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XVIII. *Some Remarks on the Plant Morphologically considered.* By the Rev. Dr. M'Cosh.

Read 10th July 1851.

According to the common idea, the Plant is composed of two essentially distinct parts, the stem and the leaf. The axis of the embryo proceeds downward and upward simultaneously, the descending axis being the root, and the ascending one the stem or trunk. Upon these axes others are formed as subterranean or aërial branches. The leaf is formed upon the ascending axis, and besides its common form, it assumes, while obeying the same fundamental laws, certain other forms, as in the sepals, the petals, the stamens and pistils. Schleiden, in 'The Plant a Biography,' gives us a picture of a typical plant constructed on this principle. This makes a plant a dual, or composed of two essentially different parts.

But to us it appears possible to reduce a plant by a more enlarged conception of its nature to a unity. According to our idea, it consists essentially of a stem sending out other stems similar to itself at certain angles, and in such a regular manner, that the whole is made to take a predetermined form. The ascending axis for instance sends out at particular normal angles in each tree, branches similar in structure to itself. These lateral branches again send out branchlets of a like nature with themselves, and at much the same angles. The whole tree with its branches thus comes to be of the same general form as every individual branch, and every branch with its branchlets comes to be a type of the whole plant in its skeleton and outline.

Taking this idea of a plant along with us, let us now inquire whether there may not be a morphological analogy between the stems and the ribs or veins of the leaf. As these veins are vascular bundles, proceeding from the fibro-vascular bundles of the stem, they may be found to obey the same laws. Physiological confirmations of this presumption may be found in the following circumstances:—1. Both stem and vein are capable of becoming a spine, the stem as in the thorn, the vein as in the thistle. 2. It is also an unsettled question whether the inflorescence and seed-vessels in many cases are formed out of metamorphosed leaves or metamorphosed branches. The very fact that there is such a dispute, shows that there is an analogy between leaf and branch. 3. The vein of the leaf is capable equally with the stem of producing a leaf-bud, as in *Bryophyllum* and *Gloxinia*.

We begin with the examination of those plants which have a fully veined or reticulated leaf, and here we shall find a morphological analogy between the leaf and the branch, and the leaf and the whole plant. We are quite aware, that in respect of physiological development there is a wide difference between the two, but this will just render the morphological resemblance, if it exists, the more curious and striking. It should be noticed that this resemblance can be observed only when both the stems and the veins are fully and fairly developed.

In prosecuting this inquiry, let us first inspect in a general way the leaf of a tree with its central vein or veins, and its side veins. Even on the most careless inspection, the central vein will be found to bear a striking analogy to the central stem or axis of the tree, and the side veins to the branches. Having viewed the leaf in the first instance, let us then look at the tree when stript of its leaves in winter, and we shall see how like it is in its contour and skeleton to the contour and skeleton of a leaf. We shall be particularly struck with this if we view it in the dim twilight or the "pale moonlight" between us and a clear sky. In both leaf and tree we see a central stem or stems with ramified appendages going off at certain angles, and we may observe that the tree in its outline tends to assume the form of a leaf.

The general impression produced by a first glance will be confirmed on farther inspection. The analogy between the skeleton of the leaf and the skeleton of the branch may be seen in a number of points as well as in the general resemblance between the ramification of the plant and the ramification of the venation of the leaf. 1. Some trees, such as the beech, the elm, the oak, the holly, the Portugal and bay laurels, the privet, the box, will be found to send out side branches along the axis from the root, or near the very root, and the leaves of those trees have little or no petiole or leaf-stalk, but begin to expand from nearly the very place where the leaf springs from the stem. There are other trees, as the common sycamore (the Scotch plane-tree), the beech, the chestnut, the pear, the cherry, the apple, which have a considerably long unbranched trunk, and the leaves of these trees will be found to have a pretty long leaf-stalk. 2. Most of our low-branching herbaceous plants, such as the mallows, rhubarb, tussilago, marsh marigold, lady's mantle, hollyhocks, send out a considerable number of stems from near the root, and it will be found in exact accordance with this, that these set off from the base of the leaf, a considerable number of main veins or ribs, which, as they spread, cause the leaf to assume a rounded shape. In these plants the morphological resemblance between tree and plant is seen *horizontally* and not *vertically*. In this respect these plants are different from our forest trees, which send up commonly one main axis with lateral branches, and have in their venation one leading vein with side veins. 3. Some trees, such as the beech, the birch, the elm, send up one large main stem, from which, throughout its length, there proceed comparatively small branches, pretty equally along the axis, and it will be found in such cases that the leaf has a central vein with pretty equally disposed veins on either side. Other trees again tend rather to send off at particular heights a number of comparatively thick branches at once. This is the case for instance with the common sycamore, the chestnut, and the laburnum. The trunk of the sycamore (*Acer Pseudo-platanus*), about eight or ten feet above the surface of the ground, commonly divides itself into four or five large branches, and in precise analogy we find the leaf at the top of a pretty long leaf-stalk sending off four or five large veins. The chestnut tends to send off at the top of the unbranched trunk a still greater number of branches, and we find in correspondence with this, that its leaf is commonly divided into seven leaflets. The laburnum (and also the broom and clover) goes off in triplets in respect of leaflet and ramification. In such cases it will commonly be found that the leaf is compound, and we are to *regard all such compound leaves as one and representative of the whole tree.* Generally, it is the whole leafage coming off at a given place which represents the whole tree, and the single leaf, when there is a number of leaves, represents merely the branch. 4. Some plants, such as the rhododendron, the azalea, and the lupin, send off leaves which have a tendency to become whorled, and their branches have also a tendency to become verticillate. 5. The stems of some trees, such as the thorn and laburnum, are not straight, and the branches have a twisted form; and it will be found that the vein of the leaf of these trees is not straight, and that the leafage is not in one plant. This is also seen in the elm. 6. In some trees, such as the beech, the stems go off in nearly straight lines, and the leaves are found to have a straight venation. In other trees, again, such as the chestnut, the branches have a graceful curve, and the veins of the leaves are curved in much the same way. 7. In most plants the angle at which the side stems go off will be found to widen as we ascend to the middle, and thence to decrease as we ascend to the apex, and the venation of the leaves will be found to obey a similar law. This helps to give both to tree and leaf their beautiful oval outline. In some plants, again, such as the poplar and birch, the angles are widest at the base and tend to narrow as we ascend, and both leaf and tree in such cases assume a kind of triangular form. 8. Generally we shall find a correspondence between the angle of the ramification of the tree, and the angle of venation of the leaf. The following table gives the result of numerous measurements of the angles of branching and venation, where those were found to agree:—

Beech	45°	Rose	50°
Plane-tree	45	Laburnum (small branches)	60
Birch	40	Box (over)	60
Oak, 50 (large branches same venation).	65–70	Thistle	60–70
		Thorn (lowest branches)	35–50
Cherry	50	Ash	60
Portugal Laurel	50–60	Elm	45–50
Bay Laurel	50–60	Bird Cherry	60
Holly	55–60	Red Dog Wood	45
Rhododendron	60	Alder	50
Lime	40–45		

We have made a sufficient number of measurements to be able to say that there is often such a correspondence. But it should be acknowledged, that while it is not difficult to determine the angle of the venation of the leaf, it is most difficult to determine what is the normal ramification of the tree, for the angle at which the branch goes off is liable to be modified by a great number of circumstances. All that we argue for is a general correspondence between the tendency of the direction of the branches, and the tendency of the direction of the veins of the leafage; a tendency liable, however, to be affected by a great number of circumstances natural and artificial. It does not follow, because there is a correspondence between the venation of the leaf and the ramification of the tree, that therefore the two—the leaf and tree—must have the same form. The form of the leaf will be to some extent modified by the quantity of parenchyma, and the form of the tree by the weight of the branches; and there are other causes producing a discrepancy. But the two—the leaf and tree—will commonly assume the same form. Even when they differ, the correspondence will be seen in the *tendency*, apart from extraneous causes, to take the same form. *It is always to be remembered, that it is the whole leafage coming out at a given place which represents the tree, and the single leaf where there are more leaves than one, represents the branch or the young tree.* It is only thus that I can bring the ash and mountain ash into accordance with these views. The whole leafage with its stalk represents the tree, and the leaf-branch and leaflets the branches and branchlets, as also the young tree.

Such facts as these strongly incline us to the belief, that in plants with leaves that strike the eye, the leaf and plant are typically analogous. The leaf is a typical plant or branch, and every tree or branch is a typical leaf. I am quite aware of the differences between these two distinct members of the plant. In particular, we find in the case of the full tree, that the branches extend all round the axis, whereas in the leaf the fibrous veins all lie in one plane. But then we have a phænomenon to connect these two in the branch, the branchlets of which often lie in one plane. The principal difference between the tree and leaf may probably be found to be in this, that the cellular tissue or parenchyma, which in the tree and its branches is collected into the pith and bark (which are connected by the medullary rays), is in the leaf so spread out as to fill up the interstices of the fibrous matter which forms the veins.

The general order as thus stated applies only to the plants which have pith and bark, and fully formed leaves intended to strike the eye. There is no such special order in plants with linear, unbranched leaves, such as firs and pines. The leaf in these plants has no ramified venation, and seems to correspond, not to the whole tree, but to the stem, and in doing so it is more in accordance with the whole morphology of the tree than a veined leaf could possibly be. But while the general order is varied to suit the different physiological structure and form of the tree, we discover here the very same general principles of order as we have been discovering elsewhere; for in the firs and pines every internode is of the same structure with every other; every branch tends to assume the outline of the whole tree, *every topmost or growing internode with its leafage is of the same form as the tree or branch.* Herein does the special morphology approach nearest to that of the plants with ramified veins, and the very cones are often types of the whole tree and of every branch.

We are not prepared to say what is the special law of order in plants of the monocotyledonous class. Some of these, such as our ordinary lilies and grasses, send off no branches, and the leaves of these plants have their veins parallel or nearly parallel to the stem, and have no ramified venation. In regard to palms, they would require to be investigated in their native climes, before their special order could be discovered. Some plants of this class, the dictyogens of Lindley, to which belong the yams, have branches like our ordinary forest trees, and it is a curious circumstance and confirmatory of our theory, that the leaves of these plants have a reticulated structure.

So far as fungi, lichens, algæ, and the whole acotyledonous plants are concerned, it is evident that they present a repetition of parts homotypal in structure and form, and thus illustrate one general doctrine—that throughout the vegetable kingdom the parts are similar to one another, and in nice accordance with the whole.

Such facts as the above incline us to the belief that the fibrous veins of the leaf bear a morphological analogy to the stems of the tree. We are inclined to regard the root, the stem, and the leaf, as the three distinct members of the fully-developed plant, these three parts, however, being morphologically allied ; so that, to adopt the phraseology of Professor Owen, as applied to another subject, they may be call HOMOTYPES. The plant thus becomes a unity with innumerable interesting diversities.

The same general truth may be arrived at by a reverse process. Looking at the lowest plants in the scale, we at once perceive that they are made up of parts which are a repetition of each other. And we may remark, that not only is one part of the same structure as every other, but that when the parts are joined together, the parts that are joined are made to assume a set of forms, every one of which is the same as every other and as the whole. We see, for instance, that every internode of the horsetail is the same as every other, and that the topmost node is a type of the whole plant. We see that in the fern every leaflet is of the same shape as its branch, and that every branch is of the same shape as the whole plant. This, be it observed, is true not only of the structure of each part, but of the form which the compound structure assumes.

Rising upward let us now look at our common herbaceous plants. Some of them, such as the hollyhock, the crowfoot, the lady's mantle, send out a number of stems from near the root, and these plants send out about the same number of main veins or midribs from the base of the leaf. I examined a great many alchemillas and found the same number of stems from the root as of main ribs from the base of the leaf; the crowfoot sends out five stems or so from its root, and it has five main ribs in its leaf. Again, it may be observed how every branch with its leaves is of the same form as its leaf, and how the branch with its leafage and the leaf resemble the whole plant. The common wood anemone sends out three stems; at the top of each of these stems is a compound leaf, divided into three smaller leaves, and each of these smaller leaves has three main veins. Other plants, such as the common thistle and the rag-weed, send up one main stem from the root and have one main vein in the leaf. Observe, too, how in such plants every leaf with its ragged leaf is a type of the whole plant with its side leaves or branches. It may be observed, too, how in these plants last-named the lateral leaves and the lateral veins of leaves both come off at a pretty wide angle.

In such plants as these it will be acknowledged, I think, that the stems of the plant and the main veins of the leaf seem to follow the same laws, or rather that it is impossible to distinguish between them in some cases, and say what is the main vein and what is the stem. But we may mount higher and now examine our common trees, and inquire if the veins of their leaves do not follow the same law of direction as the lateral stems from the trunk and branches. No doubt we may expect here to find, owing to the more complicated structure of the plant and its greater exposure to external influences, that the phænomena will be more complicated, and all that we can expect to discover is a tendency on the part of the ramification of the branches to take the same form as the venation of the leaves. Let us take up a gooseberry leaf and examine it, and we shall find that at the top of a leaf-stalk there go off three very large veins with two other lesser veins from each of the outer of the three large veins, making in all seven veins from the base of the leaf, and we may notice how the gooseberry at the top of a short unbranched trunk sends off a large number of stems. We may now see, too, how the currant leaf at the top of a leaf-stalk sends off from its base three main veins (with two other less ones), and how some little distance above the ground the trunk commonly divides into three main branches.

I have already traced some points of analogy between the ramification of the branches and leaf-veins of our common trees. I have examined the mountain ash, and found that the angle of its leaf vein is 45°, and that the angle of ramification is also 45°. A dog-berry growing near was measured, and gave the angle both of ramification and venation as 64°. Here, then, are two trees differing in their angle by 20°, and in each case the angle of branch and vein corresponding. But in carrying out the principle, it is to be borne in mind that the full-grown tree is much more complicated than the young tree or the simple branch. In such cases I apprehend that the leaf represents exclusively the young tree or the branch. This is the case with the laburnum, where the individual leaf represents the branch, with veins going off at an angle of 60° or 70°. But the trefoil leaf will represent the whole tree, which tends to send off its main branches in threes.

I think it proper to add, that while strongly convinced that there is truth in this doctrine, I am at the same time prepared to believe that it may have to submit to modification, which may correct, but will not destroy, the general view.

XIX. *Notice of a new British* Viola. By Charles C. Babington, M.A., F.R.S.

Read 11th December 1851.

It gives me much pleasure to have to record the discovery of another violet to be added to the British flora, which I have recently obtained from my friend Mr. A. G. More of Trinity College, Cambridge. He gathered it in June 1851 on peaty ground in Garry Land Wood near Gort, co. Galway.

It is only recently that we have learned, from the writings of Fries and of Grenier, to distinguish the several species which, being apparently rare in Britain, may have been confounded under the name of *V. lactea* (Sm.); and more especially discovered the necessity of separating those of them which possess rhizomes from the non-rhizomatous species. Or possibly it would be more correct to say, that we did not know of the existence of any of the former as native plants. It is curious to observe that Fries (Summa Veg. Scand. p. 34) stated in the year 1846 as a well-ascertained fact, that the whole of his group of "*Pratenses* in Anglia desunt." At that recent date the remark was justly made, for not one species of this well-marked section of Violets had then been recorded from any British locality. In the third edition of my 'Manual' and also in the 'Botanical Gazette' (ii. 144 and 178), I have introduced *V. stagnina* as our only native representative of the group, but it had previously been noticed by Mr. H. C. Watson in his valuable 'Cybele Britannica' (iii. 179). The following is the species now to be added to that group:—

Viola stricta (Hornem.); *anther-spur* short broadly lancet-shaped *blunt* (about twice as long as broad), corolla-spur short blunt (green), *leaves cordate-ovate*, petioles winged at the top, *stipules oblong*-lanceolate leaflike incise-serrate ($\frac{1}{2}$-) shorter than the petioles "on the middle of the stem," primary and lateral stems flowering and elongated.

V. stricta var. humilis, *Fries Mant.* iii. 124.
V. stricta, *Gren. et Godr. Fl. Fran.* i. 180.
V. Ruppii, *Reichenb. Icon. Fl. Germ.* iii. t. 14. fig. min.

The habit is apparently very much like that of *V. stagnina.* Stems erect, in the rather young specimens before me they are 3 or 4 inches in height, slender, glabrous. Leaves shorter and broader than those of *V. stagnina,* and cordate at their base. Stipules, when well developed, large and broad, oblong or oblong-lanceolate, all (on our specimens) about half as long as the petioles, as they are stated to be upon the middle of the stem on the continental more fully grown plants, on the upper part of which they are described as being longer than the petioles. It is highly probable that if our specimens had been allowed to advance beyond the commencement of the flowering state in which they were gathered, they would have produced longer stipules and shorter petioles than those which they now exhibit, and so have quite agreed with the character given in foreign books. The flowers are stated by Fries to be "cœrulescentibus," by Grenier "blue violet;" on the dried specimens they are cream-coloured, but had a slight tinge of blue when fresh; this difference need not present any difficulty, as those of *V. stagnina* are pale blue when fresh but nearly white when dried: their spur is short, but manifestly longer than the appendages of the calyx, very blunt, and *nearly as green as the calyx.* This greenness of the spur is stated to be constant in this and one or two other species, but I have had no experience of it. The spurs of the anthers are decidedly blunt. The capsules I have not seen, but they are stated to be truncate-obtuse and without elevated nerves.

This species consists, as do most of its allies, of two forms, a larger and a smaller, between which there is often so much difference of appearance as at first sight to lead to the opinion that they are distinct specifically; but an examination of them shows that such is not the fact. Our present plant is the smaller form of what in its larger state is rather extensively distributed in Germany and France, and in its smaller is not very unfrequent in Scandinavia.

This plant is far more nearly allied to *V. stagnina* than to any of our other violets, but the green colour of the corolla-spur, the differently shaped leaves, and remarkably different stipules clearly distinguish it. The short corolla-spur, and also that of the anthers, would be quite a sufficient cause for separating it from *V. canina,* even if the presence of a rhizome (which however I have not had an opportunity of seeing) in *V. stricta* had not afforded so manifest a distinction between them. In *V. pratensis* (Koch), which is very nearly allied to our plant, the central stipules are longer than the petioles (not $\frac{1}{2}$ of their length), the limb of the leaves is markedly decurrent on to the petioles, and the spur of the corolla is not green.

In his invaluable 'Herbarium Normale' (iv. 44) Fries states that specimens of *V. lactea* from Smith himself are exactly *V. pratensis* which is there named by him *V. lactea* accordingly, but in his 'Mantissa tertia' (123) he corrects that error, which originated from his not having then learned to distinguish *V. lancifolia* (his *V. pumila,* not that of Villars, which is *V. pratensis*), my *V. canina β. lancifolia,* from *V. pratensis.*

In Hooker and Arnott's 'British Flora' (Addenda) I am stated to give the name of *V. stagnina* to the violet which they "and most others call *V. lactea,*" but it seems to me that great difficulty exists in determining what "most" botanists really do call *V. lactea.* It is even difficult to tell what is the true plant of Hooker and Arnott, as in their text they seem to include under that name *V. lancifolia* and *V. stagnina,* but in their Addenda they state that their *V. lactea* is what I call *V. stagnina,* although many of the localities given for it manifestly are those of *V. lancifolia.* The *V. lactea* of British botanists is most frequently *V. lancifolia,* if specimens are to be trusted, and that is certainly the plant primarily intended by Smith. Continental authors do not show any such uniformity, for Smith's name has been applied to *V. pratensis* (*V. pumila,* Vill., not of Hook. and Arn., which is the true *V. canina,* Linn.), *V. stagnina,* and *V. lancifolia.*

P.S.—Since the above paper was printed in the 'Annals of Nat. Hist.' I have seen reason to suppose that too much dependence has been placed on the colour of the corolla-spur and the shape of the stipules, and to suspect that this Irish Violet may be only a state of *V. stagnina.* Mr. More has supplied me with Irish specimens of this supposed *V. stricta* having a very decided rhizome. They were gathered in Garry Land Wood on May 28, 1852, and were then in flower.