I believe, therefore, that the right plan is to put back the meeting of the American Association to its old place near the close of the summer vacation, and to leave convocation week for the smaller, more homogeneous, and less popular associations of working scientists.

WILLIAM NORTH RICE.

NATURAL SELECTION IN KINETIC EVOLUTION.*

THAT there are species, varieties, mutations or hybrids which differ in one, two, or three characters, as commonly assumed in discussions of Mendel's laws, is a misleading assumption. To speak of a species as having developed in one direction or as having a single peculiar character may be permissible for taxonomic purposes, but in evolutionary studies it is careless to forget that the diversity is general, if not complete. The diversity of varieties and species is like that of individuals, but greater. Evolution, which is a continuous summary or integration of this individual diversity, is not a simple process, but highly multiplex; as much so, indeed, as the lines of descent in which the life of the species goes forward. A composite general direction is maintained by the species because the multitudinous strands of individual descent are bound together by interbreeding. The variations take place in particular threads, but evolution signifies rather the progressive change of the whole organic network.†

The evolution of a new type means changes in many directions and of many kinds, in the germ cells and in the various tissues and organs, as well as in the external form of the complex cell-colony which we are accustomed to look upon as a single individual. Each cell, tissue, organ and feature is undergoing evolution, and for normal and permanent progress these manifold developments must keep together. When single lines or slender strands of descent are separated from the main network the congruence of type is lost. The normal variation and individual diversity of the species having been eliminated, the evolutionary coordination of cells, organs and functions breaks down, and abrupt changes or aberrations of heredity appear. These degenerative mutations may not differ in their essential nature from normal variations, but the conditions of their appearance are abnormal, and the results often disastrous.*

A domestic variety may be 'improved' by the further increase of the one or two characters or qualities which render it valuable, but a new specific or generic type is the compound or resultant of many variations in many characters. By close selection which restricts evolutionary progress to a narrow line of descent a 'single character' may push out farther in a decade than the natural multiplex evolution would carry it in a century or a millennium, but such a specialization weakens and unbalances the organism, and is a process of degeneration rather than a constructive evolution. Selective inbreeding and other forms of isolation accentuate single characters, but the interbreeding of normally diverse individuals (symbasis) weaves new types out of the variations of many lines of descent.

The neglect of this distinction vitiates much evolutionary literature, both that which treats selection as an actuating 'force,' and that which rejects selection for 'discontinuous variation' or 'the mutation theory.'† It is

* Read before the Biological Society of Washington, March 19, 1904.

† *The Popular Science Monthly*, March, 1904, p. 451.

* Mutations, like hybrids, are sometimes completely sterile, and they may have at the same time an increased vegetative vigor. The vegetative vigor of many mutative varieties of domesticated plants has doubtless delayed the recognition of their abnormal evolutionary status, though the abnormality of infertile hybrids has long been appreciated. It is paradoxical, indeed, that the increased vigor which accompanies normal variations and crosses should also attend degenerative changes, but there is room for this apparent contradiction in so complex and many-sided a process as evolution.

† Very recent examples of the latter tendency are found in Professor Morgan's 'Evolution and Adaptation' and also in Dr. D. T. MacDougal's review of this work (*Torreya*, 3: 185, December, 1903). Professor Morgan refers (p. 368) with approval to an admission by Darwin that selection can not explain dimorphism in plants be-

true that many variations of inbred domesticated plants and animals are very abruptly discontinuous, and that such changes are not caused by selection,* but these facts in no way militate against others equally obvious, that the natural evolution of new types is a relatively slow and gradual process, and that selection may easily influence the direction of this continuous vital motion. The older selective hypothesis was only half erroneous. Selection does not set stationary organisms in motion, but it often guides spontaneous change. It does not explain evolution or vital motion in general, but it does explain adaptation, or motion in some particular direction, as when one species differs from its relatives in special characters which enable it to exist in a special environment. That all adaptations are mere coincidences is as improbable as that all characters represent useful adaptations.

Selection is not, as many 'Darwinians' have maintained, the true, efficient cause of evolution; the vital motion of species proceeds whether selection is operative or not. Species do not acquire characters from the environment, but merely in accordance with it. At any point in the evolutionary journey, selection may determine whether certain characters shall be acquired or not; it is an obstacle in the environmental road over which the species would travel, instead of being the source of power of the organic automobile. By preventing motion in one direction selection may be said, of course, to cause advance in another, but it is apparent that this causality is negative and passive, or a mere figure of speech. Selection may explain why a particular character is accentuated in a particular species, but it is no more a cause of the developmental progress of the species than the turns of the road are the motive power of the vehicle. Segregation enables species to attain differential characters, and selection assists their accommodation to environment, but both these possibilities rest on the more fundamental fact that organic evolution goes forward without external causation in groups of diverse, interbreeding individuals. If a species stood still selection could effect nothing except its partial extinction. In the recognition of a continuous and universal evolutionary motion the kinetic theory supplies the long-sought explanation of selective influence. By ceasing to look upon selection as a mysterious evolutionary cause we are able to ascribe to it a practical and easily comprehensible evolutionary function.

O. F. Cook.

Washington, D. C.,
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cause it can not be an advantage to a plant to be able to breed with only half of the members of its species. The same reasoning would apply, however, to all the phenomena of sexual separation, of which the dimorphism of bisexual plants may be an incipient stage. It seems obvious, too, that to breed successfully with half of the individuals of a species is an important advantage over the alternative of breeding less effectively with all of them. The partial or complete sterility of some dimorphic plants to the pollen of others of their own caste may be due to impotency rather than to adaptation, and a dimorphism by which this fatal result could be avoided would certainly be favored by selection.

* Except as selection implies inbreeding, by which mutations are induced.

NATURE STUDY.

To the Editor of Science: In the last two numbers of Science have appeared articles by Drs. Wheeler and Chapman on the abuses of nature writing as exemplified in the writings of Wm. J. Long. These articles have expressed the fear that such work may increase and that it may invade the secondary schools as supplementary reading designed to aid in the instruction in zoology. That this is no idle fear is brought very vividly before the science teacher in the normal schools, for he stands, as it were, an outpost between science and its teaching to immature students. Permit me to call your attention to a pseudo-scientific extravaganza put forth in a seeming serious mood which exemplifies this point. Before me is a book designed evidently for students of the first grades called 'The Tree Dwellers.' It bears the publishers' imprint of Rand, McNally and Co., 1903, and its author is Katherine E. Dopp, of the Extension Division of the Chicago University. The attempt of the book is to place before the stu-