THE INHERITANCE OF SEX IN AN ABNORMAL (CARPELLODIC) WALL-FLOWER.

By

ALEXANDER NELSON, PH.D., B.SC.

Plates XVIII.-XX.

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In wall-flower (*Cheiranthus cheiri*, L.) a curious floral abnormality has long been known. The plant is quite normal until it blooms. In the flower, however, while the sepals are normal the petals are reduced to narrow strips equal in length to the sepals or slightly shorter. The stamens are as usual six in number, but adhere together, forming a closed ring round about the normal ovary. Sometimes in individual rings the line of adherence between the stamens is more or less lacking, and a split takes place and the ring is not complete. The lines of adherence are what might be regarded as the margins of the leaves which normally grow together to form the cavity within which the pollen is produced. The total effect of this form of growth is that a ring is formed with the sporogenous tissue facing into the space between the ring of adherent stamens and the normal ovary. This sporogenous tissue produces not pollen but ovules which lie within the space between the stamen ring and true ovary. The stamens are thus spoken of as carpellodic, as they produce ovules, and each has a functioning stigmatic surface at its distal end. On pollen being applied to the stigmatic area of the carpellodic stamen the ovules mature into viable seed. The flowers of any plant are all affected; one never finds normal and abnormal flowers on the same plant. We may regard the abnormal as completely female as distinguished from the normal hermaphrodite.

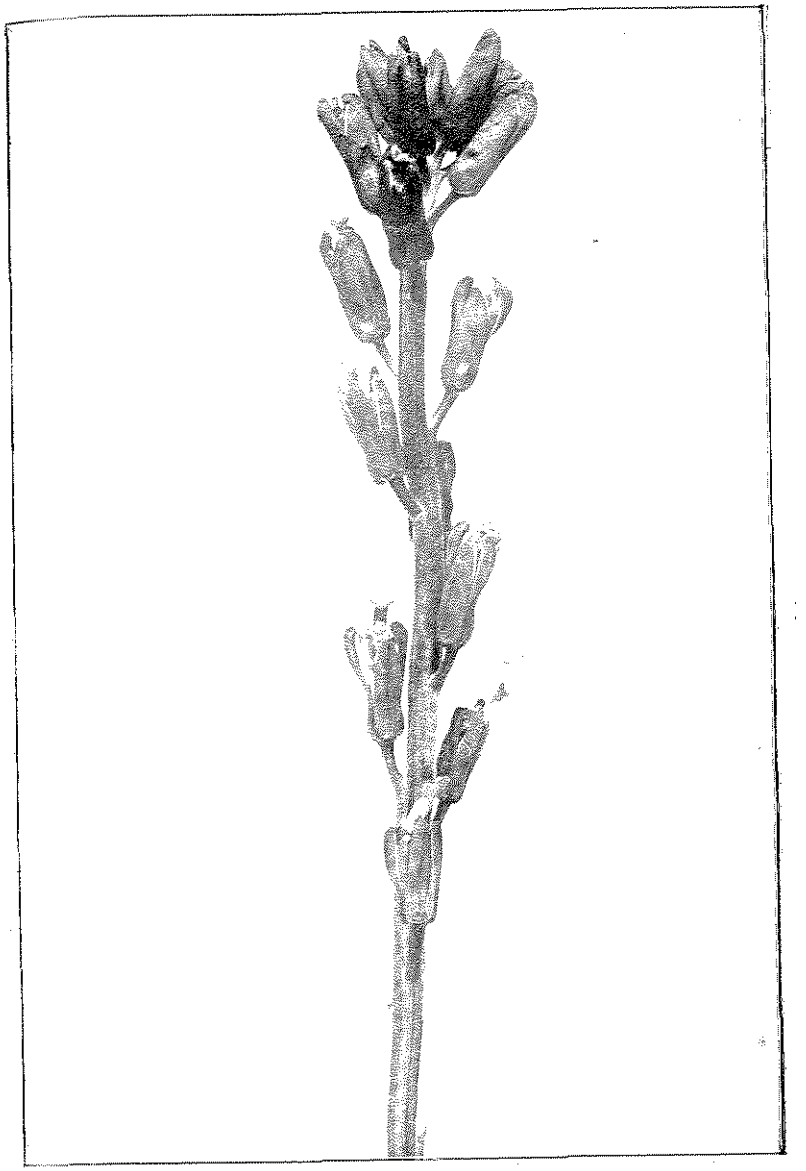
De Candolle (2) describes the abnormal as a distinct variety under the name *Cheiranthus cheiri gynanthus*. How far this is valid may be questioned, as the abnormal can only set seed when pollinated from the normal hermaphrodite, and is, therefore, not self perpetuating.

A number of somewhat similar aberrations are known in other species. The Opium Poppy (*Papaver somniferum*) sometimes shows metamorphosed stamens tending more or less completely towards the carpellodic type, but rarely is the whole androecium affected, and never all the flowers of one plant completely. Weatherwax (5) has noted a case of carpellody in Maize (*Zea mays*) resulting from the metamorphosis of the rudimentary stamens of the pistillate flowers. The metamorphosis in this case seems to depend for full development on the fertilisation of the adjacent ovary. The same author (6) finds that though the style and stigma of the carpel-like stamens are similar to those of the normal organ, there is no true ovarian cavity and no ovules are formed. The cases of maize and wall-flower described above are interesting in comparison, as in the latter functioning ovules are produced and the change is from functioning male organ to functioning female organ rather than from obsolescent male organ to non-functioning female organ. A number of cases of suppression of one or other of the sexes of normally hermaphrodite flowered plants are known. The flowers of the Sweet Pea (*Lathyrus odoratus*, L.) are normally hermaphrodite, but occasionally plants are found in which all the stamens have aborted. Bateson, Saunders & Punnett (1) investigated this case, and have shown that the condition is definitely hereditable and passed from generation to generation on a simple Mendelian scheme, the abnormal being recessive to the normal. There are a number of other cases in the literature more or less clear cut where suppression or abortion of the stamens is definitely inherited.

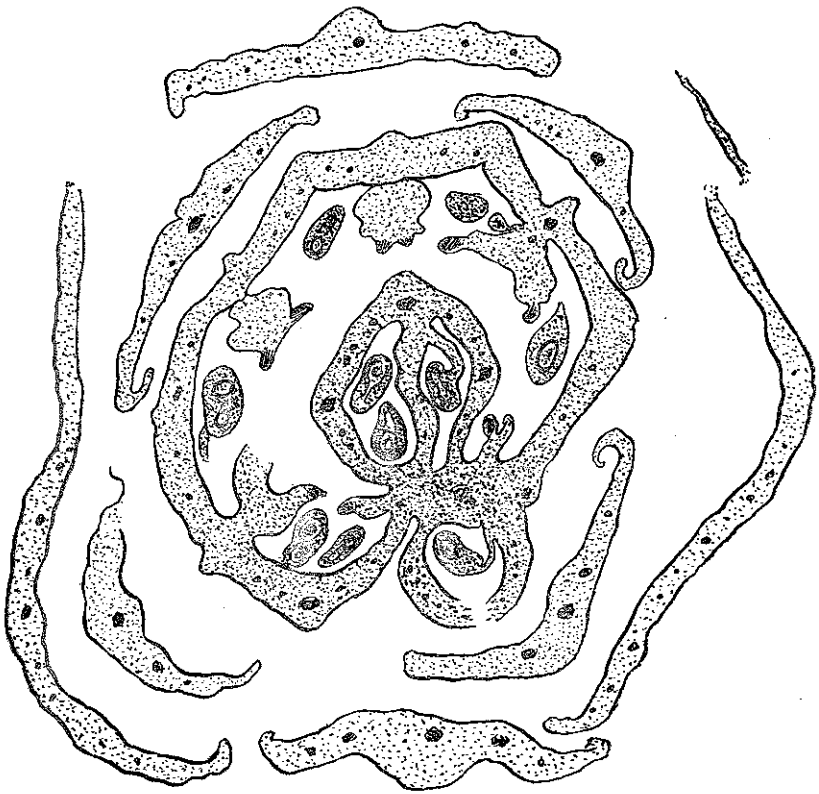
De Vries (4) discussing the carpellodic wall-flower surmised that the condition was hereditable, but offered no evidence. A number of writers, for example Schaffner (3), have stated that sex reversal is primarily dependent on physiological states, and these are subject to change and reversal through ecological factors.

The present writer discovered growing in a crop of wall-flower in East Scotland one plant which was of the abnormal carpellodic form and pollinated it with the normal hermaphrodite. (This hermaphrodite, self-pollinated, and the seed sown, produced only normals, so it may be regarded as being homozygous.)

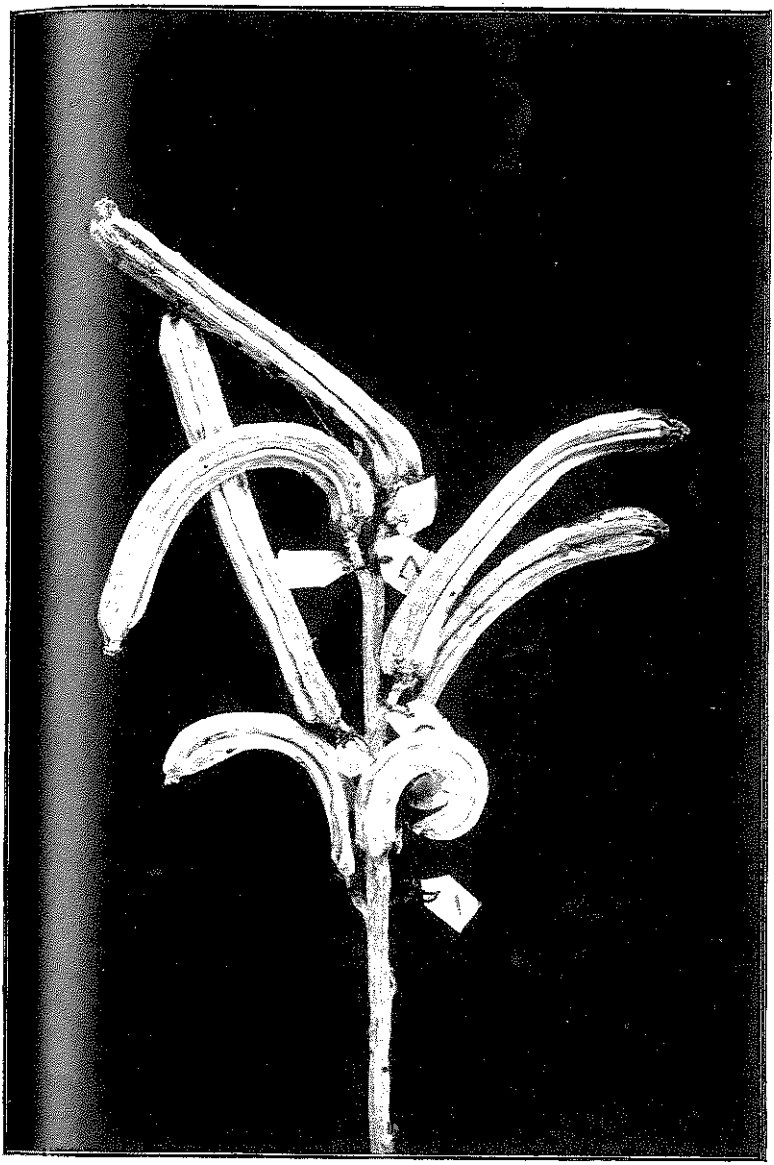
The seed from the abnormal (so pollinated) when saved produced an F1 generation, all normal. Close examina-



Carpellodic Wall-Flower in full bloom.



Cross section of flower showing stamen ring "ovary" around normal ovary.



Fruits, some showing developmental curvature due to selective pollination on the stamen ovaries.

tion of the flowers of this generation showed no trace of abnormality except that there seemed to be rather less pollen produced by the stamens. The F1 self-fertilised produced an F2 in which normals and abnormals occurred in the ratio of 3 : 1. The actual figures were 266 normal and 85 abnormal, which agrees very closely with expectation, though the figures are somewhat small. This F2 was grown partly in West Scotland and partly in S.E. England. Since then an F3 generation has been grown in Tasmania and the abnormal appeared as expected.

In this case it would seem clear that the sex reversal is not due to environment, but to a simple factor pair inherited on a simple Mendelian basis, the abnormal form being recessive.

To throw some light on the relationship of the various parts of the stamen ring the stigmatic area of various members was cut off and the remaining members pollinated. The pollen had its usual developmental effect on the ovarian tissue only on the portions which carried stigmatic tissue. Those portions originated from stamens whose stigma had been cut off did not develop. Development following on pollination was limited to the metamorphosed stamen significantly pollinated, and did not spread to unpollinated neighbours. Pollination of the true ovary had no effect on the "stamen ovary" and *vice versa*. The effect of differential development following on pollinating these different parts of the stamen ring caused bending and twisting of the composite fruit as is shown in Plate XX.

DESCRIPTION OF PLATES.

PLATE XVIII.

Carpellodic Wall-Flower in full bloom.

PLATE XIX.

Cross section of flower showing stamen ring "ovary" around normal ovary.

PLATE XX.

Fruits, some showing developmental curvature due to selective pollination on the stamen ovaries.

LITERATURE REFERRED TO.

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6. Weatherwax, 1925. Notes on Grasses II. *Proc. Indiana Acad.*, Sec. 34.