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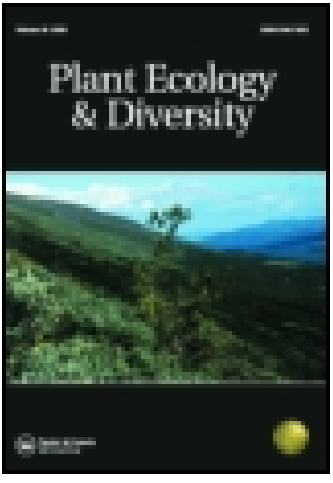

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On the Leaves of Climbing Plants

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On the Leaves of Climbing Plants. By W. E. FOTHERGILL, M.A.

(Read 14th June 1888.)

Some time ago, while working at climbing plants in quite a different connection from the present, I noticed that the leaves of most of the plants I was handling were cordate, sagittate, hastate, and sometime peltate. After drawing up

a few rough lists of orders where climbers occur, I became convinced that there must be some causal connection between the climbing habit and a large development of the basal portions of the leaves.

Accordingly, I went through the collections in the Edinburgh Herbarium, making, by aid of the "Genera Plantarum," lists of climbing plants in almost every order where they occur. In one column I placed those whose leaves were cordate, sagittate, or hastate, as I expected, and in another those not marked by this peculiarity. A glance down the column of exceptions in each order gave a clue to a rationale of the point, the apparently unfavourable cases as usual suggesting at the same time their own explanation and the basis for a general rule.

The salient feature of a climbing plant is, of course, the weakness of its stem. Whether this is the cause or the result of the climbing habit is, of course, beyond the present question.

External observation of the most typical plants in question showed that the stronger and stiffer the stem, the less marked was the basal development of the leaves. A series of sections confirmed the generalisation that *basal development varies inversely with the amount of strengthening tissue in the stem.* In some different specimens of ivy, for example, those with no large basal leaf-lobes had much more woody stems than those with markedly hastate leaves.

A large number of cases, however, contradicted the rule even as thus modified, and it was only on noticing that in all the cases where the stem was soft, and yet the leaves were not basally developed, they were sessile or on very short stalks. The *length of the petiole* then appeared as a second factor which is seen *to vary directly with the amount of basal development;* the longer the stalk, the more cordate or sagittate the leaf.

We can express these two modifications of the rule that climbing plants have basally developed leaves as follows:— Let b be the amount of basal development, s the amount of strengthening tissue in the supporting system, and p the length of the petiole, then $b \propto \frac{p}{s}$.

I must note here that, where leaves are compound or

deeply divided, so many other complexities are introduced that it is almost impossible to use them for or against a theory of this kind; but in many cases, drawing a line round the points of leaflets gave an outline which fairly showed the distribution of the weight of the leaf, and this was usually affected by considerable development of the basal lobes.

Where the petiole is much used in climbing, the point of support of the leaf is raised so much as materially to alter the relations in question, so that I prefer to exclude such cases from the explanation I wish to suggest, which deals with the general aspect of the case as stated above.

Since the supporting system is one and the same throughout the plant, with the pliant and yielding stem of a climbing plant, we find also slight bending petioles which are unable to sustain much weight, especially if it is not favourably distributed. For optimum conditions of nutrition, a leaf must not hang down too much so as to catch the light, or bend its stalk so as to compress the conducting vascular system. Sessile or shortly stalked leaves will not suffer, nor will those of climbers, whose supporting system is stronger than usual; but where petioles are long, and share the weakness of a feeble supporting system, some compensation must be made by a favourable disposition of the weight to be borne. How then are the light petioles of weak climbing plants to stand erect and bear their leaves in an approximately horizontal position?

It is clear that great development of any one part of a lamina will alter the position of its centre of gravity. In an ovate leaf the centre of gravity is near the centre, in a cordate one it is near the insertion of the petiole.

Now, the moving of the centre of gravity of a lamina away from the apex towards the base lessens the bending strain on the petiole in two ways, or rather lessens the strain on the lower part where it springs from the stalk, and on the upper part where it passes into the lamina to become its midrib.

First, it brings the centre of gravity of the leaf nearer to the main axis, and so lessens the moment of the force exerted by the weight of the leaf about the point of insertion of the petiole in the axis. *Thus basal development of the leaves of*

climbing plants must greatly relieve the bending strain on the wer part of the petiole.

Second, since basal development brings the centre of gravity of the lamina nearer the point of expansion of the petiole, there will be a much shorter distance between the point of support of the lamina and the point of action of its weight than otherwise would be the case. Thus a much slighter petiole will be able to keep the lamina approximately horizontal, if it be cordate, than if it be ovate. *Thus basal development of leaves must greatly relieve bending strain on the petiole at its point of expansion into the lamina.*

For these two reasons, then, I suppose the leaves of most climbing plants to be largely developed basally. Their petioles we may expect to be weak *a priori;* and we see that cordate and allied forms of leaves will exert less strain on these petioles than would other leaves, for the two purely physical reasons mentioned above.

Where the petiole is absent, there can be no strain on it, and this is simply the extreme case of a shortened petiole, so the shorter the petiole, the less marked is the basal development. Where the petiole is strong enough, it can also support a leaf of ordinary shape; but a long petiole, if not strong, must be helped by having the weight of the leaf brought —first, nearer the main axis, so reducing the strain at the insertion of the petiole in the axis; and, second, nearer the expansion of the petiole into the lamina, so lessening the strain at that point.

This little question appears to me deserving of the amount of trouble it has demanded. I have been unable, so far, to connect it with the question of cordation and peltation in general; for there are plenty of cordate and peltate leaves where neither *a priori* reasons nor actual examination shows weakness of supporting system, but I imagine that after eliminating the complexities of many basally developed leaves, other than those of climbing plants, the connection between the present point and the more general question may become visible.

Note.—A peculiarly pretty confirmation of the above view is given by the leaves of some Passifloræ, *e.g.*, *P. rubra* and *P. Vespertilio.* Here the centre of gravity is shifted towards the base of the leaf, not by largely developing the basal lobes, but by cutting off the apex, so that one gets a truncated or even depressed leaf apex.