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Ecology of Insectivorous Plants

Beiträge zur Biologie der Insektivoren Pflanzen. by G. Schmid

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and rooting (radial, comose, and tufted), and the two kinds of strengthening (with and without packing material); other accessory characters are drawn from the foliage (leaf arrangement, form, and structure, fate of the old leaves). In discussing the factors which produce cushion-like growth, he points out that problems of this kind have as yet been but little worked at from the standpoint of experimental morphology, though various climatic and edaphic factors have been invoked by ecologists as explanations of the cushion habit, which is regarded as an adaptation against extreme temperature conditions of soil and air, the dryness of the habitat, the mechanical and desiccating action of wind, and strong insolation.

In the author's general sketch of the ecology of cushion plants, the following points are noted. (a) The capacity of absorbing and retaining large quantities of water, serving to regulate the temperature of the plant during alternate warming and cooling of the air, to keep the air in and around the plant relatively moist, to make the underlying soil moist and warm, and in some cases to supply water directly to the aerial organs by means of adventitious roots. (b) The crowding and overlapping of the leaves, serving as a protection against direct insolation, and producing wind-still and moist capillary interspaces between the branches, thus minimising loss by transpiration. (c) The compact growth of the branches in the cushion, which enhances the capillary arrangement due to (b), and serves to collect sand and other wind-borne debris as well as the dead leaves of the plant itself, besides being the main factor in producing the cushion habit itself with its obvious protective advantages. (d) The packing material, which enormously increases the water-holding capacity of the cushion, provides food in the form of humus, and enhances the rigidity and hardness of the cushion.

ECOLOGY OF INSECTIVOROUS PLANTS

Schmid, G. "Beiträge zur Biologie der insektivoren Pflanzen." *Flora*, **104**, 1912, pp. 335—383.

It has been somewhat generally believed that insectivorous plants utilise exclusively or mainly the nitrogen of their prey, as a compensation for the poverty of the substratum (in the case of *Drosera*, etc.) with regard to this element. However, Czapek, Stahl, Jost, and others have pointed out that this interpretation of the significance of the insectivorous habit is inadequate, and have suggested that other necessary elements are concerned. Jost indicated the need for further investigations regarding the biological position of insectivorous plants, though considering it as fairly well settled that their proper place is among what may be termed "nitrogenously heterotrophic" plants. "There can be no doubt that carnivorous plants are autotrophic so far as the acquisition of carbon is concerned; all of them have abundant chlorophyll and can thrive without receiving any proteid food. The favourable action of the latter cannot well depend on the gain in organically combined carbon; it is more probable that it originates from the nitrogen supplied or certain nutritive salts. It is possible that feeding with insects is beneficial simply because a *larger amount* of combined nitrogen and materials of the ash is introduced in this way into the plant than could be obtained from the *soil only*. It is even more probable, however, that the *quality* of the materials which are absorbed by the leaves is of significance; for instance, the obtaining of organically combined phosphorus or organic nitrogen may be the end specially aimed at" (*Lectures on Plant Physiology*, English ed., 1907, p. 186).

Schmid has made a fairly detailed study of the physiology and ecology of *Drosera* and some other insectivorous plants and, besides bringing together and discussing results obtained by other investigators, contributes some interesting observations regarding the chemical composition of these plants as well as of their substratum and the insects upon which they feed; the extent and structure of the root system; the histology of the leaves; the transpiration current; the occurrence and transport of carbohydrates in the plants under various conditions, etc.

The root system and the arrangements for transpiration generally in *Drosera* are not adapted to enable the plant to obtain a sufficient amount of mineral matter from the substratum on which it grows; the root system is scanty, though the rate of loss of water from the leaves is about the same as in a balsam (*Impatiens amphorata*) used for comparison. The leaves of all the insectivorous plants investigated show more or less primitive (reduced?) structure of the parenchyma,

without differentiation of palisade tissue. All these plants further show feeble assimilatory capacity, the starch which accumulates in the leaves being converted and transported with extreme slowness, though the digestion and absorption of insects hasten these processes in a pronounced manner, this result being attributed to the intake of mineral elements. Schmid finds that *Drosera* cannot digest starch, glycogen, fats or fatty acids, but he considers that no conclusions as to the usefulness or otherwise of different substances can be drawn from the chemotactic responses made by the tentacles. Under natural conditions only nitrogen-containing bodies act as stimuli, and they act by setting up digestive activity and by supplying the plant with—in addition to nitrogen—a relatively large amount of phosphorus and potassium. Hence the plant obtains in this manner two important elements which are lacking in the substratum.

REVEGETATION OF A DENUDED AREA

Conard, H. S. "Revegetation of a denuded area." *Bot. Gazette*, **55**, 1913, pp. 80—84, 2 figures.

A brief but interesting and suggestive account of the revegetation of a region near Cold Spring Harbour, Long Island, where extensive changes in the road-bed are in progress, a hillside having been excavated and the materials so obtained dumped downhill to make a wide level shelf. This digging was done in March and April 1911, and in July 1911 many plants were well developed on the apparently denuded area. The new flora of the shelf consists of 60 species of angiosperms and one fern (*Pteris aquilina*); 53 of these grow on the hillside above the shelf. Of the plants found both above and below, 39 are long-lived perennials, growing in the new ground from pieces of root, rhizome, or entire plants carried down from the hillside. Of those growing as seedlings, 6 species of the new ground were not found on the hillside, while on the hillside there are 25 species not yet represented on the new ground below; some interesting questions arise from consideration of both classes.

The author's main conclusions are that (1) an area denuded in winter or early spring receives few or no disseminules by any agency save that of man or domestic animals, since plants are not travelling at that season; (2) an apparently denuded area may contain viable fragments of a rather large flora; (3) if the disturbance occurs during the resting period of vegetation, new plants will arise from many fragments that would perish at any other season, since the resting plant contains stored food to enable it to start new growth, and most perennials put out a whole new system of absorptive roots as well as whole new foliage each year, the extent of the new root system being greater than is sometimes supposed.

SUPPRESSIVE PLANTS

Lindman, C. A. M. "Some cases of plants suppressed by other plants." *New Phytologist*, **12**, 1913, pp. 1—6, 1 plate, 1 text-figure.

In this interesting paper the author remarks upon the familiar fact that some plants of large size and dense growth injuriously affect the accompanying flora by preventing many species from attaining normal development and finally killing them—examples briefly described are *Urtica dioica*, *Pteris aquilina*, *Fagus sylvatica*, *Taxus baccata*. Details are given for two striking examples of herbaceous plants which suppress their neighbours by the shade of their leaves combined with direct contact and pressure (*Hypochoeris maculata*) or by means of strong growth and firm stiff leaves (*Juncus squarrosus*).

During the International Phytogeographical Excursion of 1911, the author's attention was attracted by the singular influence upon the surrounding vegetation exerted by *Juncus squarrosus*, which when growing abundantly (as on high plateaux and slopes in N. England and Scotland) covers the ground entirely, forming a pure "Juncetum squarrosi" or rough pasture in which each rosette is like a shallow cup with 20 to 40 green leaves besides the dead brownish leaves from the preceding year. In June and July there are still young soft leaves in the middle, standing up close to the inflorescence, but in August they are all spreading rigidly outwards at