

acknowledged that great difficulties were encountered when efforts were made to explain the process by which the pollen reached the stigma, but the fact that the two organs, stamens and pistils, existed in such close proximity, and the further fact that the stigmas were fertilized by the pollen generally, silenced all doubts about the matter. In 1862 the view that every flower was fertilized in its own pollen was completely disproved. It is now held that a few flowers are so fertilized, but that the great majority are cross-fertilized. There are structural arrangements in most flowers that absolutely prevent close fertilization. (1) As examples we have poplars, willows, etc., which have their stamens or male flowers on one tree, and their pistils or female flowers on another. This necessitates transference of the pollen from the one plant to the other, as without this no fruit or seed would be produced. (2) Again most of our forest trees, oaks, elms, birches, beeches, hickory, hazels, etc., have the male flowers on one part of the plant, and the female flowers on a different part. The Indian corn has the male flowers at the summit of the stem and the female flowers near the base. (3) Again in very many plants the male flowers mature their pollen before the female flowers are in a receptive condition, or on the other hand the female flowers ripen first and the staminate a few days after. In each of these cases the pollen must be carried in some way from the staminate flower where it is produced to the pistillate which is ready to receive it.

With these difficulties in the way how can the plant be fertilized? How can the pollen reach the stigma? It is a case of do or die. Nature has secured the necessary agents for the work. Of these there are two which perform the greater part of it and are constantly seen attending to the duties assigned them at the proper season. These are: (1) Winds; (2) Insects and birds. Broad lines of demarcation separate these two classes of plants. Those trusting to the wind to bring them the needful pollen require no alluring displays to attract the breezes. They have small and inconspicuous flowers, presenting no light or attractive colors; they are destitute of fragrant odors and furnish no honey to reward the visits of insects. In further adaptation for transportation by the winds, the pollen is produced in immense quantities to allow for waste. The grains are also light so as to be carried by every gentle breeze, and dry and incoherent so as not to form heavy masses or to adhere to objects which might be encountered on its journey. The pistil-tips or stigmas of these plants are also especially adapted to catching and holding the grains of pollen blown upon them, as they are divided or branched into plumes or feathers and plentifully beset with hairs or bristles. The anthers also hang out to the air and wind only when just ready to discharge their pollen, and are suspended on suddenly lengthened capillary, drooping filaments fluttering in the gentlest breeze. Most of our forest trees blossom in early spring when the weather is seldom calm and before the leaves are sufficiently developed to interfere with the scattering of the pollen. They are native to the country and adapted to its climate, and consequently they produce their flowers in the most favorable season to secure cross fertilization. All grains, such as wheat, oats, rye, barley, Indian corn and all our cultivated grasses are also wind-fertilized, but they are all foreigners and they have been introduced by man. They are natives to other lands and are adapted for a different climate and are here exposed to certain disadvantages. A few fine, calm, summer days occurring at the time when they are ready for fertilization will prevent the transportation of the pollen and the harvest will prove a failure. Again, a few foggy or rainy days at the same time will equally produce the same result. The rain will wet the grains of pollen and carry them down to the ground, where they soon perish. Near the sea coast where fogs and continued rains are frequent, wheat is a very uncertain crop. From these facts it is very easy to see that a field of wheat which is ready for fertilization during a few fine days with gentle breezes will yield an abundant harvest, while another alongside of it which is not ready till a few days later when damp or rainy weather is experienced may be a comparative failure. Complete failure, however, will seldom occur for the following reason: The process of fertilization begins at the base of the head of wheat and gradually extends upwards for several days before it is complete. In the meantime several changes of weather may occur and one part of the head may be fertilized and produce good grains, while the top or some other part may be completely empty. Another fact worthy of notice is that if

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