailed manner than in any other country in Europe, a matter which has been rendered comparatively easy by the excellence of the Ordnance Survey Maps both on the 1-inch and the 6-inch scales. When the whole country has been mapped geologically, little will remain to be done in geological surveying, excepting corrections here and there, especially in the earliest published maps of the South-west of England. Palæontological detail may, however, be carried on to any extent, and much remains to be done in microscopic petrology which now deservedly occupies the attention of many skilled observers.

Time will not permit me to do more than advert to the excellent and well-known geological surveys now in action in India, Canada, the United States, Australia, New Zealand, and South Africa.

On the Continent of Europe there are National Geological Surveys of great and well-deserved repute, conducted by men of the highest eminence in geological science; and it is to be hoped the day may come when a more detailed survey will follow the admirable map executed by Sir Roderick Murchison, De Verneuil, and Count Keyserling, and published in their joint work, "The Geology of Russia in Europe and the Ural Mountains."

It is difficult to deal with the Future of Geology. Probably in

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many of the European formations, more may be done in tracing the details of subformations. The same may be said of much of North America, and for a long series of years a great deal must remain almost untouched in Asia, Africa, South America, and in the islands of the Pacific Ocean. If, in the far future, the day should come when such work shall be undertaken, the process of doing so must necessarily be slow, partly for want of proper maps, and possibly in some regions partly for the want of trained geologists. Palæontologists must always have ample work in the discovery and description of new fossils, marine, freshwater, and truly terrestrial; and besides common stratigraphical geology, geologists have still an ample field before them in working out many of those physical problems which form the true basis of Physical Geography in every region of the earth. Of the history of the earth there is a long past, the early chapters of which seem to be lost for ever, and we know little of the future except that it appears that "the stir of this dim spot which men call earth," as far as Geology is concerned, shows "no sign of an end."

III.—On the Rhætics of Notts. By E. Wilson, F.G.S.

THE author gave a summarized account of the Rhætic series in Nottinghamshire. The Rhætic sections of this district already known to geologists comprise those at Gainsboro', Newark, and Elton. The author described several additional new sections in the Rhætics of the county—viz. at Cotham and Kilvington, between Newark and Bottesford; at Barnstone, between Bingham and Stahern; the boring for coal at Owthorpe, near Colston Bassett; and the section at Stanton-on-the-Wolds, between Nottingham and Melton Mowbray. A list of the Rhætic fossils of Notts was given, and the presence of bone-beds noticed. The author could not agree with certain geologists that the green marls which are found beneath the Paper Shales in Notts (nor probably also the "Tea-green Marls" of the West of England) belong to the Rhætic series, but took them to be Upper Keuper Marls, once red in colour, which had become discoloured by some deoxidizing agent, probably carbonic acid evolved during the decomposition of the organic matters of the fossils of the Paper Shales. For, in lithological character the green marls agreed with underlying beds in the Keuper, but differed markedly from the overlying Rhætics; then there was every appearance of a passage between the green marls and the underlying red and green marls of the Keuper; and, lastly, the green marls, like the rest of the Keuper marls, were practically unfossiliferous, while with the commencement of the Paper Shales we get the remains of an abundant, and distinctly marine fauna, in part Liassic.

IV.—Remarks upon the Structure and Classification of the Blastoidea. By P. Herbert Carpenter, M.A.

THE author and Mr. R. Etheridge, jun., who are preparing a joint memoir upon the Blastoidea, have arrived at the following conclusions respecting the group.

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It is very doubtful whether the genus *Pentremites* occurs at all in Britain. Some badly-preserved fragments from the Devonian and the Scotch Carboniferous are possibly referable to it; but most of the Blastoids (besides *Codaster*) which occur in the Carboniferous Limestone belong to the genus *Granatocrinus*, Troost., which is represented by some seven or eight species.

Cumberland's *Mitra elliptica* is the representative of a new genus, distinguished by the eccentric position of the spiracles. *Codaster* is a true Blastoid, and not a Cystid, as supposed by Billings. The slit-like openings of its hydrospires are nearly on the same level as the ambulacra, which do not conceal them at all. In the ordinary Blastoids, however, they are below and concealed by the ambulacra, opening externally by pores at the sides of the latter. There are various intermediate forms between these two extremes, in which the hydrospiral slits are more or less concealed by the ambulacra, but are partially visible at their sides. It is proposed to group the species thus distinguished into a genus *Pentremitidea*, which is represented in Britain by the little *Pentremites acutus*, Sowerby, in Belgium by *P. caryophyllatus*, and in Spain by *P. Pailleti*, De Verneuil, for which last the name *Pentremitidea* had been already proposed by D'Orbigny. An arrangement of this kind has been already suggested by Billings.

The discoveries of Rofe, Wachsmuth, and Hambach, respecting the perforation of the lancet-piece by a longitudinal canal, are confirmed. This canal probably lodged the water-vessel, which must have been devoid of any tentacular extensions, as in some Holothurians, and in the arms of certain *Comatulæ*. Respiration was effected, however, by means of the hydrospires. The pores usually found at the sides of the ambulacra were not the sockets for the attachment of the appendages, but led downwards into the hydrospires, serving to introduce water, which made its way out through the spiracles. The genital ducts probably opened into some portion of the hydrospires, as they do into the closely similar structures of the *Ophiuroidea*, and the ova were discharged through the spiracles. Billings' statements are confirmed respecting the existence in many species of a single or possibly double row of joined appendages along each side of the ambulacra; but these appendages are not homologous with the pinnules of the *Crinoidea*.

In perfect specimens the peristome is covered in by a vault of small polygonal plates, any definite arrangement of which is rarely traceable. Extensions of this vault were continued down the sides of the ambulacral grooves, which could thus be closed in completely and converted into tunnels, as in recent Crinoids.

The classification of the Blastoidea must depend entirely upon morphological principles. Mere differences in the relative sizes of the calyx plates are of very little systematic value; and differences in the numbers of side plates on given lengths of the ambulacra are absolutely worthless. On the other hand, the structure and relative positions of the hydrospires and spiracles are morphological characters of much systematic value.

V.—On the Characters of the "Lansdowne Encrinite" (Millericrinus Pratii, Gray, sp.) By P. Herbert Carpenter, M.A.

The "Lansdowne Encrinite" is a species of *Millericrinus* (*M. Pratii*, Gray, sp. = *Apiocrinus obconicus*, Goldfuss) from the Great Oolite on the top of Lansdowne, near Bath. It is remarkable for the very great variation in the characters of its stem and calyx. The former may reach 50 mm. in length, and consist of 70 discoidal joints; or there may be less than ten joints, the lowest of which is rounded off below, and its central canal closed up. Various intermediate conditions may occur between these two extremes, while in some specimens there may be only two to four stem-joints; and in one case the whole stem is represented by a slightly convex imperforate plate on which the basals rest. This specimen, taken by itself, would be naturally regarded as a *Comatula* of advanced age, in which the cirrhus-sockets had disappeared from the centre dorsal just as they do in the recent *Actinometra Jukesii*. The general appearance of the calyx is very similar to that of *Pentacrinus Wyville-Thomsoni* from the North Atlantic. But it is remarkable for the number of small intercalated pieces which it may contain. The basals are frequently separated from one another, or from the radials, by minute plates which, while regularly developed all round the calyx in some specimens, are entirely absent in others.

The nearest allies of *M. Pratii* seem to be *M. Munsterianus*, var. *Buchianus*, and *M. Nodotianus*. It stands on the extreme limit of the genus, connecting it with *Pentacrinus* on the one hand, and with the free *Comatulidæ* on the other. It is thus a synthetic type, as would naturally be expected from its geological position; for it is probably the earliest known species of the genus, except perhaps for two doubtful Liassic forms, which are known only by isolated plates and stem-joints.

VI.—On the Extension into Essex, Middlesex, and other Inland Counties, of the Mundesley and Westleton Beds, in Relation to the Age of certain Hill-gravels and of some of the Valleys of the South of England. By J. Prestwich, M.A., F.R.S., Professor of Geology in the University of Oxford.

The author gives in this paper the result of observations commenced more than thirty years since, but delayed publication in consequence of doubts caused by the complexity of the phenomena. As mentioned in the preceding paper, a peculiar group of land, freshwater, and marine beds occupy, on the Norfolk coast, a zone between the Chillesford Clay and the Lower Boulder-clay. As we proceed southward, the land and freshwater conditions are gradually eliminated, and marine conditions then alone prevail. Poorly marked as the marine evidence is in Suffolk, this evidence is entirely wanting further inland, and we have only levels, superposition, and structure to rely on in correlating the fragmentary outliers into which these beds finally resolve themselves. Again on the coast of he Eastern Counties, this group forms a nearly level plane but

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little above the sea-level, resting everywhere on an undisturbed or very slightly eroded bed of Chillesford Clay, and being succeeded, with but slight evidence of denudation, by the Lower Boulder-clay, or by the Glacial sands and gravel; whereas, as it trends inland, it attains a considerable elevation above the sea-level, passes unconformably over the older Tertiary strata, and has been subjected to a great amount of denudation. On the other hand, the old land which seems to have extended from the eastward as far as the Norfolk coast, is now in great part below the level of the German Ocean. Further, whereas the succeeding Glacial beds all show a drift from northward to southward, this is the only case that has come under the author's notice of a marine drift from southward to the northward.

The Westleton Beds, in their more typical aspect, consist of quartzose sands full of flint pebbles, almost as much worn and as numerous as in the Lower Tertiary sands of Addington. With these are mixed—(1) A good many small white and rose-coloured quartz-pebbles; (2) Pebbles of Lydian stone; (3) Large flattened pebbles of a light-coloured quartzite; and (4) Rolled and worn fragments of Lower Greensand chert. It is the presence of these, and especially of the last, that constitutes so marked a feature of these beds, and which, with the absence of pebbles and rock-fragments of northern origin, serve to separate them from the Inter-glacial sands and shingle with which in places they come into juxtaposition.

The author then proceeds to trace the beds through Essex, and gives a series of railway sections showing these beds, exhibiting usually the appearance of a white gravel, with intercalated ochreous beds, and reposing on a very eroded surface of the London Clay. Near Clare there is a pit in which they exhibit oblique lamination, and might, apart from the want of fossils, be mistaken for a Crag section. Near Braintree, a remarkable section was exposed in the branch railway to that town. It showed these beds much faulted, overlaid irregularly by a darker bed full of New Red Sandstone quartzite pebbles, and the whole covered by indenting Boulder-clay.

In traversing the beds farther westward they undergo further modification. Certain characters remain, however, persistent, and on these we have to rely. 1st, the shingle is composed essentially of chalk-flint pebbles, becoming less worn as we approach the southern limits of the deposit; 2ndly, it often becomes much mixed with flint-pebbles and subangular fragments of compact sandstone derived from the underlying Tertiary strata; 3rdly, the chert and ragstone fragments often so increase in numbers as to constitute a large portion of the gravel. They are worn and subangular, and the chert is identical with the chert of the Lower Greensand of Kent and Surrey; 4thly, the pebbles of white and rose-coloured quartz, of Lydian stone, and of white quartzite become rarer, and in places are wanting. The Lydian stone and some of the small quartz pebbles may be derived, with the chert, from the Lower Greensand, but this will not account for the great number of quartz pebbles found in the Eastern Counties. The quartzite pebbles are equally large but

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lighter-coloured and more ovoid than those of the New Red. They probably have drifted from a continental area on the east, the author having found similar beds in parts of Belgium. 5thly, the absence of northern drift.

Besides their position under the Boulder-clay on the lines of railway, the Westleton Shingle caps some isolated hills in Essex, such as Danebury and Langdon Hills. It is to this age also that the author would refer the drift gravel capping some of the higher ground in Epping Forest, and also the Middlesex hills around Barnet and Southgate, and extending thence in outliers to the range of hills between Hertford and Hatfield, South Mimms and St. Albans, and possibly as far north as Tyler's Hill, near Chesham. Ranging further westward, it forms a small capping on Horsington Hill, near Harrow, which serves to connect it with its highest position on Bowsey Hill, near Henley-on-Thames. Southward, it caps St. George's Hill, near Weybridge. Approaching its southern boundary, this drift becomes less worn and passes into a subangular flint-gravel, capping several of the hills south of the Thames. At Cherry Down, near Windsor, it consists in large part of subangular fragments of chert and ragstone. It caps Hungary Hill, near Farnham; another hill west of Cæsar's Camp, near Bagshot; Meadow Down, near Guildford; and Pobly Hill, near Dorking. To this period may probably be also assigned the gravel on the top of Well Hill, near Chelsfield, Kent; and some of the sands and gravel on the top of the cliffs near Minster, in the Isle of Sheppey.

The author reserves for another occasion the description of the beds next in order; but he would mention here, that the Boulder-clay and some Glacial gravels occupy in Herts and Berks a lower horizon than the Westleton Beds. It would therefore appear that, while the eastern area was submerged, and the strata followed in regular succession upon a surface which did not undergo denudation, the southern and western area was slowly elevated, and underwent partial denudation before the Upper Boulder-clay was deposited. Previous to the period of the Westleton and Mundesley beds, it is probable that the denudation of the Weald had hardly commenced. The area was spread over by Cretaceous strata under water at the beginning of the Crag period (the Lenham Beds), and judging from the character of the beds which fringe the North Wealden area at Chelsfield, Cherry Down, etc., the author concludes that there was land south of this fringing shingle, whence the great mass of Chalk-flints and of Lower Greensand cherts and ragstone must have been derived. This mass of *débris* serves to attest to the great extent of these strata that have been removed from the Wealden area while yet it was an elevated and not a depressed area. After the rise of the area over which the Westleton Beds extended, it underwent extensive denudation, and it was at this period that the great plain of the Thames Valley received its first outlines, although it was not until much later that the river valley received its last impress.

VII.—ON THE FORMATION OF COAL. By EDWARD WETHERED, F.C.S., F.G.S.

THE author first reviewed the researches of Hutton, Goeppert, MacCulloch, Sir James Hall, Sir W. Logan, and Dr. Dawson, and then summed up the conclusions now entertained as to the formation of Coal, as follows:—

1st. That the beds of fire-clay which underlie all seams of coal represent the original land-surfaces upon which the coal-forming vegetation grew. 2nd. That the *Stigmaria* found in the underclays were the roots of that vegetation, which implies that the plants were of the Lepidodendroid order. 3rd. That the vegetation grew near the mouths of great rivers, in swampy ground, and there underwent submergence; changes then took place which converted the vegetable matter into coal. 4th. That the change of coal from one variety to another, even in the same seam, is the result of metamorphism, and is indirectly caused by the contortion of the surrounding strata, whereby facilities for the escape of gases evolved by the vegetable decomposition have been produced.

The author's exceptions to the above were—1st. That coal was not formed from trees of the Lepidodendroid type, and that therefore the *Stigmaria* found in the underclays are not the roots of the vegetation which gave rise to the coal, unless it was from the spores of such plants, which the author considered wanting in proof, though some coal did undoubtedly contain spores of some kind. 2nd. That the varieties of coal, and the change which sometimes takes place in one and the same seam, are not due to metamorphism, nor are they dependent upon the contorted state of the surrounding strata, but arise from the greater or less chemical decomposition of the vegetable mass, influenced by the circumstances under which it was submerged.

The reasons which had led up to these conclusions were:—1st. That we have proof of other vegetation during the coal-period besides the *Lepidodendra*, but their roots have not been preserved, owing to their being of a more perishable nature than the *Stigmaria*. 2nd. Beds of underclay are frequently met with full of *Stigmaria*, but are not followed by seams of coal. 3rd. Coal must have been formed from a compact mass of vegetation, such as could not have been produced by large trees (as the *Lepidodendra* were) growing *in situ.* The uniform thickness and comparative freedom from inorganic contamination would demand a mass of vegetation into which only a limited amount of sediment could penetrate. 4th. The finding of a fossil tree standing *in situ*, upon which so much stress had been laid by some authors, is a rarity. Though the author had spent much time underground in collieries, and seen hundreds of fossil trees drifted into the position in which they have been found, he had only twice seen instances of them standing where they have grown. 5th. If seams of coal were formed from Lepidodendroid trees, the tough bas-layer would be easily detected, which has never been the case in any true bed of coal. 6th. If the *Stigmaria* found in the underclays represent the roots of the coal-forming vegetation, we should expect to find the fructifications immediately over the coal, which is not the case; with the exception of *Cordaites*, remains of fossil plants are not found for the first two feet or so over the coal.

After a careful investigation underground of the conditions under which coal was formed, the author has arrived at the following conclusions:—On the land grew the vegetation of the period, represented by *Lepidodendra, Sigillaria, Calamites*, etc. As the land sank and the waters encroached, the land vegetation gradually disappeared, but the roots remained in many cases, and those which offered the greatest resistance to decay are the ones preserved in a fossil state—hence the occurrence of *Stigmaria*. As the waters advanced, the ground would become swampy, and then we might expect to see spring up reeds, mosses, and other vegetation suitable to the changed condition; it is to vegetation of this kind that the author ascribes the formation of coal.

Reference was then made to the Presidential Address of Professor Ramsay to the British Association in 1880, in which the recurrence of the same kind of incident through geological time was advocated. The author then asked, why the coal formations of the Carboniferous period should be an exception, seeing that the modern lignites and deposits of peat were instances of coal in the process of formation. It was then pointed out that these deposits were not composed of large trees, but of a lower order of growth.

Coming to the varieties of coal, and the change which sometimes takes place in this respect in one and the same seam, it was shown that the difference between bituminous and anthracite coal was, that the latter contained a greater proportion of carbon and a less amount of volatile matter than the former. It was then contended that if the decomposition of the coal-forming vegetation took place without being affected, to any extent, by minerals capable of oxidizing the carbon, that a coal would be formed having a large proportion of carbon with a less proportion of volatile matter than is found in bituminous coals. The author explained this by briefly reviewing the process by which vegetable matter has been converted into coal. It chiefly depended upon the amount of oxygen which could unite with the carbon for carbonic acid, and the amount of hydrogen which could unite with the carbon to form marsh gas. By this process oxygen and hydrogen would pass off in greater proportion than the carbon, thus increasing the proportion of the latter to the whole. If, however, the submerging waters placed in contact with the vegetable mass substances capable of supplying oxygen to the carbon, then there would be a decrease in the proportion of the latter, and what the author termed the 'fixed oxygen and hydrogen' would increase in proportion to the whole and give rise to a coal of a bituminous nature.

With a view of ascertaining whether the chemical composition of the beds overlying a seam of coal which has changed from bituminous to anthracite also changed, the Welsh 'nine feet' seam was selected, which near Cardiff is semi-bituminous and at Aberdare becomes anthracitic. Specimens of the overlying strata were selected from the two districts at each foot above the coal for five feet; these were analyzed, and it was found that the beds from near Cardiff were considerably more argillaceous and, as a whole, less ferruginous, than those at Aberdare. It would be rash to attempt to determine the exact chemical nature of the sediment deposited over the coal-forming vegetation in the two localities, as, with the exception of silicate of alumina, the silicates and other minerals would have undergone decomposition at the expense of the carbonic acid given off from the coal-forming vegetation. There was, however, a decided change in the beds of the two sections presented, which could not be ascribed to metamorphism. It rather appeared to point to the sediment containing different constituents, which must have had a very considerable effect on the vegetable mass. It was to this that the author was inclined to assign the change in the character of the coal.

VIII.—Second Report of the Committee, consisting of Prof. P. M. Duncan and Mr. G. R. Vine, appointed for the purpose of reporting on Fossil Polyzoa. Drawn up by Mr. Vine (Secretary).

After many laborious researches, naturalists, generally, have accepted Dr. Allman's *Gymnolæmata*, for one at least of the orders of the Class Polyzoa. In this order the "Polypide is destitute of an epistome (foot): and the lophophore is circular." [1] The order is divided into three sub-orders :—

I. *Cheilostomata*, Busk. = *Celleporina*, Ehrenberg.
II. *Cyclostomata*, ,, = *Tubuliporina*, Milne-Ed., Hagenow, Johnston.
III. *Ctenostomata*, ,,

The whole were "founded by Professor Busk on certain structural peculiarities of the cell." [2] Only species belonging to two of these sub-orders are found fossil, and to these alone I shall direct the attention of the reader.

I. Cheilostomata.—Polyzoa belonging to this sub-order are "distinguished by the presence of a *moveable opercular valve*." [3] This, however, is not a character on which the Palæontologist can rely for evidence; but there are others. The ova are usually matured in external "marsupiæ," or ova cells; there are also appendicular organs—*avicularia* and *vibricula ;* and later investigations have proved the existence of peculiar perforations in the cell-walls, which Reichert called "Rosettenplatten," and Hincks "communication-pores." Through these openings the "endosarcal" cord of Joilet,[4] in the living Polyzoa, passed from cell to cell. The aperture, or mouth of the cell, though variously shaped, is always sub-terminal. To prove that Polyzoa (judging from the calcareous remains of this sub-order) were present in the Palæozoic seas, it is necessary that some one or other of the above-named characters should be present in the species introduced as Cheilostomatous.

[1] Hincks's Brit. Marine Polyzoa, p. cxxxvi. [2] *Ibid.* p. cxxiv.
[3] "Corneous," Waters on the use of the Opercula. Proceedings of Manchester Lit. and Phil. Soc., 1878. (Italics mine.)
[4] Nervous tissue, Müller.

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II. Cyclostomata.—The simplicity of structure in this sub-order precludes elaborate description. There are, however, a few points of special structure to which it may be as well to direct attention. The cells are invariably tubular, or nearly so; the mouths are circular, and, generally speaking, of the same diameter as the cell. The cell-mouths in many of the Cyclostomata are covered by calcareous opercula, in both recent and fossil species, and these are considered to be—by Mr. F. D. Longe[1]—of an analogous character with the *corneous* opercula of the Cheilostomata. Be this as it may—all the Cyclostomatous opercula are calcareous—and their use has not yet been definitely made out.

In his classification of the British Marine Polyzoa, Mr. Hincks bases his genera and species, to a large extent, upon the shape and character of the cell and cell-mouth,—the habit of species is only of secondary importance. To working naturalists amongst living species his carefully worked-out divisions are of supreme importance, and the Palæontologist may do well to carry over the leading idea of Smitt and Hincks when working out fossil species, especially so when dealing with Palæozoic types. It may be well, too, to caution the student in his use of the generic names of the earlier authors. These have to be revised according to modern usage. In every case where I could retain the original designation of the author of genera and species I have done so, but it seems to me to be a folly to perpetuate a nomenclature which does not indicate generic affinity. In his otherwise carefully written "Introduction," Mr. Hincks says, "There is evidence, however (as I learn on the excellent authority of Mr. R. Etheridge, jun.), of the existence of a few Cheilostomatous genera at least within this epoch (Palæozoic), and probably the group is represented in the Silurian division of it"[2]—a conclusion which, after the most careful research, I am unable to agree with.

In this, as in my former Report, I shall revise the whole of the genera and species that have been introduced since the time of Goldfuss into the nomenclature of Silurian and Devonian literature. I would prefer to deal only with British species, but as many papers describing new genera and species, from foreign sources, have been published in this country, I cannot do otherwise than review, if not revise, these as well. But whereas, in my former Report, I dealt generally with material in my own cabinet, in this I shall refer largely to the Polyzoa in the magnificent collection of the Museum of Practical Geology. For this purpose I have handled, and noted down particulars of every specimen in the collection, from the Lower Silurian to the Devonian. This I have been enabled to do through the kindness of Mr. Etheridge, F.R.S., Palæontologist, and Mr. E. T. Newton, Assistant Naturalist of H. M. Geological Survey, Museum, Jermyn Street.

Professor Duncan has expressed a wish that in this Report I should draw up a suggestive Terminology, that would be in keeping

[1] Oolitic Polyzoa, F. D. Longe, F.G.S., Geol. Mag., January, 1881. See also Hincks's Brit. Marine Polyzoa, Introduction, p. cv, and pp. 460–1.

[2] Brit. Mar. Poly. p. cxviii. Adding in a note, "Of recent genera *Stomatopora* and *Diastopora* appear to occur in the Silurian Rocks."

with modern usage and applicable to Palæozoic species. In accordance with the spirit of this request the following terms may be accepted generally. In it I have followed the leading of Busk and Hincks, without wholly despising the terms used by our leading Palæontologists.

ZOARIUM.—"The composite structure formed by repeated gemmation," = Polyzoarium and Polypidom of authors.

ZOŒCIUM or cell. "The chamber in which the Polypide is lodged."

CŒNŒCIUM. "The common dermal system of a colony." Applicable alike to the "Frond," or "Polyzoary," of Fenestella, Polypora, Phyllopora, or Synocladia: or to the associated Zoœcia and their connecting "interstitial tubuli," of Ceriopora, Hyphasmapora, and Archæopora, or species allied to these.

FENESTRULES. The square, oblong, or partially rounded openings in the zoarium, —*connected by non-cellular dissepiments*,—of Fenestella, Polypora, and species allied to these.

FENESTRÆ applied to similar openings, whenever connected by the general substance of the zoarium—as in Phyllopora, Clathropora, and the Permian Synocladia.

BRANCHES. The CELL-bearing portions of the zoarium of Glauconome, Fenestella, Polypora, or Synocladia; or the off-shoots from the main-stem of any species.

GONŒCIUM. "A modified zoœcium or cell, set apart for the purposes of reproduction."

GONOCYST. "An inflation of the surface of the zoarium in which the embryos are developed." Modern terms from the Rev. Thos. Hincks, F.R.S.

I have no desire to discuss my use of the term 'Polyzoa' instead of 'Bryozoa.' I use it as a matter of choice after carefully considering all that has been said by my friend Mr. Waters, Hincks, Busk, and others. After all, the question of priority is still an open one, and those of my readers who desire to consult authorities will find ample material in a paper 'On the Priority of the term Polyzoa for the Ascidian Polypes,' Busk, Ann. Nat. Hist., 1852; Rev. T. Hincks' 'Brit. Marine Polyzoa,' p. cxxxii; and A. W. Waters, Ann. Nat. Hist., January, 1880.

Sub-order CHEILOSTOMATA, Busk.

Genus *Hippothoa*, Lamx.

Hippothoa inflata, Nicholson, Ann. Mag. Nat. Hist., February, 1871, pl. xi. fig. 4.

Alecto inflata, Hall, Pal. New York, vol. i. p. 77, pl. xxvi. figs. 7*a*-7*b*.

This species of Hall's has been reworked from fresh material, by Nicholson. The slight figures given by him show a habit nearly akin to *Hippothoa abstersa*, S.W., fig. 6, pl. 22, Busk's 'Crag Polyzoa,' only rather more swollen at the distal part of the cell. In the cell-mouth of Busk's figure the peristome is sinuated: in Nicholson's figure it is circular. There is also a resemblance to Goldfuss' *Aulopora dichotoma*, tab. 65, fig. 2. I know of no species of *Hippothoa*, recent or fossil, with which it can be otherwise favourably compared. Generically it has no affinity with the HIPPOTHOIDÆ of Busk, and without doing violence to the generic character of *Hippothoa* as given by Hincks,[1] it cannot be placed with the genus. The species, Nicholson says, is abundant in the Cincinnati Group of the Hudson River formation, near Cincinnati, Ohio.

Genus *Retepora*, Imperato.

Ever since this genus was introduced in 1559, it has been used

[1] Brit. Mar. Poly. p. 286.

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by authors indiscriminately for all manner of fenestrated Polyzoa. Lamarck, in 1815, fixed the type of Linnæus, *Millepora cellulosa,* calling it *R. cellulosa,* and since then, the name *Retepora* has been used for a genus of the Escharidæ. None of the so-called Retepora of the Palæozoic era have any affinity with this family, or even with the genus as now understood. The word should be entirely abandoned for every species of Palæozoic Polyzoa.

1836. *Escharina,* Milne-Edwards.
1847. *Escharopora,* Hall.

As both these genera have been used by authors[1] for Palæozoic species, it may be as well to draw attention to its misuse. The types *E. recta* and the var. *nodosa* Hall compares with *Eschara? scalpellum* —now *Ptilodictya scalpellum*, Lonsd., and the *Escharina* of Milne-Edwards, in part, is the *Microporella* of Hincks, a genus which includes species selected from no fewer than ten genera of recent and fossil Polyzoa.

Laying aside the genus *Ptilodictya,* I have no knowledge of any other Palæozoic Polyzoa that can be, even provisionally, placed with the Cheilostomata. After careful consideration I am reluctantly obliged to say that at present there is no evidence that the sub-order existed in any of the Palæozoic seas, and further, the evidence is very doubtful until we reach the Mesozoic era. Notwithstanding this decision, I shall be amongst the first to acknowledge the earlier existence of types if well-defined evidence is brought to bear in the diagnosis of new discoveries.

Taking into consideration the shape and character of the cell as presenting, apparently, an Escharide type, I think I cannot do better than begin this Report with a revision of the whole of the *Ptilodictya.* M'Coy[2] places this genus as the fourth in his family *Escharidæ*; *Berenicea* being the third genus in the family. From the characters given, "cells shallow, oblong, or ovate, often provided with an operculum, capable of being closed *by special muscles,*" M'Coy evidently believed that the Palæozoic species could be naturally placed in this family. The true Escharidæ are of later date, probably not older than the Lower Oolite, and then not as a typical, but only as a kind of passage group. Leaving the classification as an open question at present, I shall take Lonsdale's definition for the group as redescribed by M'Coy:—

1839. *Ptilodictya,* Lonsdale.
1847. *Stictopora,* Hall.

"Zoarium[3] thin, calcareous, foliaceous, or branching dichotomously; branches sometimes coalescing: a thin, laminar, flattened, concentrically wrinkled central axis; set with oblique, short, subtubular, or ovate cells on both sides, with prominent oval mouths, nearly as large as the cells within; branches often flattened, with the margin solid, sharp-edged, striated, and without cells; the boundary ridges of the cells square or rhomboidal."

[1] *Escharina angularis,* Lonsd., Morris' Catalogue; *Escharipora recta,* Hall, Pal. N.Y., vol. i. [2] Brit. Palæ. Foss. [3] Corallum, Lonsdale, M'Coy's Pal. Foss.

This genus is very fairly represented by specimens in the Museum Pract. Geol. There are no fewer than ten species named, and three marked "New Sp.," awaiting description. Accepting the work of other authors, I can do no more than furnish notes on them, just as they are named. The first specimen is *P. dichotoma*, Portlock, in the Wyatt-Edgell Coll., and is found in the Lower Llandeilo flags, and the species ranges into the Upper Llandeilo and Caradoc. In the Caradoc, also, we have the *P. acuta*, Hall, which, if correctly identified, is very widely distributed in the American and English Silurians of the same horizon; and *P. explanata*, M'Coy. Three species undescribed, but bearing MS. names by Mr. Etheridge: *P. papillata*, *P. ramosa*, *P. scutata*. In the Lower Llandovery we have the *P. fucoides*, M'Coy, a species having a very limited range. In the Upper Llandovery we have *P. lanceolata*, Lonsd., which ranges through the Wenlock Shale, Wenlock Limestone, Lower Ludlow and Aymestry Limestone. There is a departure from the type in *P. scalpellum* (*Eschara* ? *scalpellum*, Lonsd.); it is marked as appearing in the Upper Llandovery and Wenlock Limestone. Hall, in the first vol. of the Pal. New York, figures and describes *P.* (*Stictopora*) *acuta*, which he compares with this species of Lonsdale. In this species, too, there seems to be no central laminar axis. It is found in the Trenton Limestone. With regard to *Ptilodictya lanceolata*, Lonsd., and *Pl. lanceolata*, Goldfuss, there seems to be a little confusion in our varied identifications of species. In the Catalogue of Cambrian and Silurian Fossils,[1] all the *P. lanceolata* found in the Upper Llandovery to the Upper Ludlow series, with the exception of one species found in the Wenlock Limestone, are ascribed to Lonsdale. The Wenlock species is identified as that of *P. lanceolata*, Goldfuss. This confusion is to be regretted, and in justifying the course taken by Mr. E. T. Newton in the Catalogue, I would suggest that the Wenlock shale species receive a new name—*P. Lonsdalii*. There are many characters in this species distinct from the species described by Goldfuss as *Flustra lanceolata*. There is also a pressing necessity that the types of *Ptilodictya* should become fixed, either as a genus or as a family.

Ptilodictya scalpellum is a type somewhat different from that of other species, and under a family name—Ptilodictidæ—I should reconsider my own reference to this genus of the Carboniferous *Sulcoretepora*.[2]

Professor Nicholson[3] has added much to our knowledge of this group, by the publication in this country of his papers on American forms. He has also founded two new genera to take in what he considers to be allied types. The Upper Silurian species, which are new, are: 1. *P. falciformis*, Nich., allied to *Escharopora recta*, Hall. His species, however, differs from *Flustra* (*Ptilodictya*) *lanceolata*, Goldf., *P. gladiola* and *P. sulcata*, Billings. 2. *P. emacerata*, Nich., a beautifully delicate species, with "elliptical cells,

[1] Mus. of Practical Geology, 1878.
[2] Carboniferous Polyzoa, B. A. Rep. 1880, second page of Report.
[3] Ann. Mag. Nat. Hist. March, 1875.

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their long axes corresponding with that of the branches, six or seven in the space of one line measured longitudinally." "This Nicholson considers to closely resemble *P. fragilis*, Billings, and it is possible that it may be only a variety of Billings' species."[1] 3. *P. flagellum*, Nich. This also resembles *P. gladiola*, Billings, and it also very closely resembles the *P. Lonsdalii* of our own Wenlock shale, excepting that the "attenuated base" of our own species is rarely "flexuous," but more often truncated and round. 4. *P. fenestelliformis*, Nich. All these species are typical, having the non-poriferous margins and the central laminar axis. One species—*Ptilodictya? arctiopora*, Nich.—has affinities with *P. raripora*, Hall; but Nicholson doubts the possibility of keeping these two species with the genus. The cells closely resemble some of the characters of our own Silurian species, but as there is evidently a departure from the original types, it may be as well to study these passage forms, if such they be, more carefully than they have yet been done. 5. *P. cosciniformis*,[2] Nich.: Hamilton formation, Bosanquet, Ontario.

For species allied to *Ptilodictya*, Nicholson has founded two new genera, and adopted one from Hall.

1874.	*Tæniopora*, Nicholson,	Geol. Mag. 1874.			
,,	*Clathropora*, Hall,	,,	,,	,,	
1875.	*Heterodictya*, Nicholson	,,	,,	,,	

In *Tæniopora* we have a zoarium that is a flattened, linear, calcareous expansion, with cells on both sides, the branches of which are dichotomous. There is a median ridge on each face of the zoarium, having a longitudinal direction, on the lateral halves of which the cells are developed. These are longitudinally placed in rows of from three to five. The margins are usually plain and non-celluliferous. Two species are described: *T. exigua*, Nich., and *T. penniformis*, Nich., both from the Hamilton group.

In *Clathropora* the zoarium is a kind of membranous flattened expansion, with rounded or oval fenestræ of considerable size. The cells are on both sides, separated by a thin laminar axis. The fenestræ are surrounded by a striped non-celluliferous margin. One species is described—*C. intertexta*, Nich.—from the Corniferous Limestone, but in some respects it resembles *P. cosciniformis*, Nich., of which mention has already been made.

In *Heterodictya* the zoarium forms a simple, flattened, unbranched, two-edged frond, with sub-parallel sides. The cells are in two series; the central cells are perpendicular to the base, the lateral cells are oblique. "In the only species known—*H. gigantea*, Nich. —the cells of a few of the median rows of the frond are straight . . . . and, as I am only acquainted with an exceedingly large species, I should, however, suspect that *Flustra* (*Ptilodictya*) *lanceolata*, Goldf., will very probably turn out to be an example of this genus."[3]

The material for a thorough revision of this genus is not easily accessible. Many of the Bala series are beautiful casts only, and the Upper Silurian species are often bedded in blocks of the Dudley

[1] *Ibid.* p. 179. [2] Nicholson, Geol. Mag. Jan. 1875. [3] *Ibid.*

Limestone; and I think it very unwise to disturb the present nomenclature without sufficient reason.[1] The MS. names of Mr. Robert Etheridge[2] require confirmation, and the best way to do this would be to describe and figure them. The new genera of Professor Nicholson may in the future embrace some few of the forms already described, but we can hardly supersede the clear definitions of Lonsdale's types as given by M'Coy. In the Lower Ludlow rocks specimens of *P. lanceolata*, Goldf., often break up, showing the concentrically wrinkled central axis. In the Girvan District—Scotland—at least two distinct species of this genus may be found—*P. costellata*, M'Coy, and *P. dichotoma*, Portl.

(To be concluded in our next Number)

REVIEWS.

THE GEOLOGICAL BASIS OF THE CHIEF CITIES OF EUROPE. [Der Boden der Hauptstädte Europa's, etc.] By FELIX KARRER. 8vo. pp. 68, with 23 woodcuts. (Holder: Vienna, 1881.)

THIS is a small, but concise and very useful, compendium of the geology of the European cities—Vienna, Paris, London, Brussels, Berlin, St. Petersburgh, and Rome, with their environs, as determined by transverse sections of the great valleys in which they are situated. The water-supply is particularly described; and the artesian borings at the several places are described geologically, and mostly figured as illustrative sections, besides the cross-sections of the respective basins and valleys. These illustrations have been in many cases supplied by the author's geological friends in the said cities, and their aid is carefully acknowledged as well as the other authorities for compiled information. Besides the water supply (by aqueducts and wells), and the health conditions of the cities, the mineral materials of value in arts and manufactures are also noticed. Altogether, this is an excellent work, full of condensed information, and an invaluable manual of the geology of those portions of the important valleys (Danube, Seine, Thames, Senne, Spree, Neva, and Tiber) in which the great cities have been built.—T. R. J.

CORRESPONDENCE.

THE WEALDEN OF HANOVER.

SIR,—In the June Number of the GEOLOGICAL MAGAZINE, pp. 281–283, there is a Review of the Wealden of Hanover (Die Wealdenbildungen der Umgegend von Hannover, von C. Struckmann).

The monograph, we are told, is a detailed description of the Wealden formation from the beds resting upon the Portland Limestone upwards. The Wealden is divided into three stages, each forming a well-marked horizon of life. "The deepest is the "Münder or bunte Wealden-Mergel," representing the Purbeck

[1] Since writing the above I have been able to study, very carefully, the leading types of Palæozoic *Ptilodictya*. In a future paper on the Family PTILODICTIDÆ I shall be able to correct many inaccuracies of our ordinary nomenclature.

[2] Mus. Pract. Geol. iv. $\frac{4}{10}$ in Catalogue of Camb. and Sil. Fossils.