A Study of the Hydrangea in relation to Cross-Fertilization.

By Thomas Meehan.

That many flowers are arranged for cross-fertilization needs no argument to sustain it, nor is it less certain that some flowers can only be fertilized through the aid of wind or insects. Sprengel, it is well known, in the early part of the present century, placed this beyond doubt. The great question is not, do plants generally cross-fertilize? but why do they do it? Mr. Darwin's great work in this connexion has been to prove that plants abhor in-and-in breeding, that the struggle for life is necessarily the chief object of existence, and that cross-fertilization tends to make the race stronger and better fitted to engage in this struggle than close breeding would do. The results of many of Mr. Darwin's experiments sustain his views, as do those of many others; but to my mind just as large a number do not sustain them. Mr. Darwin himself has candidly stated that continuous self-fertilization does not in the least impair the fertility of the race. Mere negative vigour is the leading advantage he finds in crossed plants. (Cross and Self-fertilization, Chap. IX. p. 327.)

It is not my object now to controvert the views of Mr. Darwin, or of his numerous followers. My view of one object of nature in cross-fertilization is to aid in production of variety. I have shown ever since discussion grew warm on these subjects, that variation is essential to the present order of things,—that nature, to be consistent with herself, must provide for variations if for no other purpose than to make variety. I now propose to show, by some studies in *Hydrangea*, that the variations in the species are of the most contradictory character taken from the standpoint of benefits in the struggle for life, while they are entirely consistent with my view of variation for variety's sake. Our garden *Hydrangea*, from Japan (*Hydrangea hortensis**), has the ray-florets sterile, or rather it is the lateral florets of the compound cyme that give the enlarged sepals, and fail to perfect the gynæcium. The terminal florets are fertile. In *H. quercifolia* all the lateral florets are fertile, and it is only the terminal one that has petaloid sepals and is barren. Will any one assert that these exactly opposite conditions can have any bearing whatever as aids in a struggle for life? Suppose we say that the attractive sepals are given to these species for the purpose of attracting insects, and thus aiding cross-fertilization. With this view we examine the American species *H. arborescens*, and we find barely an attempt to make these enlarged petaloid sepals. There are small ones on a few terminals and this is all. It has made out certainly as well in the great struggle as either of its two brethren. But is it a fact that the showy sepals are given to the plant to attract

* Franchet and Savatier insist that Smith's name of *H. hortensis* has priority over *H. Hortensia*.

insects? There is neither pollen nor nectar in the male flowers of *H. hortensis*. They conceal the terminal hermaphrodites, and it is scarcely probable that many insects, if any, visit the flowers. In the other two, many insects visit the flowers—so far as my observations go, as many visit the *H. arborescens* without the attractive sepals, as the *H. quercifolia* that makes such a show of them.

Turning to the minute fertile flowers on these two species, we are struck by the immense number of stamens and the enormous number of pollen-grains one of these racemose cymes gives us. I estimated the number of stamens on one of *H. quercifolia* at 13,000; shaken over a sheet of dark paper it completely whitens it. Its pollen can be carried by the wind everywhere, why should it develop petaloid sepals to attract insects? Both species have the odour of hawthorn, but in addition *H. quercifolia* has an enormous yield of nectar, which is apparently not abundant in *H. arborescens*. In spite of all the attractions, the petaloid sepals, the abundance of pollen, the delightful fragrance, the superabundance of nectar, and the actual visits of numerous insects, the flowers are self-fertilizing. The outer row of five stamens mature pollen simultaneously with the expansion of the petals, which falls at once on the receptive stigmas, some hours after the inner series mature, and ensures that self-fertilization which the pollen from the first series may possibly have missed. The only possible aid insects can give is in self-fertilization.

It is broadly asserted that we owe to the existence of insects the various forms and colours of flowers with their grateful odours and sweet secretions. Here we have illustrations of the most dissimilar and contradictory variations in a single genus, variations which cover all the leading points called for by the insect-adaptationists, and, so far as any argument in common use goes, could have occurred with as much reason if not a single insect ever existed. The facts are absolutely inexplicable on any theory of the survival of the fittest in the struggle for life; but on my view of the absolute necessity of variation for its own sake the explanation seems simple enough.

Variation is inseparable from even the closest in-and-in breeding. We are as fully justified in saying that nature abhors a perpetuity of form as that she abhors in-and-in breeding, and we can just as earnestly claim cross-fertilization as an agent in bringing about variation for the sake of variety as for the reasons usually given, and which we find we cannot apply with consistency in so many cases.

That cross-fertilization aids variation we may well believe is a sufficient reason for its existence, without assuming that it has no other office to perform.—*Proc. Acad. Nat. Sci. Philad.* 1888, p. 277.