ADDRESS

AT THE OPENING OF THE SESSION 1876-77.

NOVEMBER 3RD, 1876.

BY THE PRESIDENT,

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Having, a year ago, considered the conditions under which the remains of plants have been preserved to us, and the nature and extent of the geological record of the vegetable kingdom, I propose to occupy this evening in investigating the bearings of these facts upon the popular speculations as to the origin of the present life forms of our globe.

Until a recent period, little diversity of opinion existed amongst students of science in regard to the origin of these organic forms. The position stated by Moses in the opening sentences of the Old Testament, in which all matter, organic and inorganic alike, is traced to the operation of an eternal and supernatural Creator, was universally adopted, though his narrative was often misunderstood and misinterpreted.

In the beginning of the century Lamarck proposed his evolution hypothesis. He held that all organisms were derived from some few simple original forms, which had come into existence by spontaneous generation out of inorganic nature. His hypothesis found a few supporters, but it was comparatively neglected by men of science until Darwin, in 1859, published his "Origin of Species by means of Natural Selection." This work wrought—at least, in this country—an almost complete change in opinion as to the origin of our present life forms.

It is no part of Darwin's purpose to account for the origin of life; his hypothesis deals only with the origin of the forms of organic life. It operates upon beings already existing. The necessary primordial organisms owe their existence, according to Darwin, to a Creator. Endowed with the properties of growth, organisation, and reproduction, and influenced by the laws of hereditary variation, over-production, and natural selection, these simple created germs have, without direction or control, produced the various forms of vegetable life which have lived, or are now living, on the earth.

The method of this development may be thus briefly stated :—Besides the characters transmitted by plants to their descendants, new characters arise in some of the progeny which were not possessed by the parent. When these new characters are transmitted to descendants, and are permanent, the plants possessing them become a variety. Some plants have a special tendency to variation, others are remarkably constant in their characters. No explanation has been suggested of the reason for these differences, or of the cause of the appearance of new characters. The differences are at first small. Their continuance depends upon the capacity they supply the organism for battling with external causes. In course of time further characters appear, or the old become intensified, and in the struggle for existence, the varieties only, or, it may be, the parent form, which possess the characters best fitted to resist the prejudicial influences that surround them, are able to maintain their ground. The less fortunate varieties, and with them most probably the parent form, perish ; and thus the connecting links between the common descendants of the original stock are destroyed. These descendants, becoming more pronounced in their characters, are recognised as species. Accordingly, the only difference between a variety and a species is the amount of divergence and the constancy of the divergent characters. And these, in a greater degree, are, according to this view, the only differences between a species and a genus.

It is, then, concluded that all forms now observed in the vegetable kingdom are due to the continual accumulation of differences in the genetic evolution of the existing plants from the one or few simple original forms ; that the natural system of plants is the external expression of this phylogenesis, or genetic relationship ; that the development of a plant from the embryonal cell to the perfect individual is a short and quick repetition of the genetic development of the tribe to which it belongs ; and that the rocks of the earth reveal, so far as the record of life is preserved, the various steps by which the phylogenesis was actually accomplished.

The evidence for or against this hypothesis must be sought in the records of the past history of the earth, for whatever progress has been made in collecting collateral evidence, no single case of evolution of one species from another has come within the observation of man. The plants pourtrayed on the ancient paintings and sculptures of Egypt, the fruits placed in coffins with embalmed bodies, and the fruits and seeds found in ancient lake dwellings all belong to existing species, with which they agree in the most minute and apparently accidental particulars. The existing order of plants, if it be due to genetic evolution, supplies no proofs of it.

Nor can the proofs be found in the series of changes which we may observe taking place in the evolutions of the fully-organised plant from the germ cell of the ovule ; for though we trace in these changes some structures more or less remotely analogous to lower plant organisms, each of them is but a stage in the life of the individual plant. Any arrest of this progress means death to the organism.

The evidence for evolution must be found in the rocks. However varied the existing forms of plants are, if this hypothesis be true, they must all have been connected together by gradational forms ; so that from the highest plant to the simplest *Bacteria* there must be in time a series of gradations by which we can pass from the one end of the series to the other. And these intermediate gradations are the fossil forms of the successive geological epochs preserved, more or less completely, in the sedementary deposits.

The palæontological record is very incomplete. Little more than a few representations are found of what must have been extensive floras, and even when a flora is fairly represented, it may occur in the midst of a series of comparatively barren strata. The record is like a tablet containing the remains of an unknown inscription represented by only a few of its numerous letters—the value of the letters that are intact is known, and each still occupies on the stone its proper position in relation to the unknown as well as to the other known letters of the inscription. In attempts to decipher the lost writing no violence must be done to these known letters or to their relative positions in filling up the blanks. Any interpretation that does not respect these conditions carries with it its own condemnation. In his hypothesis, Darwin has given us such a reading of the life of our globe. Some of the letters still preserved are yet so obscure that their value is doubtful. They have suffered injury; portions have been destroyed, and the fragments remaining may be differently interpreted. There are fossils whose nature and systematic position are, at least, subjects of dispute. These, for our present purpose, must be reckoned as blanks. But beyond them there is a large series of plant-remains completely and accurately known which supply a fair representation of the great events in plant life that have taken place in the earth since Palæozoic times. And these are more than sufficient to establish or destroy this hypothesis by their testimony.

A hypothesis can be substantiated only when it is in entire accordance with all known facts. The legal doctrine that "the exception proves the rule," though not unfrequently quoted in science, is the very reverse of the truth. Here the exception disproves the rule, for the rule is but the expression of the united testimony of all related facts, and as soon as a fact turns up that is opposed to a rule, that rule must either be enlarged to include it or set aside as no longer in harmony with nature.

Consider, now, the hypothetical phylogenetic history of the vegetable kingdom as advanced by Hæckel and other advocates of evolution, and the bearing on this history of the ascertained facts of palæontology.

The most rudimentary plants are either Fungi or Algæ. The notion lately suggested that the primal stock of the vegetable kingdom was a simple fungus may be at once dismissed, as it is impossible to imagine how a group of plants which, like the Fungi, live on organised food, chiefly obtained from other plants, could exist before there were any plants to supply them with that food; and besides, no indication of a fungus has been detected in the older Palæozoic rocks.

The presence of chlorophyl in Algæ is thought by some to place them in a higher position than the Fungi. In other respects the Algæ are the simplest and least perfect of all plants, and among them, consequently, might be found the most ancient of all vegetable organisms, out of which all other plants have originated. In the course of the primæval ages the unicellular Algæ produced the Green-, Brown-, and Olive-spored Classes and the Characeæ.

"We may suppose," writes Hæckel, "that the submarine forests of the primordial period were formed by the huge Brown

Algæ or Fucoideæ. The many-coloured flowers at the foot of these gigantic trees were represented by the gay Red Algæ or Florideæ. The green grass between was formed by the hair-like branches of Green Algæ or Chloroalgæ. Finally, the tender foliage of ferns and mosses which at present covers the ground of our forests, fills the crevices left by other plants, and even settles on the trunks of the trees, at that time probably had representatives in the moss and fern-like *Siphoniæ*, in the *Caulerpa* and *Bryopsis* from among the class of the Primary Algæ."

What is the testimony of the rocks? The abundance of animal life implies a corresponding abundance of vegetable life, but the hard parts of marine animals have been preserved, while the cellular Algæ have left the most imperfect record. The great extent of the primæval vegetation is testified to by the enormous quantity of carbon contained in the most ancient rocks. Dr. Dawson says that "it is scarcely an exaggeration to maintain that the quantity of carbon in the Laurentian rocks of Canada is equal to that in similar areas of the Carboniferous system."

But notwithstanding such evidence of an abundant flora in primordial times, the record of plant forms is very imperfect, the only markings that can be considered as due to plants having been referred to but sixteen species of Algæ. These markings are mere surface impressions, in no case exhibiting any trace of the original structure, and all are so vague that it is impossible to speak with any certainty of the systematic position of the organisms producing them. It must, however, be remembered that the nature of the plants which could live in the conditions under which these deposits were formed, and the changes that have taken place in the primal strata since their deposition, prevents us expecting any extensive representation of these early floras. But so far as the indications of the plants have been preserved, it may be said that they do not contradict the evolutionist who looks upon Algæ as the primæval plants. While making this admission in relation to the vegitation of these older rocks, I must protest against the practise of completing the geological record of life forms, by filling in particular groups without any authority except the writer's impression of the necessities of an adopted hypothesis, and then basing arguments on these assumptions in support of the hypothesis which created them. So completely has phylogenetic evolution become the creed of some leading naturalists that they unwittingly proceed in this manifestly unphilosophical method. But it is a first axiom, though one often forgotten, in this as in every scientific enquiry that no step can be made in advance which is not based on fact.

In the hypothetical phylogenesis of the vegetable kingdom, we come to the evolution from the Algæ of Fungi, Lichens, Mosses, and Hepaticæ, all of them cellular plants. They are supposed to have come into existence with the Devonian Period, the beginning of the later Palæozoic series. The mycelium of one or two species of Fungi has been detected in the Coal Measures, but, with this

FIG. 1.

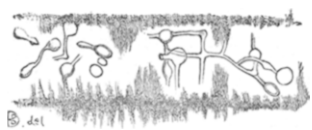


FIG. 1.—Mycelium of a Fungus from the scalariform axis of a *Lepidodendron* from the Coal Measures.

exception, there is no trace of any of these plants in Palæozoic rocks.

The later Palæozoic rocks abound in plant-remains. The first evidence of land plants is found in the Devonian rocks, and here, at their appearance, the three principal groups of the Vascular Cryptogams appear together in highly differentiated forms. All of them — Ferns, Horsetails, and Lycopods — possess the same essential structure and organisation as their living representatives, and in all the subordinate points in which they differ from them it is in possession of characters indicative of higher organisation—whether we look at the vegetative or the reproductive organs—than are found in existing forms.

These three classes of Vascular Cryptogams are held together by well-marked characters, which they have in common, and by which they are separated from the cellular plants below them, and from the phanerogamous plants above them. They all possess fibro-vascular bundles developed in fundamental tissue, and a true epidermis. In the process of development from the spore these plants exhibit two generations, in the one of which the spore produces a temporary pro-thallus, on which the sexual organs are borne, and from the fertilised archegonium the new and perfect plant proceeds, which produces the asexual spores in Ferns and Equisetaceæ and the macro spores and micro-spores in Selagineæ.

The three classes are clearly separated from each other by obvious characters. The *Ferns* have a slender or tree-like axis supporting the leaves, which are larger and more perfect than in any other group of plants. The spores are produced on the margin or back of the leaf; they are simple, of one kind, and produce a green leaf like monœcious pro-thallus. The *Equisetaceæ* have a fistular jointed stem, with the leaves reduced to a small sheath crowning the apex of each internode. The leaves are scarcely more rudimentary in any group of plants. The spores are borne on altered leaves, forming small cones, which terminate the axis; they are furnished with hygrometric elaters, and are of one kind only; when they germinate they produce a generally diœcious thallus. The *Lycopodiaceæ* have an elongated axis (except in *Isoetes*), with small simple leaves. The great majority of the plants of this order belong to the two genera *Lycopodium* and *Selaginella*, which so closely resemble each other in general appearance that the species found in Britain are referred to one genus in nearly all our Floras, yet they differ greatly in their reproductive organs. The spores are borne in the axils of more or less altered leaves, but in *Lycopodium* they are small and of one kind, while in *Selaginella* there are two kinds, called macro-spores and micro-spores. The macro-spore produces the pro-thallus, and only the part bearing the archegonium protrudes from the spore. We need not consider the structures and affinities of the *Rhizocarps*, because there is no certain evidence that they have been detected as fossils.

The three Orders appear together, as I have said, in the later Palæozoic rocks, and that not in simpler and more generalised types, but with more varied and more complex structures than are found in any of their living representatives. Thus among Ferns there is lost a remarkable group with a fundamentally different type of structure, which was contemporaneous in the Palæozoic ages with the types of ferns that have been represented all through the epochs and are now abundant on the globe. The Equisetaceæ had a large number of generic groups; their stems were arborescent, the leaves large, and the fruit cones protected by special scales, but the spores were similar in size and form to those of the living Horsetails, and were furnished, at least in some cases, with hygrometric elatérs. The Lycopods were also huge trees, and were represented by several generic groups. The structure of the stem, while fundamentally agreeing, like that of the arborescent Equisetaceæ, with the stems of the living forms, was more complex, being suited to their arborescent habit.

The floras of the later Palæozoic periods include higher elements than vascular cryptogams, for in the Devonian series we have Gymnospermous plants, increasing greatly in number and variety in the Carboniferous period; and in the Calciferous-sandstone, at the very base of the Carboniferous strata, there has been found a true Angiospermous plant.

The step from the spore-producing Cryptogam to the seed-bearing Phanerogam is a very great one. No doubt there is a general external resemblance between a lycopod and a conifer, and many points of analogy between the development of the seed and the various stages through which the lycopod passes from the germination of the spore to the growth of the fertilised archegonium. But like is here, as it is often elsewhere, an ill mark, for the resemblances are purely superficial. The minute tissues of the conifer, as well as the method in which they are arranged, differ entirely from anything either in the existing or extinct lycopods, while the production of a seed, even though it be without a protecting ovary or fruit, at once and widely distinguishes the Gymnosperm from the spore-bearing Cryptogam.

According to Hæckel, the Gymnosperms sprang out of the Lycopods during the Carboniferous, or possibly during the Devonian, period. But undoubted Coniferous wood was discovered by Hugh Miller in the Devonian rocks of Cromarty, and several anomalous woods have been discovered by Unger in

FIG. 2.

FIG. 2.—Fragment of Coniferous Wood, found by Hugh Miller in an Old Red nodule at Cromarty.

FIG. 3.

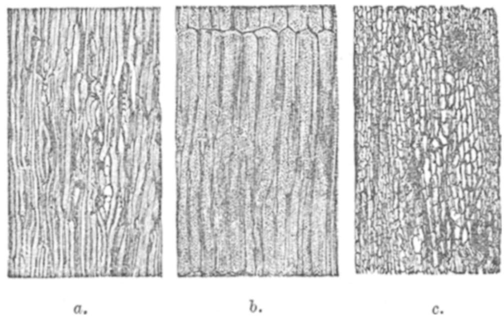


FIG. 3.—Magnified Sections of the Coniferous Wood from Cromarty. *a.* is at right angles to the medullary rays; *b.* parallel to the rays; and *c.* is a transverse section.

the Thuringian rocks of Devonian age, which were referred by him to the Coniferæ without any positive evidence except the absence from their structure of ducts. Had these been of earlier age than Miller's Cromarty wood, they might have been looked upon as one of the steps leading up to the true Coniferous structure.

The Calciferous-sandstones at the base of the Carboniferous series contain numerous specimens of Coniferous trunks, which have been drifted into the sandstones, and are well preserved through mineral replacement. These trees had attained to an immense size. A fragment of a trunk in the British Museum, from the neighbourhood of Edinburgh, is nearly forty feet long, twelve feet in circumference, and almost uniform in diameter throughout its length. It has, with other specimens, been described by Sir Robert Christison in the "Transactions of the Royal

FIG. 4.

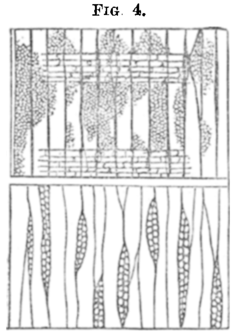


FIG. 4.—Longitudinal Sections of a Fragment of the Great Tree from Edinburgh, now in the British Museum. The Upper Section being parallel to the medullary rays, and the Lower at right angles to them.

Society of Edinburgh." Coniferous woods become more abundant as we rise in the Carboniferous measures, but the most important testimony to the abundance and variety of the Palæozoic Gymnosperms is obtained from the numerous fruits that have been discovered, in a single locality in the centre of France. The large series of fruits found there by M. Grand 'Eury have been described by Brongniart. He determined the occurrence of 26 species belonging to 17 genera, all of which have the fundamental structure of gymnospermous seeds, being orthotropous—that is, with the testa having the hilum and chalaza at the base and the micropyle at the apex, and enclosing an erect ovule, whose summit corresponds to the micropyle. But with this uniformity in essentials there is such diversity in characters of less importance, that a large number of species and genera had to be established for their reception. They all belong to the Taxineous group of Conifers, unless,

FIG. 5.

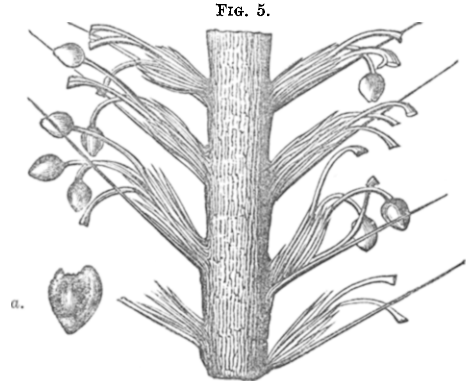


FIG. 5.—Portion of the Spike of *Cardiocarpum anomalum*, a gymnospermous plant from Coalbrookdale; *a.* a detached seed slightly magnified.

perhaps, some may be Cycadeæ. No fruits that can be referred to Abietineæ or Cupressineæ have been observed in Devonian or Carboniferous strata. On their first known appearance, then, the Gynosperms do not represent a generalised type, but both the wood and the fruits represent a remarkable variety of genera and species all as highly differentiated as existing forms.

In connection with this remarkable development of Taxineous Conifers at their first appearance, it should be noticed that the plants of this section are all diœcious, *i.e.*, have the sexes on different plants, while the other Conifers are generally monœcious.

The importance of this consideration will appear if we reflect that the production of spores from the contents of a single cell indicates the low position of the *Protophyta*, while the existence of sperm and germ elements in different cells is evidence of higher development among the cellular plants. If the occurrence of the germ and sperm elements in different flowers, and even in different individuals, is evidence, as some hold, of higher development in phanerogams, then it is important to notice the order of appearance of diœcious and monœcious groups in relation to those with hermaphrodite flowers. Advocates of evolution have maintained that dimorphic plants are now in a transition stage, progressing towards a diœcious condition. But if this view be held, the Conifers attained to the highest known development as regard this element of their structure on their first known appearance. The Abietineæ and Cupressineæ are not met with till the Permian and later periods.

The history of Monocotyledons, as far as it is known, is very curious; but as the earlier traces of these plants are very fragmentary, and their positions, consequently, doubtful, it is unnecessary to refer to them at any length. The first true Monocotyledon is the stem and spike of an Aroideous plant, of which a well-preserved specimen was discovered by Dr. Paterson about forty years ago in the lowest Carboniferous strata near Edinburgh.

FIG. 6.

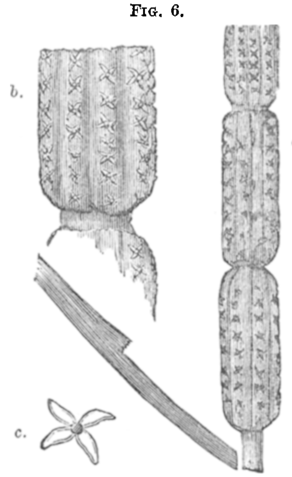


FIG. 6.—*Pothocites Grantoni*. The flowering spike of an Aroideous plant from the Calciferous-sandstone series near Edinburgh. *a.* A portion of the spike natural size; *b.* a smaller portion magnified; and *c.* a whorl of floral leaves more magnified.

Additional specimens have been recently found. The fossils which still figure in books under such names as *Cyperites*, *Culmites*, &c., are parts of cryptogamic plants; but the curious twisted bodies called *Spirangium*, believed to be Monocotyledonous fruits, make their first appearance in the Coal Measures. There are several species of *Spirangium*, as well as specimens of an allied, but yet undescribed genus in Carboniferous strata. Including these fruits, there are probably eight species of Monocotyledons in the later Palæozoic rocks. Four species have been found in the Trias, seven in the Lias, the same number in the Oolite, 15 in the Chalk, 97 in the Eocene, 185 in the Miocene, and two in the Pliocene.

According, then, to our present knowledge, the three groups of Vascular Cryptogams and the seed-bearing Gymnosperms appear together in the Devonian rocks, and Monocotyledons appear in the lowest beds of the Carboniferous series. Further, these earliest plants are not generalised forms of the various tribes to which they belong, but they are as highly specialised as any subsequent representatives of the particular group, and wherever they differ from later plants it is in the possession of a more perfect organisation.

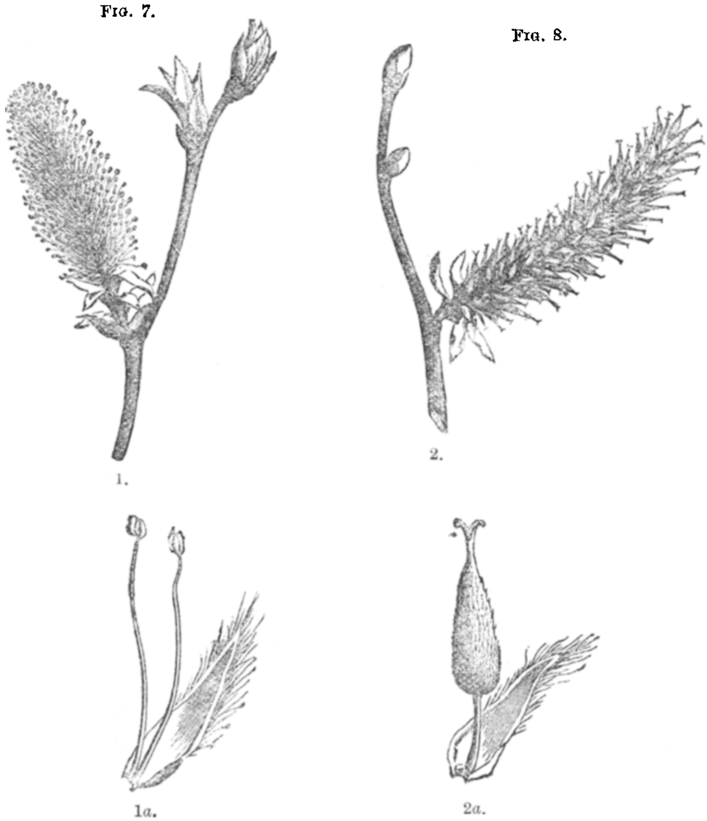
It would be contrary to the evolution hypothesis to suppose that the highly-organised Cryptogams, the Gymnosperms, and the Monocotyledons were each evolved at one step from the cellular plants which form the only known vegetation of the Pre-Devonian periods. This would be as fatal to the hypothesis as the introduction of a supernatural Creator to place these groups at once on the earth in their complete development. "The theory of descent requires that the various forms of plants must have arisen at different times, that the primitive forms of the separate classes and groups existed at an earlier period than the derived ones."

No doubt there is in the older Palæozoic rocks a great absence of any records of land life. But the evolution of the Vascular Cryptogams and the Phanerogams from the green seaweeds through the liverworts and mosses, if it took place, must have been carried on through a long succession of ages, and by an innumerable series of gradually advancing steps; and yet we find not a single trace either of the early water forms or of the later and still more numerous dry-land forms. The condition that permitted the preservation of the fucoids in the Llandovery rocks at Malvern, and of similar cellular organisms elsewhere, were, at least, fitted to preserve some record of the necessarily rich floras, if they had existed, which, through immense ages, led by minute steps to the Conifer and Monocotyledon of these Palæozoic rocks.

The complete absence of such forms, and the sudden and contemporaneous appearance of highly organised and widely separated groups, deprive the hypothesis of genetic evolution of any countenance from the plant record of these ancient rocks. The whole evidence is against evolution, and there is none in favour of it.

To complete the history of the vegetable kingdom, there yet remains for consideration the higher or Dicotyledonous division of flowering plants. Their testimony for or against evolution is the more important, because—first, of their higher organisation, by

FIG. 7. FIG. 8.



FIGS. 7 and 8.—Diœcious Flowers of the Willow. 1. Male Catkin; 1a. Single Apetalous Flower. 2. French Catkin; 2a. Single Apetalous Flower.

which, as regards their vegetative organs, they are sharply separated from the Monocotyledons, and, as regards both vegetative and reproductive organs, from the Gymnosperms; secondly, from the existence of numerous differences which supply generally obvious and well-defined characters for their systematic classification; and, thirdly, from their appearance in strata of comparatively recent age, which are consequently better known than Palæozoic deposits.

Dicotyledons are usually divided into three great groups, from characters derived from the structure of their flowers. 1. The Apetalæ, in which the corolla, and often the calyx as well, are absent. 2. The Monopetalæ, in which the calyx and corolla are present, but the petals are more or less united into a lobed corolla. And 3. The Polypetalæ, in which the calyx and corolla are also present, but the petals are free.

The phylogenesis of these groups is very circumstantially given by Hæckel. In the lower Dicotyledons, as in the case of the Monocotyledons, calyx and corolla are as yet not differentiated; hence they are called *Apetalæ*. This sub-class must, therefore, doubtless be looked upon as the original group of the Angiosperms, and it existed, probably, even during the Triassic and Jurassic periods. It was not till the Cretaceous period that the second and more perfect class of the Dicotyledons appeared—namely, the group with corollas. These arose out of the *Apetalæ,* from the simple cover of the flowers of the latter becoming differentiated into calyx and

Fig 9.

Fig. 10.

Fig. 9.—The Polypetalous Flowers of the Pink.
Fig. 10.—The Monopetalous Flower of the Tobacco.

corolla. This group is again divided into two legions — the *Polypetalæ*, in which the flower leaves remain separate, and the *Monopetalæ*, in which the flower leaves grow regularly together into a more or less bell-like, funnel-shaped, or tubular flower. In these last the differentiation and perfection of the Phanerogamic flowers attain their highest stage of development, and we must, therefore, place them at the head of the vegetable kingdom as the most perfect of all plants.

Thus far, Hæckel,—what is the record preserved in the rocks? Dicotyledons make their appearance in strata of Upper Cretaceous age. No trace of a plant belonging to this great division has yet been detected in any earlier stratum. There is no evidence whatever for the statement that the Apetalæ probably existed in the Triassic and Jurassic periods. May not, however, the want of evidence be owing to the imperfection of the geological record? This imperfection would be due either to the absence of plant-remains from the strata which were formed when, according to this hypothesis, Dicotyledons existed in abundance, or to something in the nature of Dicotyledonous plants which prevented their preservation. But we are acquainted with a considerable Keuper Flora, consisting of Equisetums, Ferns, Cycads, and Conifers; a more extensive and similarly constituted Lias Flora, with the addition of cellular plants and some Monocotyledons. Plant-remains are necessarily rare in the marine beds of the Middle and Lower Oolites, but in the Upper division of this epoch we have an abundant Flora in Yorkshire, Sweden, France, and elsewhere, consisting of cellular plants and Monocotyledons, but chiefly of Vascular Cryptogams and Gymnosperms. In the Wealden, and even in the Neocomian or Lower Cretaceous strata, we find considerable Floras of Cellular and Vascular Cryptogams and Gymnosperms. These Floras are preserved in fresh-water deposits, some of them in the very localities where they lived, but in none of them has any trace of a Dicotyledon been detected. Their absence may, however, be supposed to be accounted for by the more speedy decay of the leaves of Dicotyledons demonstrated by the interesting experiments instituted by Lindley in 1833. But it is remarkable that, excepting Ferns and Gymnosperms, he found that a larger proportion of Apetalous plants resisted decay than any other group. It cannot be doubted that the conditions favourable to the preservation of Monocotyledons and Equisetums would have secured the preservation of some of the Apetalæ, had they existed. This absence can be accounted for only on the supposition that they formed no part of the then existing vegetation. And in the deposits older than the Trias, or in any subsequent deposits, no intermediate form has been detected—no Gymnosperm or Monocotyledon which exhibits in any point of its structure a modification towards the more highly organised Dicotyledon.

Further, when the Dicotyledons appear in the Upper Cretaceous beds, representatives of the three great groups are found together in the same deposit. Moreover, these divisions are represented, not by generalised types, but by differentiated forms, which, during the intervening epochs, have not developed even into higher generic groups. Thus among the APETALÆ the *Myricacæ* are represented by two congeners of our bog myrtle ; the *Cupuliferæ* by six species of oak and beech ; the *Salicineæ* by six species of willow and nine of poplar ; the *Moreæ* by six species of fig ; and the *Laurineæ* by a laurel and six species of a *Sassafras*. Among the MONOPETALÆ the *Asclepiadeæ* are represented by a species of *Nerium ;* the *Ebenaceæ* by a *Diospyros ;* and the *Ericaceæ* by an *Andromeda*, And among the POLYPETALÆ, the *Araliaceæ* are represented by a species of *Aralia ;* the *Anacardiaceæ* by a *Rhus ;* the *Sapindaceæ* by a maple ; and the *Magnoliaceæ* by five species of *Magnolia* and two of the tulip tree.

While the rocks supply no evidence of any plant leading up to these various orders of Dicotyledons, it is equally important in its bearing on the hypothesis of genetic evolution that the generic groups just named have persisted from the first known appearance of Dicotyledons throughout the whole of the intervening ages, and still hold their places unchanged among the existing forms of vegetation. The persistence of generic and specific types, and the certain knowledge we possess of the life of many existing species of Phanerogams and Cryptogams which have come down through the Glacial Epoch, have not been sufficiently considered in their bearing on this hypothesis.

Let us take a case. None can be more fitted for this purpose than the small willow, *Salix polaris*, detected in the lowest pre-Glacial beds at Cromer, and in deposits of the same age at Bovey Tracey. This plant still lives in the Arctic regions of both the Old World and the New.

The genus *Salix* is a singularly variable one, and should supply satisfactory data for an evolutionist working out his hypothesis. According to Professor Andersson's latest Monograph of the Order (Dr. Candolle's "Prodromus," Vol. xvi., pt. 2), the genus *Salix* consists of 19 sub-generic groups, containing 160 species, and these are so variable that 222 varieties and 70 hybrids have been described and named by him. It is a genus, then, which is from the point of view of the evolutionist, at present actively moving on to a large addition to its species by the increase and persistency of the numerous varietal forms. The sub-generic groups to which *Salix polaris* belongs contain 29 species, together with 26 varieties and 9 hybrids. These are further arranged into four sections, that to which *Salix polaris* belongs containing six species. It is easy, then, to construct an exact phylogenetic tree of the genus *Salix*. The hybrids and varieties, amounting to an average of about two for each species, lead up to the recognised species. The various species converge to the parent form of the section to which they belong. The generalised sectional forms, in their turn, approach each other, and unite in the parent form of the sub-generic group. The 17 sub-generic forms gradually approach each other, until the generalised type of the genus *Salix* is reached. The shortest branches in this phylogenetic tree are necessarily the ultimate twigs which represent the evolution of the varieties from the species; but in the case of *Salix polaris* no varietal forms are known, notwithstanding the specially favourable circumstances in the history of this plant for their production, for this species has, by stress of weather, been driven, throughout the ages that intervene between the deposition of the pre-Glacial beds of Cromer and our own days, from Devonshire and Lincolnshire into the extreme northern regions; yet it has through all these vicissitudes remained unchanged. The ultimate twig in this species is that which represents its own specific life, and this must be a short twig when compared with the branches leading the six allied species to the section or those leading the section to the sub-genera, or the branches leading the sub-genera up to the genus. Yet this ultimate twig takes us back to pre-Glacial times; it covers the ages represented by the Glacial Period and its associated deposits, by the later fossiliferous deposits at Bridlington and in the valleys of the Forth and Clyde, and the subsequent period during which man has been on the earth.

But when we have reached the branch representing the generic form, we have made but little progress in the phylogenesis of *Salix*. With *Populus* this genus forms a small Order, Salicineæ. The two genera are closely allied, yet separated by well-marked characters; it is not, however, difficult to conceive of both having sprung from a generalised form. But there is no record of such a form. The two genera appear together among the earliest known Dicotyledons, the willows being represented by six and the poplars by nine species. The ordinal form, if it ever existed, must necessarily be much older than the period of the Upper Cretaceous rocks, that is than the period to which the earliest known Dicotyledons belong.

The Salicineæ are related to five other natural Orders, in all of which the apetalous flowers are arranged in catkins. These different though allied Orders must be led up by small modifications to a generalised amentiferous type, and thereafter the various groups of apetalous plants by innumerable eliminations of differentiating characters until the primitive form of the apetalous plant is reached. Beyond this the uncurbed imagination will have more active work in bridging over the gap between Angiosperms and Gymnosperms, in finding the intermediate forms that led up to the Vascular Cryptogams, and on through the cellular plants to the primordial germ. Every step in this phylogenetic tree must be imagined. The earliest Dicotyledon takes us not a step further back in the phylogenetic history of *Salix* than that supplied by existing vegetation. All beyond the testimony of our living Willows is pure imagination, unsupported by a single fact. So that here, also, the evidence is against evolution, and there is none in favour of it.

The demand upon time made by the advocate of genetic evolution is a further serious difficulty. The single species *Salix polaris* carries us back beyond the Glacial Period. Several specific forms existed, as we have seen, during the Cretaceous epoch. Beyond this, we want geological periods, which are the geologists' time divisions, to carry back, by slow and imperceptible changes, the Cretaceous *Salices* and the rich associated flora of still existing generic types to the generalised Angiosperm and on to the Gymnosperm.

The whole evidence supplied by fossil plants is, then, opposed to the hypothesis of genetic evolution, and especially the sudden and simultaneous appearance of the most highly organised plants at particular stages in the past history of the globe, and the entire absence among fossil plants of any forms intermediate between existing classes or families. The facts of palæontological botany are opposed to evolution, but they testify to development, to progression from lower to higher types. The Cellular Algæ preceded the Vascular Cryptogams and the Gymnosperms of the newer Palæozoic rocks, and these were speedily followed by Monocotyledons, and, at a much later period, by Dicotyledons. But the earliest representatives of these various sections of the vegetable kingdom were not generalised forms, but as highly organised as recent forms and in many cases more highly organised; and the divisions were as clearly bounded in their essential characters, and as decidedly separated from each other, as they are at the present day. Development is not the property of the evolutionist; indeed, the Mosaic narrative—the oldest scheme of creation—which traces all nature to a supernatural Creator represents the operations of that Creator as having been carried out in a series of developments, from the calling of matter into existence, through the various stages of its preparation for life, and on through various steps in the organic world, until man himself is reached. The real question is,—Does science give us any light as to *how* this development was accomplished? Is it possible, from the record of organic life preserved in the sedimentary deposits, to discover the method or agent through the action of which the new forms appeared on the globe? The rocks record the existence of the plants and animal forms; but as yet they have disclosed nothing whatever as to *how* these forms originated.

ORDINARY MEETING, November 3rd, 1876.

William Carruthers, Esq., F.R.S., &c., President, in the Chair.

The following Donations were announced:—

"Recherches sur le terrain Crétacé Supérieur de l'Angleterre et de l'Irlande," by Charles Barrois, D.Sc.; from the Author.

"Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country," by F. B. Meek; from Dr. F. V. Hayden.