EGLINTON.				HINDDOG, DALRY.			
		Ft.	In.			Ft.	In.
Clay, - - -	-	5	0	Boulder clay, - -	-	48	0
Sand and gravel, -	-	7	6	Gravel, - - -	-	24	0
Clay and boulders, -	-	24	0			72	0
Gravel, - - -	-	2	0	MOSSEND, DALRY.			
Clay and boulders, -	-	8	6	Sand and mud, - -	-	20	0
Gravel, - - -	-	2	6	Boulder clay, - -	-	40	0
Sand, - - -	-	2	6			60	0
		52	0	SOUTH END OF KILBIRNIE LOCH.			
BLAIR, DALRY.				Boulder clay, - -	-	40	0
Boulder clay, - -	-	24	0			40	0
Gravel, - - -	-	20	0	WILLOWYARD, BEITH.			
		44	0	(East side of same Loch.)			
COURTHILL, DALRY.				Boulder clay, - -	-	80	0
Boulder clay, - -	-	108	0			80	0
		108	0				

NOTE.—A large number of journals of bores could be added to these, but the above give a fair idea of the glacial deposits in North Ayrshire. Except in a locality where open sections can be studied, bores are of little value to the geologist in deciding the character of a bed.

XII.—*On the SILURIAN ROCKS of the SOUTH OF SCOTLAND.* By CHARLES LAPWORTH, Galashiels.

(Read 25th January, 1872.)

THE author began by calling attention to the fact that the geological framework of Scotland is essentially composed of rocks of Silurian age, which occupy almost the whole of the northern and southern divisions of the country, and form in the centre a comparatively small synclinal hollow or basin, which is filled up by deposits belonging to the later systems of the Old Red Sandstone and Carboniferous. It thus becomes one of the first problems in Scottish Geology to ascertain the order of succession among these Silurian strata, to endeavour to read the history of its life system, and in general to obtain means for a comparison of the formation with the Silurian of other countries. To this problem the crystalline and metamorphic rocks of the Highlands can never

furnish the key, which must therefore be sought among the comparatively unaltered and more fossiliferous deposits of the Southern Uplands. Here, however, we are at once brought face to face with what seem at first to be insurmountable difficulties. There is an almost complete identity of mineral character throughout the whole series; there are great thicknesses of strata from which fossils appear to be wholly absent; and, to crown all, the beds have been thrown into such a multitude of wrinkles and plications, so disturbed and inverted, that it is impossible to say on physical evidence alone, in a traverse of any distance, whether we are ascending or descending in the order of the strata. With these obstacles in the way of their thorough investigation, it becomes at once evident why so little, comparatively speaking, is known concerning them.

Nevertheless, a certain general arrangement of the strata may be said to be clearly ascertained. The lowest beds appear to form an axial or central mass of rocks, probably composed of strata of Cambrian and Lowest Silurian age, which dip N.W. and S.E. from an axial line running S.W. from Jedburgh to Kirkcudbright. To the north of these succeed a series of carbonaceous shales, of Llandeilo and Lower Caradoc age, which, together with an overlying mass of Upper Caradoc and Llandovery strata, undulate over the whole of the country lying between St. Abb's Head and the Mull of Galloway; while the district stretching from the central Cheviots to Kirkcudbright is composed of Upper Silurian strata, the northern equivalents of which pass up conformably into the Old Red Sandstone, in a few inliers that protrude through the Carboniferous of the Central Basin.

Mr. Lapworth then traced the history of discovery among these rocks, from the time of Dr. Hutton to the date of Professor Geikie's exhaustive paper on the whole subject, read before this Society in 1867. Since that paper was published the fossiliferous districts of Girvan and Wanlockhead have been mapped and described by the Geological Survey, the Pentland beds have been more fully investigated, and the rocks of the eastern districts, comprising the Gala Group, Riccarton Beds, Hawick Rocks, &c., have been examined and described by the author and his friend Mr. James Wilson.

The several sub-divisions were next described, according to the following scheme:—

- (a) *Lower Silurian.*
(1.) Hawick and Selkirk Rocks, . . .	{ Cambrian.
Skiddaw, &c.
(2.) Moffat Shale or Anthracite.	
(a) Lower Anthracite, . . .	Lower Llandeilo.
(b) Middle Anthracite, . . .	Upper Llandeilo.
(c) Upper Anthracite, . . .	Lower Caradoc.
- (b) *Middle Silurian.*
(1.) The Gala Group, Girvan Series,
Duntercleuch Beds, Wrae Beds,
&c. | { Upper Caradoc.
Lower Llandovery.
Upper Llandovery. |
|---|--|
- (c) *Upper Silurian.*
(1.) The Balmae and Riccarton Beds, .	{ Wenlock and Lower
Ludlow.
(2.) Lower Pentland Beds, . . .	Wenlock.
(b) Upper Pentland Beds, . . .	Ludlow.
(c) Pentland Sandstone, . . .	{ Passage Beds and Down-
ton Sandstone.
(3.) Lesmahagow Beds, . . .	

(a.) LOWER SILURIAN.

I.—HAWICK AND SELKIRK ROCKS.

The soft ripple-marked greywackes and sandy shales that make up the great group of the Hawick and Selkirk rocks bear a remarkable resemblance to the strata of the Longmynd, and it is not improbable that the lower beds may be of that age. The numerous instances of false bedding, the ripple and eddy markings, the rapid alternations of sand and mud, the worm burrows, the rain prints, &c., which abound in these strata, all point to the fact of their deposition in a shallow sea, the shores of which were laid bare at intervals to the rain and sun. These rocks appear to stretch uninterruptedly from the edge of the Old Red Sandstone, in the valley of the Lower Teviot, where they have a breadth of about fifteen miles, to the neighbourhood of Kirkeudbright, where they gradually die away to a point as they are overlapped by the Upper Silurian.

II.—THE MOFFAT SHALE.

Succeeding at once to the Selkirk rocks comes the remarkable deposit of the Moffat shale. It consists of a thickness of about 500 feet of finely-laminated white or grey mudstones, with beds

or bands of carbonaceous shale, crammed with Graptolites. This mass of shale makes its appearance, again and again, throughout all the Silurian country that lies to the north of the Hawick and Selkirk rocks. This great tract may be considered in effect as a sheet of Llandeilo, Caradoc, and Llandovery strata, of no great thickness, which has been thrown into innumerable wrinkles and contortions. The folds, however, although often inverting the strata, appear never to have been of sufficient intensity to bring up the underlying Selkirk rocks; and it is very doubtful if the base of the Moffat shale is anywhere exposed among them.

With so many appearances of this Moffat shale, it would naturally be supposed that its relations to the neighbouring strata would easily be ascertained; but, unfortunately, whenever it comes to the surface, it is so crushed and crumpled, and so broken up by faults, that two entirely contrary opinions have been held regarding it. By Professor Harkness these shales are considered to be part of one and the same deposit, and to owe their present position to great faults that run along the strike of the beds. By others—and this opinion has been lately adopted by the Geological Survey—it is held that there are several of these bands, some of them separated from each other by thousands of feet of intervening strata.

The author assumed that he had proved that there was but a single mass of this shale, and of the thickness and character given above. This Anthracitic shale is separable, lithologically and paleontologically, into three portions, viz.:—(1.) *The Lower Anthracite*, of about 200 feet in thickness, and consisting of several distinct bands of mudstone and black shale; (2.) *The Middle Anthracite* (100 feet), consisting in its lower portion of black shale, in its upper part of green mudstones; (3.) *The Upper Anthracite* (150 feet), made up of a lower portion, consisting of black shale, and an upper portion (*Halli* beds), consisting of alternations of grey and black shales. Each of these great divisions contains many fossils peculiar to itself (see Appendix, p. 170), and each is separable into several stages or zones, characterized by the presence of some peculiar group of forms; and these zones are easily recognizable and hold the same inter-relations, in localities forty or fifty miles asunder. Middle and Upper Anthracites are unknown in the Moorfoot and Wanlockhead district, but the Lower Anthracite is present in all its sub-divisions.

(b.) MIDDLE SILURIAN.

The *Middle Silurians*, which were held to comprise all the strata which lie in the several troughs formed by the Moffat shale, were described in order as they range from east to west, under the several titles of the Gala Group, the calcareous beds of the Wrae Hill, Winkstone, and Duntercleuch, the Girvan Series, &c. Of these the Gala group and the Girvan beds were shown to represent the extreme types; those of Girvan having been apparently deposited in shallow water, and are remarkable for their massive conglomerates and limestones, which abound in fossil testacea. The Gala group was apparently the product of a deep sea, and yields few fossils beside Phyllopoda and Graptolites; while the beds which fill up the intermediate districts combine the characters of these two extremes, their calcareous strata furnishing the shells of the Girvan series, while their associated shales yield the fossils of the Gala group. The lower beds of this great formation consist of immense masses of grit and conglomerate, which attain their maximum development in the Girvan district, the included stones gradually decreasing in size as we proceed eastward. The proofs of the great extent of these deposits, their connection with those of Wales and Ireland, and the wonderful agreement of the various sets of fossils collected in the different localities, were pointed out, as well as the impossibility of subdividing the strata with our present knowledge.

(c.) UPPER SILURIAN.

Rocks of Upper Silurian age have long been known to geologists in a single area to the south of the axial line; i.e., on the shores of Kirkcudbright Bay. The lecturer has, however, lately traced these Upper Silurian strata through all the country lying between that locality and the centre of the Cheviot Hills, and their complete identity over the whole district is proved by the discovery everywhere of their distinctive fossils. It was shown that they correspond in age with the Wenlock and Lower Ludlow Beds of England, and that they are simply the northerly continuation of a mass of exactly the same character lately mapped by the Geological Survey of England in the counties of Cumberland and Northumberland. The Upper Silurian rocks, as exposed in the Pentland Hills, were next alluded to, where, as Messrs. Brown and

Henderson have shown, not only are both the Wenlock and Ludlow formations represented, but it is very probable that the so-called Old Red Sandstone of that district will prove to be the equivalent of the Downton Sandstone of Siluria. After a brief glance at the *fauna* of the Leshmahagow beds, and pointing out the fact that in future these beds would have a greater interest to the geologist, as furnishing the only section in Scotland where there was an unequivocal passage of Silurian into the Old Red Sandstone, Mr. Lapworth concluded by observing that, "although much difficult work in the investigation of these ancient strata remains yet to be accomplished, the grand outlines of their history may now be said to be fairly sketched out. They appear to contain no representatives of those primordial limestones of Wales and Bohemia, with their quaint Trilobites and Lingulæ. In that primeval time, all here seems to have been inland lake or shallow sea. But when we reach the threshold of the Middle Silurian, all is life and animation. The peculiar Anthracite beds give evidence of a deep and tranquil sea which stretched over the South of Scotland, over Ireland, and probably over Central Europe, and North America also, swarming with millions of zoophytes, whose remains now afford the richest Graptolite *fauna* of the Silurian world. Even at this early stage, in the thinning out of the anthracites to the north and west, and the gradual coming in of limestone and conglomerates, we have evidence of the same general arrangement of land and water which prevailed in the succeeding epoch. We next get glimpses of an interval during which these anthracitic beds were in some places elevated into dry land, altered into flinty slate, and their broken fragments rounded by the running brooks or the waves of the shore, and spread out as a fine conglomerate on the ocean bed. As we reach the higher strata of the Middle Silurian, the proofs of the proximity of land gain form and distinctness, and we have clear evidence of a great sea which lashed the shores of an ancient Atlantis, far to the west of our present Scotland, from whose now vanished cliffs the iceberg floated with its load of boulders, dropping them in lesser and lesser quantities as it passed outward to the slowly deepening sea. Meanwhile, the testacea and zoophytes flourished in the waters below, the accumulated exuviae of the shell-fish forming the limestones and calcareous sandstones of the west, which gradually thin out as they pass into the eastern depths, of which the Graptolite and Phyllopod seem to have been

almost the only inhabitants. Next comes the great epoch of the Upper Silurian, and we pass on through the wonderfully uniform time of the Kirkcudbright series into the swarming seas of the Pentlands, and finally reach the period of the great lobster-like Crustaceans of Lesmahagow, which ushers in a second cycle of inland seas and shallow waters; and the next chapter of the history opens with the Old Red Sandstone."

APPENDIX.

LISTS OF THE FOSSILS OF THE VARIOUS SUBDIVISIONS OF THE SOUTH SCOTTISH SILURIANS.

NOTE.

THE following lists of fossils have been inserted here at the desire of the Council of the Society, and may collectively be taken as a rough index of our present knowledge of this Silurian Fauna. They have been abridged from more general tables, in the compilation of which the principal authorities consulted were:—

M'Coy's *Paleozoic Rocks and Fossils; Siluria*; the various papers by Sir R. I. Murchison, Professors Nicol, Harkness, and Geikie, Mr. J. C. Moore, Mr. Salter, &c., in the *Quarterly Journal of the Geological Society*; Dr. Bigsby's *Thesaurus Siluricus*; the works of Mr. Thomas Davidson; the papers of Messrs. Brown and Henderson, and Mr. Haswell, on the Pentland Hills; and the several memoirs and explanations published by H.M. Geological Survey.

(C. L.)

(a) LOWER SILURIAN.

I.—FOSSILS OF THE HAWICK AND SELKIRK ROCKS.

Arenicolites didyma.	Protovirgularia.
„ sp.	Protichnites Scoticus.
Palæochorda.	

FOSSILS OF THE MOFFAT SHALE.

II.—FORMS PECULIAR TO LOWER ANTHRACITE.

Cœnograpsus gracilis.	Dicranograpsus formosus.
„ surcularis.	Dicellograpsus Moffatensis.
Thamnograpsus typus.	Climacograpsus bicornis.
Rastrites Barrandii.	Diplograpsus bimucronatus.
Didymograpsus sagittarius.	„ spinosus.
„ serratulus.	„ tricornis.
Dicranograpsus sextans.	„ angustifolius.
„ furcatus.	

III.—FOSSILS PECULIAR TO THE MIDDLE ANTHRACITE.

Cladograpsus linearis.	Dicellograpsus elegans.
„ capillaris.	Climacograpsus teretiusculus.
„ divaricatus.	Diplograpsus pristis.
Dicranograpsus ramosus.	„ mucronatus.
„ Nicholsoni.	Lingula brevis.
„ Clingani.	Siphonotreta micula.
Dicellograpsus Morrisii.	Acrotreta Nicholsoni.

IV.—FOSSILS WHICH MAKE THEIR FIRST APPEARANCE IN UPPER ANTHRACITE.

Diplograpsus vesiculosus.	Monograpsus sagittarius.
„ cometa.	Rastrites peregrinus.
„ palmeus.	Peltocaris aptychoides.
Monograpsus convolutus.	„ Harknessi.
„ lobiferus.	Discinocaris Browniana.

V.—FOSSILS WHICH MAKE THEIR FIRST APPEARANCE IN THE HALLI BEDS.

Monograpsus Halli.	Rastrites Linnæi.
„ Nilssoni.	„ urceolus.
„ Sedgwickii.	„ maximus.
„ turriculatus.	Diplograpsus Hughesi.

(b) MIDDLE SILURIAN.

VI.—FOSSILS OF THE GALA GROUP.

Those marked "G" are also known in the Girvan Series.

Monograpsus priodon (G).	Retiolites obesus.
„ Sedgwickii (G).	„ Geinitzianus (P).
„ convolutus (G).	Climacograpsus bullatus (G).
„ Salteri (G).	Dictyonema.
„ turriculatus.	Protovirgularia.
„ Nilssoni.	Nereites Cambrensis.
„ socialis.	Crossopodia Scotica.
„ colonus.	Peltocaris.
„ Halli.	Dictyocaris.
Rastrites Linnæi.	Ceratiocaris.
„ maximus.	Orthoceras tenuicinctum (G).
Cyrtograpsus Grayianus (G).	

VII.—FOSSILS PECULIAR TO CENTRAL DISTRICTS OF DUNTERCLEUCH (1), KILBUCHO (2), WRAE HILL (3), AND WINKSTONE (4).

Petraia bina, 1, 2.	Lingula ovata, 2, 4.
„ uniserialis, 1.	Porambonites intercedens, 3.
Glyptocrinus basilis, 1, 2, 4.	Spirifer plicatella, 1.
Trinucleus fimbriatus, 1.	Raphistoma elliptica, 1.
Phacops Odini, 3.	„ lenticularis, 1.
„ Stokesii, 2.	Lituities cornuarietes, 3.
Orthis protensa, 1.	Cyloceras multicameratum, 3, 2.
	Orthoceras ibex, 3.

VIII.—FOSSILS COMMON TO GIRVAN AND THE CENTRAL DISTRICTS.

Nidulites favus, 1.	Strophomena corrugata, 1.
Favosites fibrosa, 1, 2.	„ pecten, 1 (P).
„ aspera, 1.	„ grandis, 1.
Petraia elongata, 1.	„ rhomboidalis, 1 (P).
Ptilodictya dichotoma, 1.	Atrypa marginalis, 1.
Trinucleus concentricus, 1.	„ hemispherica, 1.
Phacops candatus, 1, 2.	Meristella augustifrons, 1.
Leptena sericea, 1.	Pentamerus oblongus, 1.
„ tenuicincta, 1, 3.	Bellerophon acutus, 1, 3.
„ transversalis, 1 (P).	„ trilobatus.
Orthis calligramma, 1, 4.	Orthis biforata, 3.
„ elegantula, 1, 2 (P).	„ parva, 3.
„ Actoniae, 1, 2, 3.	

IX.—FOSSILS OF THE GIRVAN SERIES.

The Letter “P” is placed opposite the Names of those Fossils which pass upwards into the Upper Silurian of the Pentland Hills.

Teutaculites Anglicus.	Atrypa reticularis (P).
„ ornatus.	Chonetes lata.
Stromatocerium rugosum.	Discina crassa.
Chonetes Fletcheri (P).	„ perrugata.
Favosites crassa.	Leptena alternata.
Halysites catenulatus.	„ quinquecostata.
Heliolites favosus.	Acroculia haliotis.
„ interstinctus.	Orthis reversa.
„ tubulosus.	„ tricenaria.
„ inordinatus.	Rhynchonella œmula.
Petraia œquisulcata.	„ augustifrons.
„ subduplicata (P).	„ cuneata.
Ptilodictya acuta.	„ borealis (P).
„ costellata.	Strophomena filiosa.
Acidaspis callipareos.	Bellerophon bilobatus.
„ hystrix.	„ dilitatus (P).
Asaphus gigas.	„ falcatus.
Bumastes Barriensis.	„ carinatus (P).
Bronteus Hibernicus.	Ecculiomphalus Bucklandi.
Calymene Blumenbachii (P).	„ Scoticus.
„ brevicapitata.	Conularia Sowerbyi (P).
Cheirurus gelatinosus.	Maclurea Logani.
„ bimucronatus.	„ M'Coyi.
„ octolobatus.	„ macromphala.
Encrinurus punctatus.	„ magna.
„ sexcostatus.	Theca reversa.
Illenus Bowmanni.	„ vaginula.
„ nexilis.	Conocardium dipterum.
„ Thomsoni.	Acroculia haliotis.

<i>Illeus latus.</i>	<i>Holopella obsoleta</i> (P).
<i>Lichas laxatus.</i>	<i>Cyclonema crebristria.</i>
<i>Phacops Dalmanni.</i>	<i>Murchisonia augustata.</i>
„ <i>Brogniarti.</i>	„ <i>cancellatula.</i>
<i>Staurocephalus globiceps.</i>	„ <i>pulchra.</i>
„ <i>M'Lareni.</i>	„ <i>simplex.</i>
<i>Trinucleus seticornis.</i>	<i>Ophileta compacta.</i>
<i>Beyrichia tuberculata.</i>	<i>Pleurotomaria Moorei.</i>
<i>Raphistoma striatula.</i>	<i>Orthoceros angulatum.</i>
„ <i>lenticularis.</i>	„ <i>Barrandii.</i>
„ <i>equalis.</i>	„ <i>bilineatum.</i>
<i>Cycloceras mulicameratum.</i>	„ <i>calamiteum.</i>
„ <i>subarcuatum.</i>	„ <i>politum.</i>
	„ <i>vaginatum.</i>

(c) UPPER SILURIAN.

X.—FOSSILS OF THE UPPER SILURIAN BEDS OF KIRKCUDBRIGHT,
DUMFRIES, AND ROXBURGH.

<i>Monograpsus Flemingii.</i>	<i>Rhynchonella nucula.</i>
„ <i>colonus.</i>	„ <i>nasuta.</i>
„ <i>priodon.</i>	<i>Leptena sericea.</i>
<i>Peltocaris Wilsoni.</i>	<i>Atrypa reticularis.</i>
<i>Ptilograpsus</i>	<i>Chonetes sarcinatus.</i>
<i>Cyrtograpsus.</i>	<i>Pterinea lineatus.</i>
<i>Ceratiocaris.</i>	<i>Orthonota decipiens.</i>
<i>Pterygotus.</i>	„ <i>inornata.</i>
<i>Phacops candatus.</i>	<i>Bellerophon trilobatus.</i>
<i>Beyrichia tuberculata.</i>	<i>Avicula lineata.</i>
<i>Leptena alternata.</i>	

XI.—FOSSILS OF LOWER PENTLAND BEDS.

Those Marked "L" pass Upwards into the succeeding Divisions.

<i>Ptilodictya fucoides.</i>	<i>Ctenodonta obesa</i> (L).
<i>Ceriopora granulosa</i> (L).	<i>Cuculella antiqua</i> (L).
<i>Chonetes lata.</i>	<i>Anodontopsis bulla</i> (L).
<i>Meristella tumida.</i>	<i>Orthonota thracoides.</i>
<i>Strophomena Walmstedtii.</i>	„ <i>truncata.</i>
„ <i>compressa.</i>	„ <i>impressa.</i>
„ <i>applanata</i> (L).	<i>Mytilus mytilimeris.</i>
„ <i>antiquata.</i>	<i>Pterinea asperula.</i>
<i>Orthis polygramma.</i>	<i>Platyschisma simulans.</i>
„ <i>Lewisii.</i>	<i>Euomphalus funatus</i> (L).
„ <i>biloba.</i>	„ <i>sculptus</i> (L.)
<i>Rhynchonella Wilsoni.</i>	„ <i>rugosus.</i>
„ <i>nucula.</i>	<i>Phragmoceras compressum.</i>
<i>Pentlandia</i> (L).	<i>Dictyocaris Ramsayi.</i>
<i>Nucleospira pisum.</i>	<i>Entomis tuberosa</i> (L).
<i>Athyris compressa.</i>	<i>Beyrichia Klœdeni</i> (L).
<i>Goniophora cymbæformis.</i>	<i>Turrilepas Wrightii</i> (L).

XII.—FOSSILS OF UPPER PENTLAND BEDS.

<i>Chondrites verisimilis.</i>	<i>Lingula lata.</i>
<i>Favosiles alveolaris.</i>	<i>Pterinea retroflexa.</i>
<i>Protaster Sedgwickii.</i>	<i>Bellerophon expansus.</i>
<i>Spirifer exprorecta.</i>	<i>Acroculia antiquata.</i>
„ <i>crispa.</i>	<i>Orthoceras Maclareni.</i>
<i>Crania implicata.</i>	„ <i>gregarium.</i>
<i>Discina rugata.</i>	<i>Slimonia acuminata.</i>
	<i>Cythere umbilicata.</i>

XIII.—FOSSILS OF THE LESMAHAGOW GROUP.

<i>Lingula cornea,</i>	<i>Eurypterus obesus.</i>
„ <i>minima.</i>	„ <i>lanceolatus.</i>
„ <i>unguiculata.</i>	„ <i>chartarius.</i>
<i>Platyschisma simulans.</i>	<i>Himanopterus bilobus.</i>
<i>Ceratiocaris papilio.</i>	„ <i>acuminatus.</i>
„ <i>stygius.</i>	„ <i>perornatus.</i>
<i>Physocaris vesica.</i>	<i>Slimonia acuminata.</i>
<i>Dictyocaris Slimoni.</i>	„ <i>scorpoides.</i>
<i>Pterygotus gigas.</i>	<i>Neolimulus falcatus.</i>

XIII.—On the ORIGIN OF PETROLEUM.

By RICHARD ANDERSON, F.C.S., F.G.S., Uddingston.

Read 28th March, 1872.—(Abstract.)

IN the opening of his paper, the author alluded to the different theories which had been propounded by geologists on the subject. There was, first, the distillation theory, that petroleum has been produced by the slow distillation, at low temperature, of coal and other bituminous substances within the earth. Next was the theory which supposed petroleum to have been produced from decayed vegetable matter by a process similar to that by which coal was formerly supposed to have been formed, viz., by the mineralisation of woody fibre which evolves marsh gas, carbonic acid, and water. The next notable theory was that petroleum in many cases must have been of animal origin, from the fact of its being found in the lower palæozoic strata, which contain no traces of land plants. Then there was Mr. Wall's "special mineralisation" theory, that bituminous matter has proceeded from vegetable remains which