

SPECIAL ARTICLES

DECIDUOUS ROOTLETS OF DESERT PLANTS

A STUDY of the roots of many perennials and of a few annuals growing under arid conditions in the Tucson region, shows that there are two sorts of rootlets which, to a degree, have similar functions, but which usually have an unlike fate. Whether analogous plants of the more moist regions have similar rootlets is unknown to the writer. A characterization of the rootlets in question can be made by describing those of a typical shrub, such as *Franseria deltoidea*, and by referring to analogous rootlets of some of the annuals.

In *Franseria* the tips of the main roots end in a brush of slender rootlets which bear root hairs. Most of these terminal rootlets are formed during the moist seasons, generally summer, and die during the following dry season, but some survive to extend the root-system. Such rootlets are found on the most deeply penetrating, as well as the most shallowly placed roots. But on the more superficial roots only there is, in addition, another type of rootlet. These are filamentous, 2 cm., more or less, in length, in groups of about one half dozen, which occur from 2 to 4 cm. apart. They arise from older roots only, and hence are adventitious. Since these rootlets are formed during the moister seasons each year, and die during the succeeding dry season, and never, or almost never, persist to form permanent roots, I have referred to them as deciduous.¹

The deciduous rootlets, as before suggested, are found on roots which are placed near the surface of the soil. From this fact, and from the known variation in water content of the superficial soil horizon, it is assumed that the deciduous rootlets are perhaps the first absorbing organs, after the beginning of the rainy season, to function. Also owing to the fact that the superficial soil layers are the first to become desiccated, it is assumed that the deciduous rootlets cease activities before the

other type referred to. It is probable, therefore, that the deciduous rootlets are of great importance in providing water absorption surface during the time of maximum, or optimum, water supply, and that the second type of rootlets in deeper soil, lingering longer, serve to provide the plant with water during a longer period, probably until the next season of precipitation.

Undoubtedly an important factor in the physiology of water absorption, and in the water relation, generally speaking, is that of the distance of water transport. Where the distance from the point of absorption to the place of evaporation is great it is probable that a given amount of water is less efficient in a longer than in a shorter transport. We have, in the formation of the deciduous rootlets, the interesting condition that the water absorption surface is enormously increased without at the same time increasing the distance of water transport. The importance of this in the physiology of the plant will appear at a glance.

Nearly all perennials which have been examined are provided with deciduous rootlets. It is not supposed, however, that these rootlets are essentially different from the other type, although they have a different origin, and although they appear to have a somewhat different function. From a few instances it has been seen that permanent roots may be derived from groups of rootlets which probably were indistinguishable from the deciduous rootlets, but which were so fortunately placed that survival was possible.

An analogous condition, but naturally differing in many ways, is to be found in the root-systems of several desert annuals. In such forms; in addition to the usual and, of course, ephemeral absorbing roots, there are at the base of many laterals rudimentary rootlets. These may remain rudimentary, never developing, or if the moisture conditions favor, they may develop. Where such rootlets are not found, it seems from certain experiments that they can not easily be induced. Probably the greatest advantage to an annual bearing rudimental rootlet is that

¹"The Root Habits of Desert Plants," W. A. Cannon, Carnegie Institution of Washington, Publication No. 131, 1911.

should there be a return of rains, following a rainy season, so soon after the rainy season that the annuals are still living, the rudimentary roots quickly develop, enabling the plant to complete its growth, or to renew it. The matter of distance of water transport in the annuals would hardly come into the problem.

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THE EFFECT OF NARCOTICS UPON THE DEVELOPMENT OF THE HEN'S EGG

ONE of the evident difficulties experienced in experimentation with the eggs of birds is that due to their large size, which makes it impossible to use the large numbers of eggs that may be handled in the case of fishes or amphibians. Also, while it is usually possible to obtain eggs at any season of the year, if one be willing to pay the price, the percentage of infertile eggs is usually so high except during the spring that the time for profitable experimentation is quite limited.

The experiments here described are of a purely preliminary nature. It is the purpose of the writer to continue the experiments until the number of eggs used will justify some general conclusions.

The reagents used were alcohol, ether, chloroform, chlorotone and magnesium chloride. One or two of these proved so almost universally fatal in their effects that they will probably not be employed in further experimentation.

Alcohol.—This reagent was employed as follows: the eggs were placed in the incubator and left for a number of hours (five to seventeen, in different experiments); they were then placed in a glass specimen jar having a glass cover, with raw cotton wet with from 1 to 5 c.c. of 95 per cent. alcohol; the jar was covered and replaced in the incubator, where it was left for from three to twelve hours, after which the eggs were removed from the atmosphere of alcohol, thoroughly aired and replaced in the incubator (which had also been aired) for about forty-eight hours before being opened. The glass jar was of about 1,200 c.c. capacity, and not more than eight

eggs were placed in it at once, so that there was a considerable volume of air for each egg. When the lid was removed, to take the eggs from the jar, there was always a strong smell of alcohol.

Of the eggs treated in this way only about 25 per cent. contained living embryos when opened. About half of the embryos obtained from these eggs were abnormal to a greater or less extent. The character of the abnormalities, will be described when further experiments have furnished more material.

Ether.—The experiments with ether were conducted in the same general manner as those with alcohol, except that, as a rule, only 1 or 2 c.c. of ether were used.

The effect of ether seemed to be much less severe than that of alcohol, only about 35 per cent. of the embryos being killed. Of the embryos removed from the eggs, less than half were abnormal.

Chloroform.—Chloroform was employed in the same manner as was ether, and, while fewer experiments were tried, not a single egg, opened after being submitted to this reagent, contained a living embryo, showing that it is much more toxic in effect, under these conditions, than either alcohol or ether.

Chlorotone.—This reagent was employed as a .1 per cent. solution in distilled water. In one experiment the eggs were kept in the incubator for ten hours before introducing the chlorotone; in the other experiments the chlorotone was introduced into the fresh egg. The method employed was to carefully remove about a square centimeter of shell from the side of the egg, and, with a clean glass tube, blow out about 5 to 10 c.c. of the albumen, without touching the yolk; the space thus made was filled with the reagent; the opening was then sealed with a piece of fresh shell, with strips of shell membrane stuck around the edge with some of the albumen that had been blown out of the egg. This is the method of closing an incubating egg used by Miss Peebles.

This treatment proved fatal to more than 90 per cent. of the embryos, but a few control experiments, where the eggs were opened and