"Account of the Colony of South Australia."

"Descriptive Catalogue of Rock-specimens in Museum of Economic Geology."

"Descriptive Catalogue of the Economic Minerals of Canada in the International Exhibition."

"Nova Scotia and her Resources."

"Annual Report of the Plymouth Institution, for 1861." Presented by the Institution."

The following paper was read:—

"On Coal Plants." By Professor Morris, F.G.S.

Among the more important and most valuable researches of the geologist and palæontologist, probably there are none more interesting than the enquiry into the early condition of the ancient physical geography of the globe, as derived from the study of organic remains. Replete as the sedimentary strata are with the remains of ancient life, it is only when we study them in connection with the habits and distribution of existing allied forms, that we can derive information of any practical importance. As the marine and fresh-water shells imbedded in the different rocks reveal to us the subaqueous conditions under which they were accumulated, so also may the remains of plants inform us of the ancient terrestrial conditions, and the successive changes which the earth's surface has undergone.

The accompanying notice on the vegetation of the Coal-period is merely intended as a summary of the subject, and will be considered as briefly as possible under the following heads:—

1stly, the nature of fossil plants generally; 2ndly, the history of the coal-plants in particular; 3rdly, their mode of occurrence, condition, and state of preservation; 4thly, their natural history and relation to existing vegetation; 5thly, their numerical proportion and geographical distribution; and, sixthly, the consideration, perhaps, of general inferences deducible from the study of them.

Fragments of plants are distributed through most of the fossiliferous strata. Well-preserved specimens are found in many of the sedimentary rocks, but they are irregularly distributed,

being but scantily represented in some deposits, and occurring in great abundance in others—sometimes so as to form thick beds of coal. Those met with in deposits near the surface, such for example as the peat-bogs and turbaries, which consist of the latest accumulation of vegetable matter, contain only plants or trees identical with existing forms; as, however, we recede in time, greater differences become observable, and living generic types are only found. Thus it is that in the Pliocene strata the plants are nearly all of existing species; in the Miocene, some new; and in the Eocene, more new species. The brown-coal of Europe, of Lower Miocene or Upper Eocene age, represented in this country by the Bovey coal of Devon, contains some existing genera and a few existing species; the Lower Eocene deposits, *i.e.*, the London Clay and Woolwich beds, contain a tolerably abundant flora, chiefly, however, consisting of fossil fruits, but the forms are markedly distinct from those of the European flora, and present affinities to tropical and extra-tropical types; thus we have *Nipadites* allied to the *Nipa* of the Moluccas; *Petrophyloides*, which were proteaceous plants with cone-like fruits, like those found in New Holland and South Africa; and also the genera, *Hightea*, *Wetherellia*, *Cucumites*, &c., besides fragments of Palms and Conifers. The Cretaceous rocks of England contain but few plant-remains; these belong to the *Fuci*, *Coniferæ*, and *Cycadaceæ*. But the same rocks in other parts of Europe contain an abundant flora, including many dicotyledonous plants, as in the vicinity of Aix la Chapelle, in Germany, and in Russia. The plants of the Wealden are more numerous, comprising Palms, Cycads, Conifers, and Ferns; and, although in this country only scantily distributed, in other districts, as in Hanover, where thick beds of coal occur, the vegetation of this period must have been more luxuriant. Some divisions of the Oolitic rocks here and there abound in plants—the Coniferous and Cycad trunks above the Portland beds are well known; but the Lower Oolite of Oxfordshire, Yorkshire, and Sutherlandshire contain many species of Ferns, Cycads, and some Conifers, which in the two last-mentioned districts have probably contributed to form the Moorland and Brora coal. The Lias, both in this country and in Europe, generally has vegetable remains similar to those of

the Oolite, but differing in species ; in this country, they do not form coal, though in some localities, this flora must have been very luxuriant, for thick beds of coal of this age are found in Hungary, Austria, the Caucasus, and at Richmond, in Virginia. The Trias has its Cycads, Conifers, and some Ferns ; the New Red Sandstone, for example, having a somewhat similar flora to the Lias, with some *Coniferae*, of which the *Voltzia* is the principal. The Permian formation of England, Germany, and Russia contains remains of about one hundred and eighty species ; the plants, however, of this system are more allied to Palæozoic than Mesozoic forms. One division of the Palæozoic rocks—that which in this country at least contains the most numerous remains of an extinct vegetation and the thickest beds of coal, has been aptly termed the Carboniferous formation, and may be said strictly to represent the Palæozoic flora ; not, however, that we are here presented with the first traces of vegetation or even of a terrestrial one, as formerly supposed, for the Devonian rocks of Ireland contain fossil Ferns, *Adiantites*, and stems of *Cyclostigma*, related to the *Lepidodendron* and *Calamite*, which have been well described by Professor Haughton.* From rocks of similar age in New Brunswick, Maine, and Canada East, Dr. Dawson has described more than fifty species belonging to the genera, *Calamites*, *Dadoxylon*, *Aploxyton*, *Sigillaria*, *Asterophyllites*, *Lepidodendron*, *Lepidostrobus*, *Lycopodites*, *Psilophyton*, *Selaginites*, *Cordaites*, *Pycnophyllum*, *Cyclopteris (Jacksoni)*, *Sphenopteris*, and *Neuropteris*. Of these forms, one, *Calamites transitionis*, is found in Europe, and another, *Cyclopteris Jacksoni*, may be compared with the *Cyclopteris hibernicus* from Ireland. Professor Goeppert, referring to Germany and Silesia, enumerates fifty species of land-plants, and seven others obtained from similar deposits ; but, while there is an equal generic identity between the Devonian plants of Europe and America, there appears to be a greater specific difference than is noticed when the Carboniferous flora of the two countries are compared.† Below these are the Silurian and Cambrian rocks which present us with few remains of vegetable life, unless indeed we include the coal-

* Journal Geological Society, Dublin.

† American Journal of Science, vol. xxviii, p. 279.

field of Oporto, referred by Sharp to Silurian age, but certainly containing Carboniferous fossils. The plants of Silurian age are chiefly fucoid-like plants or *Algæ*, and spore-cases of Lycopods.* It will thus be seen that the study of fossil plants leads to the same results as the study of extinct animals, the farther we recede in time the greater is the difference, as compared with existing forms. Remains of fossil plants attracted the attention of the earlier naturalists, who gave figures and descriptions of them under the name of Phytolithes, Lithonylites, &c. Of the works upon this subject, it may be useful to notice the more important and accessible.

Of the early publications in which coal-plants were referred to are those by Gesner, in 1561; Cordus in 1651; and by Major in 1664. Among the more important works on this subject in the eighteenth century were those of Petiver, in 1702; Scheuchzer, (*Herbarium Diluvianum*,) 1709; Büttner, in 1710; Wolfart, in 1713; Valentin, in 1714; Mylius, in 1718; Volkmann, in 1720; Swedenborg, in 1722; Bruckmann, in 1727; Schülze, in 1755; Walch, in 1773; Schröter, in 1784; and Suckow, in the same year. At the commencement of the present century, there appeared the "*Flora der Vorwelt*," 1804, by Schlotheim; the works of Rhode and Steffens, 1810; and subsequently, from 1821 to 1838, the celebrated work of Count Sternberg, who was assisted in his arduous labours, especially in the late volume, by Corda and Presl. Corda himself afterwards published a valuable work on the structure of fossil wood, and Professor Goeppert has enriched the literature of coal-plants by numerous memoirs; of which the "*Systema Filicum Fossilium*," and his "*Gattungen Fossilien*," are very important. The coal-flora has been further noticed in the works of Von Martius, Unger, Endlicher, Cotta, Bronn, Germaix, and Gutbier, the last carefully describing the coal-flora of Zwickau. In Russia, the subject has been treated by Eichwald, and in Germany by Roemer and others. Professor Geinitz has admirably illustrated the coal-formations of Saxony in a work which contains many important observations; the coal-plants of Saarbrück have been partly described by Goldenburg, and those of the South Harz and Piesberg by Römer. Many interesting forms of fossil seeds or fruits have also

* Hooker, *Quarterly Journal Geological Society*; vol. ix, p. 12.

been described and figured by Dr. Berger and Professor Goeppert. Prussieu, Dulack, and Sauvage have contributed to the history of fossil plants in France, but the most important and valuable of the French works are those of Adolphe Brongniart, whose classic work, "*Histoire des Végétaux Fossiles*" (unfortunately not completed), is well known. Besides this, the various papers by the same author which have appeared in the French periodicals, including his important memoirs "*On Sigillaria*," and also the "*Prodrome*," published in 1827, and the "*Tableau*," in 1849, should be consulted by the student of the coal-flora. In America, attention has been directed to the subject by Dr. Granger, Dr. Hildreth, Dr. Newbery, and Mr. Wood.

Steinhauer published in the Transactions of the Philosophical Society of Philadelphia, for 1818, a memoir on fossil plants, including a detailed description of *Stigmaria*, the result of observations made by him in this country. Professor Dawson, in his "*Acadian Geology*," and in the "*Journal of the Geological Society of London*," has published many interesting researches on the coal-plants of Nova Scotia. The most important memoir, however, and that which has contributed most largely to our knowledge of the coal-plants of America, is the valuable work of Mr. Leo Lesquereux, which is appended to the Geological Survey of Pennsylvania; it contains many important remarks on the character and affinities of the fossil plants of the coal, their distribution and comparison with European species, as well as a description of two hundred and thirty-one species, and figures of one hundred and two of them. To the same author we are indebted for a catalogue of American fossil plants (including about two hundred and eighty species) published for the Scientific Society of Pottsville, Pennsylvania; and for other papers bearing on the subject which have appeared in the "*American Journal of Science*," vol. xxxii.

Passing to perhaps the more interesting portion of the subject—the consideration of the plants of Coal-measures in particular, it may be stated that in this country we have notices of coal-plants by Plott, in 1686; Woodward, in 1690; Llwyd, in 1699; Costa, in 1755; and at the commencement of the present century, by Morton, in 1809; Parkinson, in 1811; and subsequently, in the works of Artis and Mammatt, in 1827; Witham, in 1831; the "*Fossil Flora*"

by Lindley and Hutton in the same year; and the interesting memoirs by Dr. Hooker; besides important papers published in various scientific journals by Bailey, Burney, Brown, Bunbury, Dawes, Harkness, Haughton, Hawkshaw, King, Pattison, Tate, and Williamson. The plants of the coal occur, as already stated, in an extremely fragmentary condition, although large portions of stems are sometimes met with; the different parts of the plant are rarely found in juxtaposition, the stem, root, leaves, and fruit being mostly isolated. These fragments are differently distributed; in the under-clay, or clay below the coal-seams, the *Stigmara*, with its rootlets, penetrating the bed in every direction, is very abundant, associated occasionally, with other plants. The coal itself contains compressed specimens of *Sigillaria*, *Stigmara*, and *Lepidodendron*. But the most abundant remains are those found in the roof-shale and "trub" (a carbonaceous bed) and mostly parallel to the plane of deposition; these consist of Fern-stems and fronds (sometimes showing traces of fructification), also stems of *Calamites* (more or less compressed, and some feet in length), *Sigillaria*, *Lepidodendron*, and its fruits and leaves: occasionally, the *Sigillaria* are found in a vertical position and uncompressed, with their roots spreading out to some distance around. In the associated sandstone (as the flagstone series near Halifax) stems are chiefly found of *Halon*, *Lepidodendron*, *Sigillaria*, and *Calamites*; rarely Fern-fronds but sometimes many fruits (*Trigonocarpon*) as in the Peel Delph quarry, near Bolton. The nodules of shaly ironstone, as at Low Moor, Coalbrookdale, and South Wales, frequently enclose remains of plants, especially Ferns, with the venation well defined; these are in a different condition to similar remains found in the shales: they are less carbonized, the vascular tissue being frequently filled with ferruginous matter, and thus preserved, whilst the cellular tissue is destroyed. Stems below the coal in Northumberland are associated with marine shells. These plant-remains occur in different states of preservation, generally compressed in the shales, or, when not so, their original structure destroyed; the outer part being converted into coal, the inner part being replaced by clay or sometimes coal. In the sandstone, the structure is mostly destroyed, except traces of the ligneous cylinder; a cast only remaining of the plant. The fronds of Ferns are

generally well preserved, but when soriferous, or even otherwise, are usually attached to the shale by their under side. In some uncompressed specimens of *Lepidodendron*, *Sigillaria*, and *Stigmaria*, the tissues are well preserved, being replaced by iron, carbonate of lime, and pyrites, and sometimes silicified; thus allowing the original structure to be easily examined. The *Stigmaria* not unfrequently presents the vascular cylinder eccentrically placed, or even lying against the margin, the interior being filled with clay or sandstone. This eccentric position of the cylinder arises, as first noticed by Steinhauer, from the decay of the looser tissues, so as to allow the more solid portion to subside to the lower side when in an horizontal position. About three hundred species of fossil plants are recorded as found in the Coal-measures of England—the greater number consisting of Ferns, which are the characteristic plants, the larger portion of the remaining number comprising *Lepidodendron*, *Sigillaria*, *Calamites*, and some *Coniferæ*. Many species are widely distributed, although locally abundant, not only in our own coal-fields, but are common to those of Europe and America, and some have a great vertical range in the coal-measures. The most common forms are:—*Neuropteris cordata* (*N. hirsuta* of Lesquereux); *N. flexuosa*; *N. heterophylla*; *Cyclopteris orbicularis*; *Alethopteris lonchitidis*; *A. nervosa*; *A. Serlii*; *Pecopteris arborescens*; *P. polymorpha*; *P. arguta*; *Asterophyllites foliosa*; *Sphenophyllum Schlotheimii*; *Asterophyllites tuberculata*; *Calamites approximatus*; *Stigmaria ficoides*; some *Sigillariæ* and *Lepidodendra*. Of two hundred and twenty specimens examined by Mr. Lesquereux from the coal-fields of America, more than one hundred were identical with, and fifty others bore a close relation to, European forms, and which might prove to be the same when better specimens were procured. Sir C. Bunbury had previously alluded to the striking similarity of the two floras when describing the coal-plants of Maryland, and also those from Cape Breton, where, of thirty-seven species examined, twenty-four were identical with, and four or five others only varieties of, European forms.* Professor Goeppert enumerates eight hundred and seventy-nine species belonging to one hundred and

* Quarterly Journal Geological Society, vol. ii, p. 87; and vol. iii, p. 435

twenty-four genera, of which species thirteen are classed as cellular, and eight hundred and sixty-six as vascular plants, of the coal-period. The *plantæ cellulares* comprise, of the *Aphyllæ*—two *Fungi* and eleven *Algæ*, there being no *Foliosæ*—neither *Hepaticæ* nor *Musci*. The *plantæ vasculares* comprise, Monocotyledones, seven hundred and thirty-five *Cryptogamiæ*, and thirty-seven *Phanerogamiæ*; and of Dicotyledones, twenty-one are *Monochlamydæ*, two *Christopetalæ*, and seventy-one doubtful.* On the other hand, Adolphe Brongniart† enumerates five hundred species of which, according to his arrangement, three hundred and forty-six are acrogens, and one hundred and thirty-three Gymnospermous Dicotyledons. The Cryptogamous Amphigens comprise four *Algæ* and two *Fungi*. The Cryptogamous Acrogens, two hundred and fifty *Filices*; eighty-three *Lycopodiaceæ*; and thirteen *Equisetaceæ*. The Dicotyledonous Gymnosperms include forty-four *Asterophyllitæ*; sixty *Sigillariæ*; twelve *Næggerathiæ*; three, probably, *Cycadæ*; and sixteen *Coniferæ*.

With a view of showing the mode in which the fossil plants are distinguished from each other, it may be well to state that the whole of the numerous species and genera of plants are comprised in six classes. Firstly, there are the Thallogeous, or tongue-shaped plants, which include the *Algæ* and *Fuci*. Secondly, the Anogens, which include the Liverworts, *Hepaticæ*, and Mosses. Thirdly, the Acrogens, which include the Club-mosses, the Ferns, the Pepperworts, the Quillworts, and the Pillworts. Fourthly, the Gymnogens, which include the Conifers and the Cycads. Fifthly, the Endogens, comprising the Palms proper and Grasses. And, sixthly, the Exogens, which include the woody and strong timber-trees, such as the Birch, Apple, Pear, &c. Of the Thallogens we have very little evidence of development in the seas of the coal-period, perhaps because their structure is such that they were readily decomposed. Occasionally specimens have been found and are recorded by Brongniart, although the *Fucoides serrata* and *Fucoides dentata* are undoubtedly Graptolites. One only was found by Prestwich in the coal-measures of Coalbrookdale. *Fungi* are also scarce: the *Polyporites Bowmani*, referred to this class by

* Bronn, Index Palæontologicus, vol. iii, p. 727.

† Tableau des genres de Végétaux Fossiles, 1849.

Lindley and Lesquereux, requires further examination, and is probably a fish-scale. The *Excipulites Neesii* and *Gyromices Ammonis*, Göpp., also referred to the *Fungi*, and found attached to fronds and stems of Ferns, and in the shales of the coal, are considered to be identical with the *Spirorbis (Microconchus) carbonarius*, and to belong to the *Annelida*. Of Mosses, again, we have no distinct evidence, though Lesquereux thinks that he has discovered traces of them. The Acrogens embrace the great Fern tribes, and the fossil plants allied to the *Lycopodiaceæ*. Recent Ferns consist of roots, stems, branches or fronds, and certain organs of fructification, called sori and spores. But ere we enter upon the consideration of fossil Ferns we should look into some of the difficulties met with, even in the study of recent species, the classification of which is in part dependent on the character and position of the sori, or organs of reproduction; and these being mostly absent in the fossil species, their determination, or relation to existing types, is very unsatisfactory.

Some years since a paper was communicated to the Linnæan Society on the difficulty of determining the genera of plants embedded in the coal-shales; and the subject has been subsequently investigated by Dr. Hooker, in a valuable memoir published by the Geological Survey. A notion may perhaps be obtained of these difficulties, when it is known that the same form of venation may exist in very different ferns; as for example, in some species of *Gonioptrix*, *Stengoramma*, *Nephodium*, and *Meniscium*, and which could be distinguished by their fructification only. Hence we learn that similarity of venation does not necessarily indicate similarity of species, and that sometimes different venations belong to the same species. On the other hand, there are some Ferns in which the fertile and barren fronds differ considerably in shape, and others in which the outline of the frond varies, as in *Polypodium*, *Lundscea*, *Asplenium*, &c., which, in a fossil state, would render their determination difficult. Generally the fructification has been so modified by fossilization, that a frond with an indusium, and a frond without one, would present the same appearance. Brongniart, therefore, divides them according to the venation, and considers that the classification of fossil Ferns must be established on the nervation, and

its relation with the general form of the pinnules and of the fronds.

Fossil Ferns are divided into three great groups. The *Pecopteridæ*, *Neuropteridæ*, and *Sphenopteridæ*. The first, *Pecopteridæ*, includes *Pecopteris*, *Alethopteris*, *Callipteris*, *Lonchopteris*, as well as probably *Woodwardites*. *Pecopteris* has generally large fronds, tolerably coriaceous, and divided into three or four branches, or are, as it is termed, bi-pinnate, tri-pinnate, or bi-tripinnatifid. The bases of the leaflets are united to the stem. The leaflets have always a mid-rib, from which the secondary veins branch out towards the margin. In *Alethopteris* the pinnæ are thick, adnate, and decurrent; and the genus *Corynepteris* (Bailey) is probably the fertile frond, with hexagonal sori, of a species belonging to *Alethopteris*. In *Lonchopteris* the pinnæ have a mesial rib, and the secondary veins reticulate; *Woodwardites* has also reticulate venation, but the mid-rib is nearly obsolete; the British species referred to this genus probably belongs to *Dictyopteris*. The second group is the *Neuropteridæ*; they have the frond pinnate or bi-pinnate, the pinnules round or oblong, mostly entire, more or less free at the base, and without a mid-rib, except such as is formed by the union of the veins, and becomes obsolete towards the apex, or where the veins radiate directly from the base. This group comprises *Neuropteris*, *Odontopteris*, *Dictyopteris*, and some species of *Næggerathia* and *Cyclopteris*. In *Odontopteris* the leaves are bi-pinnate, and attached by the entire base to the rachis, the pinnules are cuneiform, with no distinct mid-rib. *Næggerathia* and *Cyclopteris* have also been referred to the same group, though doubts have been expressed of late concerning some species of the latter genus, which are considered, with some reason, to be merely the leaves of the Coniferous genus, *Dadoxylon*. In the *Dictyopteris*, again, the mid-rib is very nearly wanting, and the venation reticulate: it is found in the coal-measures of Saxony, Nova Scotia, and America. The third group is the *Sphenopteridæ*, which comprise a group of delicate ferns with the frond bi-pinnate or bi-pinnatifid, the pinnules slender, more or less trilobed, and generally detached from the rachis. To this division belong *Sphenopteris*, *Hymenophyllites*, *Trichomanites*, *Schizopteris*. The genus *Sphenopteris* in-

cludes a large group of Ferns which present affinities with the recent genera *Dicksonia*, *Devallia*, and *Chelanthus*. The *Caulopteris* is a large species of Fern, or Tree-fern, of which the trunk is usually covered with so-called scars or oblong discs. These scars give the trunk a peculiar appearance; they are, however, merely the cicatrices left by the bases of fronds, similar to those scars observed in recent Tree-ferns from New Zealand and Jamaica.

Another characteristic plant of the coal-period is the *Lepidodendron* or scaly tree, which had a dichotomous branching stem, covered with rhomboidal or elongate scars, the bases of long linear leaves called *Lepidophylla*; the branches terminated by cylindrical cone-like bodies containing seeds, and termed *Lepidostrobi*. The internal structure consisted of a central continuous vascular cylinder, surrounded by a mass of cellular tissue, from the former of which arose vascular bundles, which proceeded more or less obliquely through the cellular portion to the bases of the leaves.

To the family *Lepidodendræ* belong also the *Ulodendron*, *Bothrodendron*, and *Halonía*; the last was probably the root of *Lepidodendron*, and was furnished both with small scars and prominent tubercles.

The family *Sigillariæ* includes two characteristic forms, *Sigillaria* and its root *Stigmaria*.

Sigillaria has a fluted stem with oval, pentangular, or long scars, from the form of which the name of the genus was suggested (*Sigillum*, a seal).

The scars exhibit a more or less spiral arrangement. The *Sigillaria* was a large tree branched at its upper extremity. Goldenberg has found the fructification of this very interesting genus.*

The internal structure differed somewhat from that of *Lepidodendron*, and consisted of an internal vascular cylinder, not concentrically uniform as in that genus, but separated into wedge-shaped portions; to this succeeded a mass of cellular tissue, which was surrounded by an outer layer or bark.

Stigmaria was the root of *Sigillaria*, the outer surface is marked with mamillate tubercles, arranged quincuncially, and giving insertion to long cylindrical rootlets.

* Flora Sarrafontianæ.

The internal structure of *Stigmaria* resembled that of *Sigillaria*, but the position of the vascular bundles in relation to the cylinder was somewhat different in the two genera.

Another plant very common in the Coal-measures is the *Calamites*, a reed-like plant, somewhat similar to the Bamboo, and formerly considered to belong to the same family, but the researches of Dawes, Binney, and others, have shown that the internal structure presents affinities to that found in Gymnogens, Endogens, and Acrogens. The stem was striated and jointed at intervals, around which were nodes or tubercles, which supported branches or leaves; these appendages being probably some of the forms referred to the *Asterophyllitæ*, a group of plants with slender stems and verticillate leaves, including *Bornia*, *Bruckmannia*, *Sphenophyllum*, &c.

Volkmannia possessed a cylindrical, fluted, and articulated stem, bearing tubercles or nodes at the joints, and terminated by an oblong cone-like body, consisting of numerous whorls of short subulate leaves, a combination presenting some analogy to the genus *Ephedra*, as pointed out by Dr. Hooker.*

The last principal group is the *Coniferæ*; it abounded, but not in the same proportion as the others.

But few remains of cones or leaves have yet been found. The evidence of *Coniferæ* being chiefly dependent on the structure of the woody tissue, which is specially marked by pores surrounded by large discs, and arranged in the fibres of the wood either in a single row or in double or treble rows, as in *Araucaria* which the coal-wood most nearly resembled. The genera *Pitus*, *Peuce*, *Pissadendron* belong here. One genus, *Dadoxylon* is remarkable for its large pith, the cast of which was formerly described under the name of *Sternbergia* and *Artisia*. The *Dadoxylon* is considered by Salter and others to be the tree of which some forms of *Cyclopteris* are the leaves, and *Trigonocarpon* the fruit.

Of the 300 fossil plants found in the British Coal-fields, more than one-half are Ferns. Of the 900 Coal-plants enumerated by Goeppert the greater part are vascular cryptogams; and Brongniart states that out of 500 coal-plants, 350 belong to the same class.

* Quarterly Journal Geological Society, vol. x, p. 199.

From the above brief remarks it may be observed that the flora of the Carboniferous period was characterized by the absence of the Dicotyledonous Angiosperms, and the paucity of Monocotyledons, and by the presence of Gymnogens, the predominance of the Acrogens, and the great development of a peculiar group of plants, namely, the *Sigillaria* and allied forms,—plants having affinities on the one hand with the last division, and on the other with the Dicotyledonous Gymnosperms.

That the old Coal-flora was uniform over a considerable area there can be no doubt, for Lesquereux mentions that of two hundred and thirty American coal-plants, one hundred are identical with European plants, and with regard to many others he might not be able to discover the difference after more careful comparison. When the plants of the Coal-period are studied, it will be seen not only that there was a considerable extent of country occupied by the coal-formation, but that the period was one that indicated a humid or moist climate, and that there must have been some peculiar physical conditions by which such a luxuriant vegetation was supported.

In the subsequent discussion, Mr. G. E. Roberts said, that with respect to the *Corynepteris* of Bailey, he had brought a specimen in which the hexagonal sori were well shown; it had recently been found in the coal-field of the Titterstone Cleve Hills.

The Rev. Mr. Wiltshire enquired whether in the different beds of coal, or in the upper and lower portions of the same seam, different plants were met with? They all knew that, taking rocks generally, different fossils were found in the different strata, and he should be glad to learn whether a similar arrangement was observable in the coal.

Professor Morris said that that was a question that could scarcely be answered at present. It was only in a very fragmentary state that the specimens were usually obtained, and, in consequence, portions of the same plants had been described as distinct species; for instance, in the genus *Sigillaria*, were included many so-called species which were parts of the same stem, in different states of preservation, as

pointed out some years ago by Mr. Binney and Professor King.* The prevailing opinion seemed to be that there is a great uniformity in the plants of the upper and lower portion of the coal-measures; in Yorkshire and Lancashire there are certain plants which occurred in the bottom coal more than in the other, many of these had been carefully worked out and described by Mr. Binney.† Lesquereux had also pointed out that there were plants more common in the lower than in the upper coal; but the subject was one requiring further investigation, and could only be undertaken by those who had ample opportunities of examining specimens from shales over different coal-seams, or from the different beds passed through in sinkings for coal.

Ordinary Meeting, Monday, December 1st, 1862.

Professor Tennant, F.G.S., President, in the Chair.

The following gentlemen were elected members of the Association:—H. Mackillop, Esq.; Fredk. Wm. Hadden, Esq.; and — Dé Burglio, Esq.

The following donations were announced:—

Presented by Mr. E. S. Biden.

“Catalogue, Victorian Exhibition.”

“Guide to the Land-law of Victoria.”

“Supplement to Catalogue of the Products of the Colony of New Brunswick.”

“The Products and Resources of Tasmania.”

“Imperial and Royal Geological Institute of the Austrian Empire—Catalogue of the Mining and Metallurgical Products: Class I., International Exhibition.”

“The Smithsonian Report for 1860.” By the Smithsonian Institution.

“Indian Catalogue, International Exhibition.” By J. Forbes Watson, Esq.

* Edin. Phil. Journ.

† Quart. Jour. Geo. Soc., vol. xviii, p. 106.