Peloria in Linaria and Other Plants.

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Peloria is a term derived from the Greek meaning monstrous. Applied to flowers, it is a kind of monstrosity or malformation. It is usually defined as "the phenomenon when usually irregular flowers, such as those with some of the petals or sepals spurred or saccate, develop all the parts of each set alike, thus becoming radially symmetrical." This condition was first observed and described by Linnaeus, "who found the spurred flowers of the Butter and Eggs or Toad flax (Linaria vulgaris) with five spurred petals instead of the normal one." To this condition he gave the name peloria.

Linaria is a genus belonging to the Figwort family (Scrophulariaceae). Peloric flowers of various species of this family have been reported from time to time in different countries. The species having such flowers are Linaria vulgaris Hill (4, 5, 6, 7, 8, 9, 10, 12),* Linaria dalmatica and other species of Linaria (6, 12), the snapdragon (Antirrhinum majus L.) (6, 12), and the foxglove (Digitalis purpurea L.) (4, 6, 12). Many other instances of peloric flowers of other families

Fig. 1. Linaria vulgaris Hill. Toad flax or Butter and Eggs. Normal plants to the left bearing normal flowers with one spur. Abnormal plants to the right bearing peloric flowers with five spurs.—Photograph by Mr. E. J. Kohl.

* The numbers in parenthesis refer to the same numbers opposite the references at the end of this paper.

"Linaria vulgaris Hill"

...Floral and Fruit Features of Normal and Peloric Plants...

Fig. 2. A typical Peloric flower.

A typical Normal flower. Fig. 3.

Fig. 4. Corolla lobes of a normal flower.

Fig. 5. Corolla lobes of a peloric flower which have remained 2-lipped.

Fig. 6. Normal flower with lower lip displaced showing the didynamous stamens.

Fig. 7. Basal portion of a peloric flower showing five stamens in two sets, two stamens being longer than the other three.

Fig 8. Capsule and seed of a normal plant.

Fig. 9. Capsule and seed of a peloric plant— the former much smaller than the capsule of a normal plant.

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Some additional Abnormalities of Floral parts.

Fig. 10.
PICEA EXCELSA L.
An abnormal cone developed from a terminal bud bearing microsporophylls with large sporangia and a middle zone of sterile scales shaped like megasporophylls.
– Heterogamy.

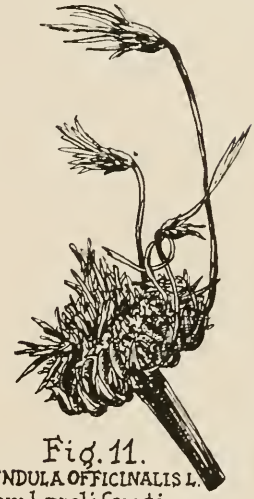

Fig. 11.
CALENDULA OFFICINALIS L.
Floral proliferation of the inflorescence.

Fig. 12.
DELPHINIUM BELLADONNA.
Phyllody of the calyx. A sepal in each case has reverted partially to the leaf condition in form and color.

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are on record, which indicates that pelorism as a mutation is frequent (6, 12). Fig. 1.

Prior to October, 1921, the author knew nothing of peloria, although he had seen and collected various kinds of monstrous flowers. At the time above noted the author's attention was directed by Dean Stanley Coulter to a peculiar modification of the flowers of Linaria found growing along a street in the city of Lafayette. These peculiar plants were discovered by Miss Hester Meigs, a student of Jefferson high school. The writer visited the place twice and collected both normal and abnormal plants. Whole plants of each kind were pressed and dried and flowering portions of each kind were preserved in formaldehyde. Seeds of the normal plants were very plentiful, but only a few seeds were obtained from the peloric plants. Transplants were also collected and these are now sending up new shoots. After having disposed of the material in satisfactory manner for safe-keeping, the subject was investigated.

The normal plants were identified as Linaria Linaria (L) Karst. of Britton and Brown (or Linaria vulgaris Hill of Gray) and here below the genus description it is stated that the corolla, especially the terminal one of the raceme, occasionally has five spurs and is regularly five-lobed, and is then said to be in the peloria state (7). In Gray's Manual it is noted that in abnormal specimens the corolla is sometimes regularly five-spurred (8). Several large dictionaries give short definitions for the term peloria, but most of the ordinary botany books and the Encyclopaedia Britannica do not contain the term and the condition is alluded to in only two (9, 10) of the general texts examined, one of which states that regular flowers become diversely irregular and irregular kinds perfectly regular (9). This book advises the examination of Masters' Vegetable Teratology. (An old English book, London, 1868, 534 interesting pages.)

The normal flowers of Linaria have an irregular corolla with one spur at the base. The corolla is two-lipped, the upper lip erect and two-lobed, covering the lower in the bud. The lower lip is three-lobed and spreading (Fig. 3). There are four stamens which are didynamous (in two pairs of unequal length) (Fig. 6). The seeds are numerous in numerous capsules (Figs. 1, 8).

From an examination of the plants with abnormal, that is, with peloric flowers, it was found that differences existed in different peloric flowers. The corolla in all flowers examined was regularly five-spurred, the spurs alternating with the calyx lobes. The corolla tube tapered gradually to the top, where it was rolled over and divided into five small lobes which were quite regular in most cases (Fig. 2). In some instances, however, the lobes were unequal, there being a tendency to develop into two lips, the upper lip being pronounced and of two lobes, the lower lip consisting of the usual small middle lobe and two much smaller lateral lobes (Fig. 5). In all cases these more or less slight variations of lobes were found on plants with many flowers, all being pelorized, having five spurs.

All of the peloric flowers examined had five stamens instead of the normal didynamous stamens (Fig. 7). In some of the flowers there

were three short stamens and two longer ones (Fig. 7), while in others all stamens were of practically the same length, i. e. regular. Balfour (Encyclopaedia Britannica IV, 1876) has stated that in some instances by pelorization it is found that tetradynamous plants become tetrandrous.

In the peloric plants collected only a very few seeds were produced. The capsules producing them were smaller than the normal capsules (Figs. 8, 9). In 1860 Darwin stated that "there is, I believe, only one case on record of a peloric flower being fertile" (1). DeVries in his experiments begun in 1886 hand pollinated peloric flowers of Linaria which produced considerable seed (6).

Before proceeding further the definition of peloria must be modified. It is a kind of abnormality (but not any kind) of the corolla. It may be slight or pronounced, complete or incomplete. It is usually understood to mean a change from irregularity to regularity—designated as a kind of reversion (as in Linaria), but it may also be just the reverse. In the latter case radial flowers become zygomorphic (4). Examples of this are seen in many Compositæ when corollas of the disk florets become strap-shaped, as in the cultivated asters, sunflowers, and chrysanthemums. In still another case the peloric condition arises from the failure of the development of regular normal parts. Normal columbine flowers have five spurs. Peloric columbine flowers with no spurs at all have been reported (4). It is also noted that the spur in Linaria species is sometimes obsolete (7). Peloria is connected with floral variation in general and it has been of specific interest in the problem of mutation (1, 6).

What is the cause of such floral malformation? The cause is not determined. Some believe that a change in relation to light is a prominent factor, especially one-sided illumination appearing favorable for the development of peloria (5). DeVries in his experiments on Linaria sought to observe the anomaly in his pedigree cultures. The experiments were begun in 1886 with normal plants. A few peloric flowers were produced, which is not uncommon in this genus. The next few generations produced nothing more than the normal number of peloric flowers. In the third generation, among many thousands of flowers, there occurred one having five spurs. This was inbred by hand and produced much seed. All other seed was discarded. The next generation contained about twenty plants having only one peloric flower among them. The peloric plant and one other were bred together, producing abundant seed. From this seed fifty plants were produced. Eleven of them bore the normal number of peloric flowers. One plant was found to bear peloric flowers only. This was, according to DeVries, a mutation, for it bred true in future generations (6).

It seems that many plants produce a few peloric flowers occasionally or more or less regularly, but that individuals which are wholly peloric are comparatively rare. In the observations of last October more than a dozen individuals were noted which were wholly peloric.

It is said that flowers far surpass all other organs in the abundance of abnormalities and monstrosities (9). Besides Linaria three other floral monstrosities have come to the author's notice. One of these is a case of phyllody of the calyx of Delphinium belladonna,

grown by Mr. E. J. Kohl. The monstrosity is a reversion. One sepal is prolonged and divided and is also partly green, i. e., leaf-like in two respects (Fig. 12). Another monstrosity is a variation in the head of Calendula grown in the writer's garden. Instead of the usual head, some flowers are changed into small heads set on long pedicels. This is a floral proliferation of the inflorescence (Fig. 11). A number of such abnormalities occurred on one plant. The third monstrosity is a peculiar modification of a spruce cone (Picea excelsa L.) in which a cone bearing microspores (pollen) developed from a terminal bud, the normal place for a normal megacone. No leaves were produced from the bud. The lower part of the cone consists of very small, loose scales with rather large microsporangia full of microspores. The middle zone is made up of sterile scales similar in form to megasporophylls. This is evidently a case of heterogamy. (Fig. 10.) (Collected by author on Purdue campus.)

Peloric forms have been of little significance in horticulture (4). Peloria and other abnormalities, however, are of biological interest in discovering certain natural laws. All kinds of organic abnormalities are worth investigation, as is clearly shown by many of our cultivated plants which, like the navel orange, Fultz wheat and other kinds of wheat, the copper beech, the Shirley poppy, and cupid sweet pea, all of which arose from sudden variations or mutations.

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