# CLASSICS OF SCIENCE: Darwin on Orchids

*Biology*

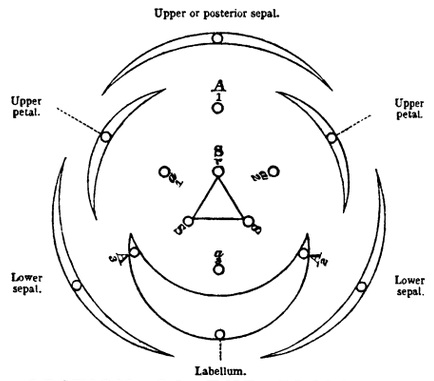
**Can you identify in the flower the fifteen organs which Darwin found to make up, in various modifications, the typical structure of the orchid blossom?**

*ON THE VARIOUS CONTRIVANCES BY WHICH BRITISH AND FOREIGN ORCHIDS ARE FERTILISED BY INSECTS, and on the Good Effects of Intercrossing. By Charles Darwin, M. A., F. R. S., etc., London,* 1862.

## *Diversity of Adaptations*

I have now nearly finished this too lengthy volume. It has, I think, been shown that Orchids exhibit an almost endless diversity of beautiful adaptations. When this or that part has been spoken of as contrived for some special purpose, it must not be supposed that it was originally always formed for this sole purpose. The regular course of events seems to be that a part which originally served for one purpose, by slow changes becomes adapted for widely different purposes. To give an instance: in all the Ophreæ, the long and nearly rigid caudicle manifestly serves for the application of the pollen-grains to the stigma, when the pollinium attached to an insect is transported from flower to flower; and the anther opens widely that the pollinium may be easily withdrawn; but in the Bee Ophrys, the caudicle, by a slight increase in length, and decrease in thickness, and by the anther opening a little more widely, becomes specially adapted for the very different purpose of self-fertilisation, through the combined aid of the gravity of the pollen-mass and the vibration of the flower. Every gradation between these two states would be possible—of which we have seen partial proof in O. arachnites.

Again the elasticity of the pedicel of the pollinium in some Vandeæ is adapted to free the pollen-masses out of their anther-cases; but by further slight modifications, the elasticity of the pedicel becomes specially adapted to shoot out the pollinia to a distance. The great cavity in the labellum of many Vandeæ serves to attract insects, but in Mormodes ignea it is greatly reduced in size, and only serves to keep the labellum in its proper position on the summit of the column. From the analogy of many plants we may infer that a long spur-like nectary is primarily adapted to secrete and hold a store of nectar; but in many Orchids it has so far lost this function as only to contain fluid between its two coats. In these Orchids, in which the nectary contains both free nectar and fluid in the intercellular spaces, we can see how a passage from one state to the other could have been effected, namely, by less and less nectar being secreted from the inner membrane, and more and more being retained within the intercellular spaces. Other analogous cases could be given.




*SECTION OF THE FLOWER OF AN ORCHID. The little circles show the position of the spiral vessels.*

*SS. Stigmas; Sr, stigma modified into the rostellum.*

*$A_1$. Fertile anther of the outer whorl; $A_2$ $A_3$, anthers of the same whorl combined with the lower petal, forming the labellum.*

*$a_1$ $a_2$. Rudimentary anthers of the inner whorl (fertile in Cypripedium), generally forming the clinandrum; $a_3$, third anther of the same whorl, when present, forming the front of the column.*

Although an organ may not have been originally formed for some special purpose, if it now serves for this end we are justified in saying that it is specially contrived for it. On the same principle, if a man were to make a machine for some special purpose, but were to use old wheels, springs and pulleys, only slightly altered, the whole machine, with all its parts, might be said to be specially contrived for that purpose. Thus throughout nature almost every part of each living being has probably served, in a slightly modified condition, for diverse purposes, and has acted in the living machinery of many ancient and distinct specific forms.

In my examination of Orchids, hardly any fact has so much struck me as the endless diversity of structure—the prodigality of resources—for gaining the very same end, namely, the fertilisation of one flower by the pollen of another. The fact to a certain extent is intelligible on the principle of natural selection. As all the parts of a flower are co-ordinated, if slight variations in any one part are preserved from being beneficial to the plant, then the other parts will generally have to be modified in some corresponding manner. But certain parts may not vary at all, or may not vary in the simplest corresponding manner, and these variations, whatever their nature may be, which will bring all the parts into more perfect harmony with each other, will be seized on and preserved by natural selection.

To give a simple illustration: in many Orchids the ovarium (but sometimes the foot-stalk) becomes for a period twisted, causing the labellum to hang downwards, so that insects can easily visit the flower; but from slow changes in the form and position of the petals, or from new sorts of insects visiting the flower, it might become advantageous to the plant that the labellum should resume its normal upward position, as is actually the case with Malaxis paludosa; this change, it is obvious, might be simply effected by the continued selection of varieties which had their ovarium a little less twisted; but if the plant only afforded varieties with the ovarium more twisted, the same end could be attained by their selection until the flower had turned completely round on its axis: this seems to have occurred with the Malaxis, for the labellum has acquired its present upward position, and the ovarium is twisted to excess.

Again, we have seen that in most Vandeæ there is a plain relation between the depth of the stigmatic chamber and the length of the pedicel, by which the pollen-masses are inserted; now if the chamber became slightly less deep from any change in the form of the column or any other unknown cause, the shortening of the pedicel would be the simplest corresponding change; but if the pedicel did not happen to vary in length, any the slightest tendency to an upward curvature from elasticity as in Phalænopsis, or to a backward hygrometric movement as in one of the Maxillarias, would be preserved, and the tendency would be continually augmented by selection; thus the pedicel, as far as its action is concerned, would be modified in the same manner as if it had been shortened. Such processes carried on during many thousand generations (*Turn to next page*)

## Darwin on Orchids—*Continued*

in various ways, with the several parts of the flower, would create an endless diversity of coadapted structures for the same general purpose. This view affords, I believe, the key which partly solves the problem of the vast diversity of structure adapted for closely analogous ends in many large groups of organic beings.

### *Ingenuity of Nature*

The more I study nature, the more I become impressed with ever-increasing force with the conclusion that the contrivances and beautiful adaptations slowly acquired through each part occasionally varying in a slight degree but in many ways, with the preservation or natural selection of those variations which are beneficial to the organism under the complex and ever-varying conditions of life, transcend in an incomparable degree the contrivances and adaptations which the most fertile imagination of the most imaginative man could suggest with unlimited time at his disposal.

The use of each trifling detail of structure is far from a barren search to those who believe in natural selection. When a naturalist casually takes up an organic being, and does not study its whole life (imperfect though that study will ever be), he naturally doubts whether each trifling point can be of any use, or indeed whether it be due to any general law. Some naturalists believe that numberless structures have been created for the sake of mere variety and beauty—much as a workman would make a set of different patterns. I, for one, have often and often doubted whether this or that detail of structure could be of any service; yet, if of no good, these structures could not have been modeled by the natural preservation of useful variations; such details could only be vaguely accounted for by the direct action of the conditions of life, or the mysterious laws of correlation of growth. . . .

### *Value of Crossing*

Considering how precious the pollen of Orchids evidently is, and what care has been bestowed on its organization and on the accessory parts—considering that the anther always stands close behind and above the stigma, self-fertilisation would have been an incomparably safer process than the transportal of the pollen from flower to flower. It is an astonishing fact that self-fertilisation should not have been an habitual occurrence. It apparently demonstrates to us that there must be something injurious in the process. Nature thus tells us, in the most emphatic manner, that she abhors perpetual self-fertilisation. This conclusion seems to be of high importance and perhaps justifies the lengthy details given in this volume. For may we not further infer as probable, in accordance with the belief of the vast majority of the breeders of our domestic productions, that marriage between near relations is likewise in some way injurious—that some unknown great good is derived from the union of individuals which have been kept distinct for many generations?

**Charles Darwin** was born February 12, 1809, at Shrewsbury, England, and died April 19, 1882, at Down. He went to Edinburgh to study medicine at the age of 16, but was unsuited to that profession. At 19 he entered Cambridge University to study for holy orders. The year he graduated he set out on the five-year voyage on the *Beagle* which was his real preparation for his life's work. When he returned, at 28, he had already begun to make notes on the "Transmutation of Species," although publication of his theory waited on the experiments and verifications of the next 20 years. In the two decades following the publication of the "Origin of Species" a rapid succession of books appeared as the fruit of his earlier studies.

*Science News-Letter, January 26, 1929*