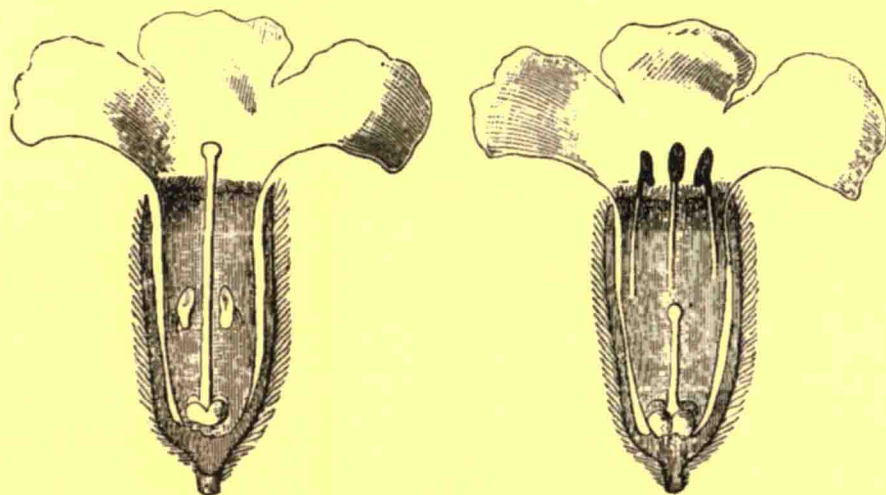


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THE DIFFERENT FORMS OF FLOWERS ON PLANTS OF THE SAME SPECIES

CHARLES DARWIN



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THE
DIFFERENT FORMS OF FLOWERS
ON
PLANTS OF THE SAME SPECIES.

By CHARLES DARWIN, M.A., F.R.S.

WITH ILLUSTRATIONS.

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The Different Forms of Flowers on Plants of the Same Species

CHARLES DARWIN



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AND CHANCING CROSS.

TO
PROFESSOR ASA GRAY

This Volume is Dedicated

BY THE AUTHOR
AS A SMALL TRIBUTE OF RESPECT AND
AFFECTION.

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THE
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INTRODUCTION.

THE subject of the present volume, namely the differently formed flowers normally produced by certain kinds of plants, either on the same stock or on distinct stocks, ought to have been treated by a professed botanist, to which distinction I can lay no claim. As far as the sexual relations of flowers are concerned, Linnæus long ago divided them into hermaphrodite, monœcious, diœcious, and polygamous species. This fundamental distinction, with the aid of several subdivisions in each of the four classes, will serve my purpose; but the classification is artificial, and the groups often pass into one another.

The hermaphrodite class contains two interesting sub-groups, namely, heterostyled and cleistogamic plants; but there are several other less important subdivisions, presently to be given, in which flowers differing in various ways from one another are produced by the same species.

Some plants were described by me several years ago, in a series of papers read before the Linnean Society,*

* "On the Two Forms or Dimorphic Condition in the Species of *Primula*, and on their remarkable Sexual Relations." 'Journal

the individuals of which exist under two or three forms, differing in the length of their pistils and stamens and in other respects. They were called by me dimorphic and trimorphic, but have since been better named by Hildebrand, heterostyled.* As I have many still unpublished observations with respect to these plants, it has seemed to me advisable to republish my former papers in a connected and corrected form, together with the new matter. It will be shown that these heterostyled plants are adapted for reciprocal fertilisation; so that the two or three forms, though all are hermaphrodites, are related to one another almost like the males and females of ordinary unisexual animals. I will also give a full abstract of such observations as have been published since the appearance of my papers; but only those cases will be noticed, with respect to which the evidence seems fairly satisfactory. Some plants have been supposed to be heterostyled merely from their pistils and stamens varying greatly in length, and I have been myself more than once thus deceived. With some species the

of the Proceedings of the Linnean Society,' vol. vi. 1862, p. 77.

"On the Existence of Two Forms, and on their Reciprocal Sexual Relation, in several Species of the Genus *Linum*." Ibid. vol. vii. 1863, p. 69.

"On the Sexual Relations of the Three Forms of *Lythrum salicaria*." Ibid. vol. viii. 1864, p. 169.

"On the Character and Hybrid-like Nature of the Offspring from the Illegitimate Unions of Dimorphic and Trimorphic Plants." Ibid. vol. x. 1868, p. 393.

"On the Specific Differences between *Primula veris*, Brit. Fl. (var. *officinalis*, Linn.), *P. vulgaris*, Brit. Fl. (var. *acaulis*, Linn.), and

P. elatior, Jacq.; and on the Hybrid Nature of the Common Oxlip. With Supplementary Remarks on Naturally Produced Hybrids in the Genus *Verbascum*." Ibid. vol. x. 1868, p. 437.

* The term "heterostyled" does not express all the differences between the forms; but this is a failure common in many cases. As the term has been adopted by writers in various countries, I am unwilling to change it for that of *heterogone* or *heterogonous*, though this has been proposed by so high an authority as Prof. Asa Gray: see the 'American Naturalist,' Jan. 1877, p. 42.

pistil continues growing for a long time, so that if old and young flowers are compared they might be thought to be heterostyled. Again, a species tending to become dioecious, with the stamens reduced in some individuals and with the pistils in others, often presents a deceptive appearance. Unless it be proved that one form is fully fertile only when it is fertilised with pollen from another form, we have not complete evidence that the species is heterostyled. But when the pistils and stamens differ in length in two or three sets of individuals, and this is accompanied by a difference in the size of the pollen-grains or in the state of the stigma, we may infer with much safety that the species is heterostyled. I have, however, occasionally trusted to a difference between the two forms in the length of the pistil alone, or in the length of the stigma together with its more or less papillose condition; and in one instance differences of this kind have been proved by trials made on the fertility of the two forms, to be sufficient evidence.

The second sub-group above referred to consists of hermaphrodite plants, which bear two kinds of flowers—the one perfect and fully expanded—the other minute, completely closed, with the petals rudimentary, often with some of the anthers aborted, and the remaining ones together with the stigmas much reduced in size; yet these flowers are perfectly fertile. They have been called by Dr. Kuhn* cleistogamic, and they

* 'Botanische Zeitung,' 1867, p. 65. Several plants are known occasionally to produce flowers destitute of a corolla; but they belong to a different class of cases from cleistogamic flowers. This deficiency seems to result from the conditions to which the plants have been subjected, and

partakes of the nature of a monstrosity. All the flowers on the same plant are commonly affected in the same manner. Such cases, though they have sometimes been ranked as cleistogamic, do not come within our present scope: see Dr. Maxwell Masters, 'Vegetable Teratology,' 1869, p. 403.

will be described in the last chapter of this volume. They are manifestly adapted for self-fertilisation, which is effected at the cost of a wonderfully small expenditure of pollen; whilst the perfect flowers produced by the same plant are capable of cross-fertilisation. Certain aquatic species, when they flower beneath the water, keep their corollas closed, apparently to protect their pollen; they might therefore be called cleistogamic, but for reasons assigned in the proper place are not included in the present sub-group. Several cleistogamic species, as we shall hereafter see, bury their ovaries or young capsules in the ground; but some few other plants behave in the same manner; and, as they do not bury all their flowers, they might have formed a small separate subdivision.

Another interesting subdivision consists of certain plants, discovered by H. Müller, some individuals of which bear conspicuous flowers adapted for cross-fertilisation by the aid of insects, and others much smaller and less conspicuous flowers, which have often been slightly modified so as to ensure self-fertilisation. *Lysimachia vulgaris*, *Euphrasia officinalis*, *Rhinanthus crista-galli*, and *Viola tricolor* come under this head.* The smaller and less conspicuous flowers are not closed, but as far as the purpose which they serve is concerned, namely, the assured propagation of the species, they approach in nature cleistogamic flowers; but they differ from them by the two kinds being produced on distinct plants.

With many plants, the flowers towards the outside of the inflorescence are much larger and more conspicuous than the central ones. As I shall not have occa-

* H. Müller, 'Nature,' Sept. 25, 1873 (vol. viii.), p. 433, and Nov. 20, 1873 (vol. ix.), p. 44. Also

'Die Befruchtung der Blumen,' &c., 1873, p. 294.

sion to refer to plants of this kind in the following chapters, I will here give a few details respecting them. It is familiar to every one that the ray-florets of the Compositæ often differ remarkably from the others; and so it is with the outer flowers of many Umbelliferæ, some Cruciferæ and a few other families. Several species of *Hydrangea* and *Viburnum* offer striking instances of the same fact. The Rubiaceous genus *Mussaenda* presents a very curious appearance from some of the flowers having the tip of one of the sepals developed into a large petal-like expansion, coloured either white or purple. The outer flowers in several Acanthaceous genera are large and conspicuous but sterile; the next in order are smaller, open, moderately fertile and capable of cross-fertilisation; whilst the central ones are cleistogamic, being still smaller, closed and highly fertile; so that here the inflorescence consists of three kinds of flowers.* From what we know in other cases of the use of the corolla, coloured bractæ, &c., and from what H. Müller has observed† on the frequency of the visits of insects to the flower-heads of the Umbelliferæ and Compositæ being largely determined by their conspicuousness, there can be no doubt that the increased size of the corolla of the outer flowers, the inner ones being in all the above cases small, serves to attract insects. The result is that cross-fertilisation is thus favoured. Most flowers wither soon after being fertilised, but Hildebrand states‡ that the ray-florets of the Compositæ last for a long time, until all those on the disc are impregnated; and this clearly shows the use of the former. The ray-florets,

* J. Scott, 'Journal of Botany,' London, new series, vol. i. 1872, pp. 161-164.

† 'Die Befruchtung der Blu-

men,' pp. 108, 412.

‡ See his interesting memoir, 'Ueber die Geschlechtsverhältnisse bei den Compositen,' 1869, p. 92.