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## ECOLOGICAL VARIETIES AS ILLUSTRATED BY SALIX INTERIOR.

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The recent advances in our knowledge of fluctuations, mutations and Mendelian phenomena of inheritance have given a new conception of the nature of a species and its subordinate groups. It is perfectly clear to any one who has studied Mendelian phenomena that no individual can contain all of the characters present in our ordinary species and that no description of a species based on a single individual is adequate. The description of a type individual is no doubt desirable to fix specific names, but it should be regarded as the description of the individual which may or may not give a fairly reliable picture of the species to which it belongs.

The fact of necessary fluctuation is firmly established and it is quite evident that no amount of selection of a fluctuating unit will advance or degrade the character involved. There are, however, fluctuations or adaptations related definitely to the environment which still present one of the important and fundamental problems of biology. The fluctuation induced by environment may be quantitative or qualitative. In mere quantitative fluctuation there may develop enormous differences between individuals of the same variety or species. For example, in the wild variety of the western *Helianthus annuus*, the mature plant may be 3 inches high with a single small head at the top or it may be 17 feet high with a multitude of branches and heads, with a corresponding thickness of stem. In various species of plants belonging to different orders, the individual may develop as a tall, strictly erect plant in one environment and in another may assume a perfectly prostrate, mat form.

The fluctuation I wish to call attention to is of a somewhat different character and involves morphological peculiarities of form and quality. The common sandbar willow, *Salix interior*, is typically a rather smooth plant with long linear lanceolate leaves. For several seasons I have had this plant under consideration at Cedar Point, Ohio, and last summer collected a series of forms ranging from the water's edge on the bay side to the driest sand dunes and blowouts on the lake side. There is a perfect gradation from nearly glabrous plants at the water's edge to very white-hairy individuals in the hot dry sand, and from the long linear-lanceolate leaves of the hydrophytic plants to the long oval-lanceolate leaves of the individuals growing in the extreme xerophytic conditions. The latter form has been called *Salix wheeleri*, being regarded by some as a species and by others as a variety. When one compares the two extremes, there is a most striking difference—a much greater difference than exists between a very larger number of recently manufactured species. Now why is there such a gradation from plants growing in one extreme to the other? The final answer cannot be given until breeding experiments are carried on. It might be mentioned that carpellate plants are more abundant in the wet soil while the dry sand plants are nearly all staminate. The observations in the field indicate that the individual responds in its growth to its environment. Either the same hereditary factors can respond so as to produce diverse structures or there are factors latent under one set of conditions and active in another. If a complex hereditary constitution is involved it should be possible to segregate at least part of the factors involved and thus establish distinct, pure varieties which would no longer be able to respond in such an extreme manner. But if, as is probable in this case, it is merely the response of factors to a greater or less degree to environmental causes, during growth, than no such segregation could be brought about. Whether the one or the other extreme could be established as a permanent, hereditary variety would depend on whether it is possible to produce hereditary responses of the same nature as are shown in the individual response during growth. This is an open question far from being settled at the present time. There is no objection in asserting the one or the other hypothesis. But so far we have no direct evidence that the individual response can influence the hereditary constitution thru which it acts. It is important, however, to recognize the reality of the diversity of individual response leading to individual adaptation to the environment. Some who have speculated along these lines have evidently not had a very thoro systematic and morphological knowledge of the plants in the field with which they were dealing.