LEAF MARKINGS OF CERTAIN OHIO PLANTS.*

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Among the most familiar objects of our fields and gardens are such plants as the red and white clover with definite light-colored markings on the leaflets. Another equally prominent plant in gardens is the ribbon-grass (Phalaris arundinacea picta), whose leaves show variegated longitudinal bands of white and green color.

Sometime ago the writer began to collect data on the native and introduced plants of Ohio which show any definite type of markings. The problem is rather difficult since the markings usually disappear when plants are dried. It becomes necessary, therefore, to become acquainted with the plants in the living condition. During the past year a considerable number of species showing markings of various kinds have been observed, and the list could without doubt be considerably extended.

It has usually been customary to ascribe some purposeful effect or utility to the markings on the animal body and to the fantastic patterns shown by many flowers. It is open to question, however, whether such an assumption should be generally applied. The markings on the leaves of plants are favorable objects in this connection and may throw considerable light on the subject.

In many species, certain individuals have the markings while others lack them. There are probably elementary species present which might be segregated. These forms should make interesting material for the study of mutations and inheritance. In some species the markings are only on the younger leaves, in others only in connection with the inflorescence and thus on the latest leaves to be developed.

The markings of the leaves studied may be grouped under three general heads as follows:

1. Markings due to abnormal or diseased conditions, or the so-called variegations.
2. Markings more or less accidental, depending on some internal structure and evidently having no relation with the development of a definite pattern.
3. Markings which are of more or less definite patterns not dependent on fundimental structures.

Under the first group mentioned above would fall such forms as Phalaris arundinacea picta, already mentioned and the numerous vairegated species commonly cultivated in greenhouses. The white bands or spots being due to a lack of chlorophyll in the parts. White stripes are frequently to be observed in young plants of corn, Zea mays, and occasionally the entire plant is white. These latter individuals usually do not survive long.

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The leaf-markings distinguished in the second group, namely, those depending on some structural peculiarty, are perfectly normal and may also be present generally or only on some individuals. The leaves may be covered with minute spots or dots caused by internal glands as in Hypericum maculatum where the dots are often black or dark blue, and as in Boebera papposa where they are oval in shape and of an orange color. In most species the dots or punctations are, however, too small to be seen by the unaided human eye, although conspicuous under a lens. Nelumbo lutea has a peculiar light-colored marking in the center of the large peltate leaf that has some resemblance in outline to certain species of beetles. The marking is purely structural and accidental, yet were green beetles in the habit of frequenting these leaves it might be cited as a remarkable case of mimicry.

The most common markings of this general type are those which follow the venation of the leaf-blade, often forming reticulations. Examples of species with red veins and reticulations are Hieracium venosum, Viola hirsutula, and Rumex obtusifolius. Argemone mexicana is perhaps the most striking example among those with white markings over the veins. The leaves of Mitchella repens show a pale-green narrow stripe over the midrib and Euphorbia nutans has part of the midrib marked by a white streak. The leaves of Peramium pubescens has a beautiful white reticulation over a dark-green background, with occasional white blotches.

The most interesting examples of leaf workings, however, come in the third group designated above. In the first place, the leaf blade may be some permanent, uniform color other than green. Oxalis rufa is a plant of this character. The color in such cases may have a physiological use in protecting the chlorophyll.

Numerous leaves have a silvery mottled or blotched appearance of more or less definite pattern. Among such are the following: Hydrophyllum appendiculatum, H. macrophyllum, H. virginicum, Hepatica hepatica, H. acuta, and Chimaphila maculata. Smilax glauca has the same type of markings at least in the young condition. Cucurbita pepo and C. maxima have prominent angular silvery patches, covering the leaf blade, in the angles of the veins. In the Hydrophyllums, the main variegation usually extends on each side of the midrib and occurs in smaller spots beyond, especially at the notches of the serrations.

Other plants having mottled or blotched leaves are Erythronium americanum, E. albidum, Lamium album, L. maculatum, Trillium sessile and T. recurvatum. In Trillium sessile the markings are usually very prominent, while in T. recurvatum they are not always visible. Arisaema triphyllum has beautiful reddish-brown and whitish spots on the sheathing bracts, petioles and peduncles but the leave blades are green.

The plants of the greatest interest are those with definite, often symmetrical patterns, which can have no relation to the general structure. For here we come face to face with the difficult problem of symmetrical coloration in general. Oxalis grandis has beautiful leaves with an ornamental brown margin. Euphorbia marginata has milk-white bands on the leaves surrounding the flower clusters. In the second example the claim might be made that the striking color patterns around the flowers were developed through insect selection. In the first case such an explanation would, of course, be out of the question. In Euphorbia maculata and E. nutans, the leaf blades have an irregular oval dark-red spot in the center, the latter species having in addition the white streak over part of the midrib, as mentioned above. Some individuals of Euphorbia nutans do not show the red spot.

Trifolium pratense and T. repens have light-colored ornamental markings on the three leaflets which together make a very striking and symmetrical design. Oxalis violacea often has a similar marking on the leaflets but it is red or purple in color.

Polygonum lapathifolium has a faint, irregular, elongated spot in the middle of the leaf on the upper side while P. virginianum has somewhat similar dull, reddish spots in the center of the leaves. In Polygonum pennsylvanicum, the leaf has a dark-colored sagitate spot in the center, the point extending in the direction of the tip of the blade. In some individuals the leaves show no markings. The leaves of Polygonum persicaria have a very definite dark reddish or brownish oval spot in the center. Occasionally one finds individuals having in addition a distinct band of the same color running along each margin. The central spot may also be slightly sagitate in outline. Such leaves are among the most fantastic in design to be observed and well deserve careful study.

It seems out of the question to attempt to explain the origin and presence of ornamental and symmetrical patterns on leaves from the standpoint of utility. We are led to the position that there are both useful and useless structures developed in plants, the useless markings under consideration not representing degenerations. By no exercise of the imagination could one see in these designs and patterns any use to the possessor. They have probably come about through mutative changes and represent elementary species. The beautiful colors and patterns are of as much use to the plant as the beautiful colors and forms are to a rock crystal or to a snowflake.

Because of the numerous purposeful and useful structures and functions exhibited by organisms, biology was misled far into the camp of the utilitarians. But the philosophy of life has many sides and the recent discoveries in Mendelian inheritance, mutation and orthogenesis have revealed some of its complexity.