PROCEEDINGS
OF THE
GEOLOGISTS' ASSOCIATION.

ADDRESS

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BY THE PRESIDENT,

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The life of the globe during any past period of its existence is known from the remains preserved in the sedimentary rocks that have been, more or less accidentally, exposed. Our knowledge is bounded by the extent to which the exploration of the rocks has been carried, a boundary always being extended through man's labours. It is absolutely limited by the organic remains actually contained in the rocks. These, even if completely known, would necessarily constitute a defective record. As regards the vegetable kingdom, the strata most abounding in plant remains contain but a small proportion, as we shall presently see, of the vegetation existing at the time of their formation, while many deposits of great thickness, which represent immense epochs in the earth's history, are, as far as we at present know, completely destitute of all trace of plants. The extent of this varying record largely depends on the conditions under which the beds were formed.

Before enquiring into the material of the records, it is, then, desirable to look for a little at the physical conditions under which the rocks were formed, and the influences these conditions exer-

cised in determining the nature and extent of the record. We should not look upon a series of plants collected while a ship touched for a short time at some hitherto unexplored island as the flora of the island. However active and successful the collector may have been, his materials could be accepted as only a contribution towards the knowledge of the island's vegetation. The place visited contained but a small proportion of the plants of the island, and the time spent was too short to procure specimens even of all the plants in the limited locality. The inland and upland plants, as well as those peculiar to bogs and meadows, would probably be wanting on the rocky or wooded shore where the collection was made. Knowing the nature and extent of the limited locality, and the time at the collector's disposal, we might fairly predicate what kinds of plants would be absent from his herbarium. And so the petrified herbarium, spread out on the stone-leaves of the stratified rocks, may, from the conditions under which it has been collected and preserved, represent only a portion of the existing vegetation. Are we able to point out gaps that necessarily exist in the geological plant record, or are we in possession of facts which may, at least, enforce caution in attempted generalisations? If so, we may be saved from erroneous as well as defective estimates of extinct floras.

First of all, we should remember that the plant-bearing sedimentary rocks have been formed under water. The materials of which these rocks are composed have been brought to the place they occupy by running water, which, in its course, had access to a supply of the material deposited, and had velocity and body sufficient to carry it. The arrangement of the particles in the bed has also been the work of water. The organisms buried in the bed have consequently been subjected, for a longer or shorter time, to the action of water. In the case of rapidly deposited gravels and sandstones this action may have operated for a short time, and the specimens may consequently have been buried before any great change had taken place. But plants preserved in shales must have been subjected for a considerable period to this action, and even after they sank to the bottom and were buried in the mud the action of the water would continue. The readily perishable portions of the plant structure would necessarily perish under the influence of this continued water action. The interesting experi-

ment instituted by Lindley as to the capability of different plants to resist the action of water is of great importance in this connection. He placed 177 specimens of plants belonging to the more remarkable natural orders of plants into a large iron tank filled with water. The vessel was placed in the open air and left uncovered and untouched, except when water was added to make up for the loss by evaporation, for two years and one month. The contents of the tank were then examined, when it was found that nothing recognisable remained of thirteen cellular plants, that the two species of *Equisetum* had also perished, but the six Ferns and one *Lycopod* were still recognisable. Further, that of the eighteen *Gymnosperms*, fifteen species, or 83 per cent., were recognisable; of the thirty-one *Monocotyledons*, twelve species, or 40 per cent., could be determined; and of the 106 *Dicotyledons*, fourteen species, or 13 per cent., were recognisable. The various plants were selected so as to represent fairly the general structure, as well as the systematic position, of the existing members of the vegetable kingdom. An examination of the list operated upon shows that all plants that were to any considerable extent cellular, and all the herbaceous species, perished, while those that resisted decay sufficiently to be recognised were indurated forms, like the palm and butcher's broom among the *Monocotyledons*, and the oaks, *Casuarina* and *Dryandra* among the *Dicotyledons*.

We cannot, then, expect to find cellular structures preserved among fossils, and they are, indeed, rarely met with, even in specimens where the general tissues are well preserved; while plants that were entirely cellular in their structure have altogether perished. Thus, in the extensive flora of the Carboniferous Period, only two exceptionally preserved cellular plants are known, though the physical conditions were singularly favourable for their growth. The humble moss, the creeping hepatic, the epiphytic lichen, and the leafless fungus—all cellular and moisture-loving plants—would find habitats suited to their special tastes in the dense damp and warm Carboniferous forests. There can be little doubt that they flourished there in greater luxuriance and vigour than during any previous, or, perhaps, subsequent, period of the earth's history. Their remains may even have contributed some share to our now amorphous coal, but no recognisable trace of them has been left behind, if we except two fungi—the one described by Mr. Athey from the Newcastle coal field, the other observed by

myself, though not yet described. Both of these owe their preservation to exceptional circumstances. Mr. Athey's specimens are probably masses of indurated mycelium, which, like the "cockspur" or ergot, were adapted to maintain the vitality of the plant in a dormant condition; while the specimens observed by myself are the mycelium of a fungus which, having penetrated the indurated vascular tissue of a *Lepidodendron*, was thus protected from destruction, and preserved, with these surrounding tissues, by the petrifying mineral.

Specimens of fungi have been found in Irish bogs in so perfect a condition that they have been identified with certainty. They are *Polyporus fomentarius*, Fr., *P. igniarius*, Fr., and *Boletus suberosus*, Sow.—species of a firm and indurated nature, fitted to resist decay. Lindley believed he had obtained a similar woody species from the Coal Measures, to which he gave the name of *Polyporites Bowmani*, and figured and described it in the "Fossil Flora;" but better materials have shown that the fossil is only a large ganoid scale of *Holoptychius Hibberti*, Ag. With the exception of the instances referred to, fungi have not been detected in any of the sedimentary rocks until we reach the Tertiary beds, where a number of minute parasitic forms occur on the leaves of dicotyledonous trees. No less than eighty species have been determined from Eocene strata.

The earliest evidences of plant-remains are generally referred to *Algæ*—indeed, the Cambrian, Silurian, and Lower Devonian systems form the first botanical epoch of Professor Schimper, to which he gives the name of the "Period of Thalassophytes," because only seaweeds are found in these rocks. The evidence of their existence is found in certain markings on the surface of the beds. With one remarkable exception, no trace of structure—not even of carbonaceous stains—has been noticed belonging to any of these supposed *Algæ*. The markings have received specific names, and have been grouped into genera, but it is very doubtful whether there is sufficient evidence to show that they are really impressions of plant forms, especially in view of the interesting observations of Dr. Nathorst, who has noticed on the mud of the Baltic shores markings and impressions produced by flowing water acting on small obstacles, or on plants which are identical with those found on the surface of Palæozoic rocks. The remarkable exception to which I have referred is *Nematophycus Logani*, Carr.

which occurs in the Palæozoic rocks of Canada, the minute structure of which is beautifully preserved, and shows it to have been a cellular plant, most probably a giant seaweed.

Undoubted Algæ are met with in Tertiary strata, as in the Eocene beds of Vienna and Monte Bolca, while the presence of the curiously twisted fruits, which have been called *Gyrogonites*, shows that species of *Chara* lived in Secondary and Tertiary waters. Some of the undoubted plant-remains which have been referred to *Algæ* from the older rocks, are only badly preserved specimens of more highly organised plants, like the *Haliserites* of Devonian age, which is the leafless branches of one of the Lycopodiaceous plants, to which Professor Dawson has given the name of *Psilophyton*.

The only fossil *Lichens* determined with certainty are some fragments of Miocene age which Göppert has discovered in Baltic amber. In the same amber are preserved nearly all the fossil *Mosses* and *Liverworts* that are known.

It cannot be doubted that cellular plants abounded in epochs long before any traces of them have been found in the rocks; indeed, the abundant animal life which peopled the older Palæozoic seas, and the remains of which abound in the rocks, necessitate the coexistence of an abundant marine vegetation, which either directly or indirectly supplied them with food.

Though only one or two forms of cellular plants from undoubted and unmistakable remains are known as forming part of the flora of any Palæozoic or Mesozoic period, we should certainly be in error were we to assert that they were absent from the vegetation of these periods, or, indeed, that they formed an inconsiderable portion of these ancient floras. Their remains are absent from the rocks because the water action, to which all fossil plants have been subjected, has accomplished their complete destruction.

In estimating the relation that the buried remains bear to the actual vegetation of a period, we must further remember that we very rarely meet with these remains in the localities where the plants themselves grew. Unlike most animals, plants are fixed to the spots where they live, and we have, in the main, preserved to us only the dismembered fragments which have been carried by water from their native localities. There are a few exceptions to this, like the coal-beds of the Carboniferous age and the so-called "Dirt-bed" of the Lower Purbeck in the Isle of Portland. But such old land surfaces preserved along with the remains of the vegetation they sup-

ported are very rare. They supply, when they occur, the most certain data for the restoration of an extinct local flora. In the coal we have preserved the whole of the vegetation of the locality, except the plants and portions of plants which readily perished. Roots, stems, leaves, and fruit united to form the coal, and although it may be impossible to recognise them in the generally amorphous mass, they are occasionally preserved in concretions of minerals which were dissolved through the vegetable substance before its organic elements were destroyed, and which, happily, in their segregation and crystallisation, have enclosed the specimens and fixed their tissues by replacing the perishable organic structures with the imperishable mineral. Such concretions occur in the Yorkshire and Lancashire coal fields, where they are called "coal-balls;" and to them we are indebted for much of the accurate and ever-growing knowledge we possess of the structure of coal and the nature of the plants which have gone to form it. In the Portland "Dirt-bed" we have only the trunks of the cycadean and coniferous trees, converted into amorphous siliceous, still occupying their original position. No traces of leaves or fruit have been found associated with these trunks.

The fossil vegetable remains are, however, chiefly fragments of dead and dismembered plants borne to their resting-place by water. As long as the specific gravity of the fragments was less than that of the water, they floated and rotted; when completely water-logged and heavy, they sank to the bottom as soon as the velocity of the current was insufficient to make up for the excess of weight. Thus we find immense trunks enclosed in sandstone rocks, the force of the current being evidenced equally by the size of the fossil as by the nature of the rock in which it is bound. The porous sandstones, permitting the passage through them of water and oxygen, have secured the destruction, by slow combustion, of the substance of the wood, where it has not been fixed or replaced by foreign minerals. There remains in such cases only a cavity representing the fossil, which is either empty or filled by a cast of the stem formed of the amorphous substance of the enclosing rock forced into the cavity, or of some mineral diffused through the rock, which has crystallised in the cavity. When this dissolved mineral had access to the wood before decay has taken place, a pseudo-morph of the vegetable structure, preserving its minutest details in marvellous perfection is produced.

The plant remains which were floated into still water were buried in mud, and this in the older rocks is now generally indurated into shales. The mud having closely invested the plants and prevented the access of water or oxygen, has preserved their original elements, though a metamorphic or chemical rearrangement of these elements has taken place, resulting in the production of a homogeneous substance, having the form without the structure of the original organism. This process may be called carbonisation, as opposed to that of mineral replacement or petrification.

To the operation of these conditions we owe the preservation of the plant-remains which form our great beds of coal. Chemical changes have taken place, but the hermetically closed envelope of the under and roof clays has confined these changes to each particular bed, and has prevented the escape of volatile or dissolvable elements to any great extent. These coal beds then preserve nearly all the original elements of the plants, without almost any of the structures into which they were originally built up.

Having thus passed in review the conditions under which the carbonised or petrified remains of plants have been preserved, we are in a better position to enquire to what extent the floras to which these remains belong may be expected to be represented by them.

Fossil plants are rarely found, as we have seen, in the localities where they grew. The association of the vegetation with the soil which supported it, when it occurs, supplies valuable help to a right interpretation of the flora. We thus learn from the soil on which the coal beds rest, as well as from the great expanse of the coal seams themselves, that in the Coal Measures we are dealing with the vegetation of extensive swampy plains. The contemporary upland vegetation is represented by the trunks of trees and the indurated fruits found in sandstone deposits, as at Edinburgh and Manchester. These certainly testify that at least some, if not all, of the woody trees which clothed the higher ground were Gymnosperms. The areas of dry land supplying the abraded materials now forming the shales, sandstones, and conglomerates of the Carboniferous age must have been immense. And these immense areas were, without doubt, covered by vegetation, probably as abundant as the land vegetation of the present day, and no doubt more varied than the remains known to us indicate. But just as our dry-land vegetation now lives and perishes, leaving little to testify in future ages to its nature or extent, so, with the

exception of the trunks and fruits to which I have referred, no record remains of the upland floras of the Carboniferous period.

We have no means of estimating the relation between the marsh and dry-land Carboniferous floras. The woods supply only a few specific forms belonging to these types, perhaps, of generic value, but the fruits described by Göppert, Berger, Brongniart, Lesquereux, and others show that there must have been a large series of generic as well as of specific types of gymnospermous plants clothing the higher lands. The marsh flora, though almost confined, as far as it remains testify, to three natural Orders, was nevertheless remarkably numerous in specific forms.

If we may venture to suppose that the relation between the marsh vegetation and the entire flora of these Palæozoic ages, was at all similar to that existing between the bog plants of our country and its entire flora, we may form some estimate of the imperfections of the Carboniferous plant record. Our marsh peat contains the remains of oak, fir, alder, and birch, and more rarely of ash, hazel, mountain ash, and willow among trees; of two or three species of heath, the bog myrtle, and the cranberry; and of the sundews, the bog bean, and some twenty other marsh plants, together with a few grasses, and sedges, some horsetails, and, most abundant of all, one or two species of bog-moss. Probably the entire enumeration would amount to 60 species, or less than four per cent. of the whole British flora, omitting the cellular plants entirely. Prof. Schimper records 504 species from the beds associated with the Coal Measures proper, excluding the gymnospermous woods and fruits. Let us allow for errors arising from the description of different parts of the same species under two or more specific or even generic names, by deducting two-thirds of this number, and we would have 167 species remaining as a marsh flora, representing, if the proportion is of any value, an upland flora of 500 species, of which we at present know the remains of only about 50 species.

But, on the other hand, it may be that these Palæozoic highlands were peopled by a gymnospermous vegetation, consisting of a comparatively small number of species, just as in our own day extensive regions of mountainous countries are tenanted by a few species of coniferous plants.

Similar caution in generalisation must be exercised right through

the whole series of sedimentary strata. We must remember that the physical conditions under which the plant remains were deposited have exercised, so to speak, a power of selection which has set aside whole groups of plants, and left out the representatives of immense areas of vegetation. In the Palæozoic measures, this selection was exercised to the exclusion of nearly all plants that were not vascular cryptogams. The *Pothocites Grantoni* is the only known certain relic of phenogamous vegetation higher than a Gymnosperm. And again, this selective power in the Eocene deposits has rejected the cryptogamic members of the then existing vegetation, while at Sheppey it has conserved to us innumerable fruits, only a tithe of which have been figured and described by Bowerbank; and at Alum Bay, Bournemouth, and other localities, it has spread out hardy foliage chiefly of deciduous Dicotyledons on the surface of white clays, and so preserved the evidence of an extensive flora about which we may hope by and by to know more, through the persevering and successful labours of Mr. J. S. Gardner.

Let me, now, in a few sentences, refresh your memories as to the great divisions of the vegetable kingdom.

It is not possible to range the members of the vegetable kingdom in a strictly linear series; nevertheless, an approach to such a series may be made, at least, as far as it is necessary for our purpose to go, without very serious violence. The characters upon which the most natural grouping is based, are derived from the organs of reproduction. And it is important for us to observe that, as a rule, the more rudimentary organs of reproduction are associated with the more simple organs of vegetation.

The vegetable kingdom was divided by Linnaeus into Phanerogams and Cryptogams—a division which is as satisfactory now as it was a century ago, although all the characters that were then ascribed to the Cryptogams have one by one been discovered to be incorrect. Still, however, the seed-bearers and the spore-bearers, which are the two great groups of Linnæus, separate the more highly organised plants from those that are lower.

Looking at the organs of vegetation alone, the Cryptogams are obviously divided into Thallogens and Acrogens. A nearly parallel division into Cellulares and Vasculares was proposed by Decandolle, which is of special value to the geologist, because of the

absence of cellular plants from sedimentary deposits, to which I have already referred at length. The Acrogens are all Vasculares, except the Mosses and Hepaticæ, which, therefore, belong to Decandolle's lower division of Cellulares.

The simplest Thallogens are those *Fungi* and *Algæ*, which, as far as at present known, have their spores produced from the contents of a single cell, and which are, therefore, asexual. These

FIG. 1.

FIG. 1.—*Nostoc*. a. General aspect of a mass of the plant, with b. magnified portion, immediately below the surface, and c. still more magnified fragments of two threads, and of separate spores produced from the contents of a single cell.—(Thuret.)

include *Nostoc*, *Oscillatoria*, and *Bacteria*. From the absence of chlorophyl, it has been proposed to place *Bacteria* among the *Fungi*; and an advocate of the genetic relationship of all plants, has recently suggested that in *Bacteria* we have the starting-point of the development of the vegetable kingdom.

Rising in the scale, we have the remaining Thallogens, in which there is sexual reproduction, from the action of the contents of one cell upon those of another. This group includes the great majority

FIG. 2.

FIG. 2.—*Peronospora Alsinearum*, Cesp. a. Young oogonium and antheridium. b. The antheridium sending out a fecundating tube into the oogonium.—(De Bary.)

of the *Algæ* and *Fungi*, and all the *Lichens*, being variously modified in different divisions.

The Mosses and Hepaticæ form a group of Acrogenous Cellulares, though the Hepaticæ include among them some plants which

are true Thallogens. The sexual reproductive organs in these two

FIG. 3.

FIG. 3.—*Polytrichum commune*, Linn. a. The upper part of a plant with its capsule. b. The capsule, with the lid and calyptra detached. c. A male plant. d. Section of the same, showing a number of elongated sacs and paraphyses seated on the end of the axis, and surrounded by a rosette of leaves. d. A single antheridian sac, with three paraphyses, the contents being discharged at the summit of the cell.

Orders are more complicated, being differentiated into Antheridia and Archegonia.

The Vascular Cryptogams consist of five Orders, in three of which, the Ferns, Moon-worts, and Horsetails, the spores are uniform in size, while in the other two, the Rhizocarps and Club-

FIG. 4.

FIG. 4.—Male and Female Organs of *Pteris*. a. Spermatozoids from the antheridium. b. Single Archegonium.

mosses, they are of different sizes. In these two groups the macrospores and microspores foreshadow the differentiation of organs in the more highly organised phanerogamous plants.

FIG. 5.

FIG. 5.—*Pinus sylvestris*—the Scotch Fir. a. Cone, natural size. b. Male inflorescence, with a single stamen separate. c. Female inflorescence, with back and front aspects of a single scale, showing the two ovules at the base of the scale; and portion of a scale with section of the naked ovules.

The Phanerogams are divided into two well-marked groups, from the manner in which the seeds are borne. In the lower group, the Gymnosperms, the seeds are naked; while in the Angiosperms they are enclosed in a cavity composed of one or more carpellary leaves. The Gymnosperms include two groups of plants of great geological importance, the Cycads and Conifers. The ovule has generally a single covering, and is borne on the naked surface or the margin of altered leaves, which never form a true ovary or vessel enclosing the seeds, though they often enlarge to protect the seeds,

FIG. 6.

FIG. 6.—Section of the Flower of a *Campanula*, showing the relative position of the various parts. *c.* calyx, *cor.* corolla, *s.* stamens, and *p.* pistil, containing the ovules in the ovary, and surmounted by the style and stigma.

as in cones of the fir. The Cycads have the general aspect of Palms or Ferns, but agree with Conifers in the structure of their seeds.

FIG. 8.

FIG. 8.—Section of the stem of a Palm, showing the arrangement of the vascular bundles in an endogenous stem.

FIG. 7.

FIG. 7.—Longitudinal section of the seed of *Calla*, showing the monocotyledonous embryo.

In the Angiosperms the ovules are produced in the interior of a closed vessel or ovary, which terminates in a stigma, upon which the pollen grains germinate. The pollen tube reaches the ovule, and after fertilization the embryo is produced.

The structure of the embryo in the Angiosperms supplies good characters for their division into Monocotyledons and Dicotyledons. The single cotyledonary leaf in the seed of the Monocotyledons is associated with other distinguishing characters, the most obvious of which is the endogenous growth of the stem, while the embryo of the Dicotyledon has two cotyledonary leaves, and the stem is exogenous. Some systematists, overlooking the

FIG. 9.—Dicotyledonous embryo of *Agrostemma Githago*, Linn. Corn-cockle.

FIG. 10.—Transverse section of the trunk of Oak (*Quercus Robur*, Linn.), of eighteen years' growth, showing the exogenous growth. A. The new or sap wood, added exogenously below the bark, E. B. The old or heart wood.

fundamental differences in the seeds, have, from the exogenous growth of the stems of Gymnosperms, placed them beside the Dicotyledons, and thus separated the two closely allied groups of Angiosperms.

We must content ourselves with this rapid sketch, and not trace further the divisions of the vegetable kingdom; and our review of the extinct forms of plant-life must be confined to the same main lines.

The presence of *Algæ* is determined chiefly by impressions on the surface of the laminae of stratified rocks. These impressions are without structure, and supply little more than flattened outlines to guide in estimating the nature and position of the plants which have produced them. The presence of *Algæ* has, from such materials, been determined in Silurian and all subsequent formations. The

minute spiral spores of *Chara* are met with in Oolitic rocks, and they are singularly abundant in some Tertiary beds.

Fungi are known in the Palæozoic rocks from their mycelium being preserved in woody stems of Carboniferous age. It is remarkable that no evidence of epiphytal *Fungi* has been detected on the fronds of ferns in the Coal Measures; the earliest beds in which such fungal forms have been observed are of Permian age, where they have been noticed on ferns. In the Oolites they are seen on the leaves of Cycads, and they abound on a variety of phanerogamous leaves in Tertiary strata.

Lichens have as yet only been observed in amber and on lignites of Miocene age.

Mosses and *Hepaticæ* are also known only as Tertiary plants being found in Eocene and Pliocene deposits.

The greatest number and variety of fossil plants belong to the natural Order of *Ferns*. Our first knowledge of them is in rocks of Devonian age, and they are found in the deposits of every subsequent period. One remarkable type, not uncommon in Palæozoic rocks, has become extinct—that of which Corda's *Stemmatopteris* may be taken as the representative. It differed in the structure of its stem, as much from the majority of its contemporaries, which were of the same type as living tree ferns, as the stem of a monocotyledon differs from that of a dicotyledon. Yet the foliage and fruit characters of the two forms appear undistinguishable. The ferns found in the Yellow-sandstone of the South of Ireland, of Upper Devonian age, are singularly well preserved, and they exhibit, a structure both as regards their vegetative and reproductive organs that makes it difficult to separate them generically from living forms.

The *Equisetaceæ* have been with the *Lycopodiaceæ* and *Gymnosperms*, the contemporaries of the Ferns, from their first appearance in the Devonian period. Though these Palæozoic horsetails had a more complex organisation than their later representatives, yet they cannot be separated more than generically from them, and they supply a variety of types to a natural Order which is represented in existing vegetation by a single genus, and that a genus which has very little variation in the different known species.

The *Lycopodiaceæ* are also very closely related to the living forms; the differences that have been detected being mainly the greater complexity of the foliage and stems. The fruits of the Palæozoic *Lycopodiaceæ* differ only in their greater size. No trace

of the order has been observed in strata of the Tertiary period, and only doubtful forms have been referred to *Lycopodiaceæ*, in Secondary strata.

Rhizocarps are known fossil only in Eocene deposits, and belong to species of existing genera.

As already noticed, the *Gymnosperms* appear with the Ferns in Devonian rocks. The number of forms largely increase in the Carboniferous series, and all belong apparently to the Taxineous group of the *Coniferae*. The *Abietinae* appear in Permian strata, and greatly increase through the later deposits. Some fruits of the Palæozoic Gymnosperms are thought to have belonged to the *Cycadeæ*, but the earliest remains that can with certainty be referred to this Order, are found in Secondary rocks. A remarkable group, with a fleshy fruit, analogous among the *Cycadeæ* to that of the *Taxineæ* among Conifers, occurs in Oolitic and Cretaceous strata, but is now extinct.

The first evidence of *Monocotyledonous plants* is the spadices of the remarkable Aroideous fossil called *Pothocites*, found in the lowest beds of the Carboniferous series, near Edinburgh. The anomalous spiral fruits first found in the Carboniferous beds, and persisting down to the Wealden, which are called *Spirangium*, were most probably Monocotyledons. The remains of this great division of flowering plants are more abundant in the Secondary rocks, and the forms preserved have all been referred with little uncertainty to existing Orders. These plants form a large proportion of the Tertiary Floras.

Dicotyledonous plants suddenly appear in beds that are referred to the Upper Cretaceous series, and not only in great abundance, but in large variety of form, representing all the great groups into which this important section of the vegetable kingdom is divided. Some of the leaf-forms have not been correlated with living forms, and they may represent extinct genera; but sufficient evidence cannot, I believe, be obtained from foliage alone to determine with absolute certainty the systematic position of the unknown plant, to which it belongs. Only a few of the numerous forms found in the latest Secondary and the Tertiary periods have not been referred to genera represented by living plants.

The bearing of the facts which I have thus rapidly placed before you, on popular speculations, though very tempting, must be deferred to another and more fitting opportunity.