SCIENCE

VOL. LXII NOVEMBER 13, 1925 No. 1611

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 8, 1879.

HODMEN OF SCIENCE

IT was not often that Huxley, careful of justice and equally so of the value of words, made a false step. But he certainly did so in the reference, in one of his addresses, in which he referred to "species-makers, the hodmen of science." This contemptuous phrase involved in itself certain falsehoods, mistakes in fact, or else failure in understanding. There are no "species-makers." There are describers of forms of life—and, as elsewhere in science, some of them are ignorant, amateurish or careless. Their work may be of no aid to science, and except for the necessary bookkeeping, they have no integral part in it. But poor work is not confined to taxonomy, and Huxley's words could be just as justly applied to workers in morphology.

It was a favorite phrase with Agassiz, "Strive to interpret what really exists." What really exists in the animal and plant world is a prodigious variety of definable forms, which have run the gauntlet of life and which have endured. These groups, called species, are varied within themselves and differ in highly varying degrees from other similar groups, the boundaries of species being well defined or ill defined, usually in proportion to the barriers that surround or separate them. That which concerns us as naturalists is the truth, whatever it may be, and the expression of the individual facts in tangible and recordable form.

In these matters, exactness of records is as vital as good maps are to geography, and in biology, as in geography, early work is inferior to late work, and inaccuracy is likely to intrude anywhere. In zoology and botany it is equally important to know the usual or normal form, and as far as may be, the variants or connectives which may spring from it.

Two very important branches of science are absolutely dependent on broad and accurate knowledge of species as they exist in nature, and these can not be separated far from each other. These are geographical distribution, on the one hand, and organic evolution, on the other. The relation of the first is evident; that of the other is not less vital. The major problem of organic evolution is summed up in the "Origin of Species." We assume, and must assume, that every feature of life, as we know it, has behind it some sufficient cause. The grouping and generalization of these multitudes of elements constitutes our answer to this problem of the "Origin of Species." All serious students agree as to the

cumulative evidence as to the *orderly change,* our knowledge of which as applied to animals and plants constitutes organic evolution.

But here agreement ends. Observers, experimenters and philosophers have each different points of view. Observers in the field, assuming the facts of heredity and variation, the former inherent in the chromosomes, the latter in large degree at least promoted by double parentage and unequal division of chromosomes in maturation of germ-cells, find natural selection a universal factor in life adaptations; moreover, that barrier-isolation with its consequent segregation and preservation from mass-breeding is an efficient cause of the moulding of species as they are. That species, as they exist in nature, are *real "species,"* not products of species-makers, whether "lumpers or splitters" (two slang names for incompetents) must be admitted.

That forms equally distinct to all appearance may be developed in a short time, in the breeding-pen or greenhouse, may be admitted. These are produced in the same way—by a chosen variation being placed under a new and non-competitive environment, the basis of selection being wholly changed, and the product carefully segregated. It does not compete with the mass, nor can it interbreed with it. These imitation species, or "creations," to use the florist's term, have not entered the gauntlet of life. They have not endured and mostly would not endure. In the open they would be swamped by mass breeding, by lack of prepotence—or in most cases by lack of competitive vitality.

It is probable that every species in nature is purged by natural selection and retained through segregation. Every one we know has, more or less clearly, a relation to geographic (or in rare cases to physiological) barriers. Most closely related species will interbreed (plants especially so) when opportunity favors. Yet hybrid individuals are relatively few, a few dozens recorded among birds and fishes, while not a single species known can be reasonably supported to have arisen from hybridism.

Most experiments on "species" have been made along the selection of unusual examples or with hybridization of existing species. It is natural that one who has not realized the cumulative evidence, which shows the relation of distinctness of species to geographic isolation ("räumliche Sonderung"), should, in contemplation of "mutation" and "Mendelism" as species-formers, be "agnostic" regarding the whole matter of causes of evolution. For hybridism or mutation are rarely or never the basis of a species in nature. The experiments of de Vries with a garden flower, presumably a hybrid, are not typical of the ways of "wild nature." Several writers, especially on botany, calmly ascribe the division of genera into species to "mutation." We have yet to hear of any single species which could be, with any probability, regarded as having arisen by "mutation" or by "Mendelian hybridism." The experimenters can not afford to ignore the students of "things as they are," and who "strive to interpret what really exists," the men whom Huxley termed "hodmen of science."

The conception of Darwin that the accumulation of favorable variations may of itself and without segregation produce new species within the territory of the parent stock is as yet unproved and seems improbable. We must note two general facts. First, the features which distinguish species or subspecies are not as a rule matters of survival importance. Selection will, as a rule, speedily eliminate injurious qualities. But one existing species is (under like stress) just as well adapted as another.

Second, closely related species never occur within the same limits (a few cases attributed to reinvasion excepted). Nor are they as a rule widely separated, being on different sides of some barrier, mountain, sea, desert or other feature, not wholly insurmountable but rarely crossed. This feature of "island life" and "mountain life" is well known to all actual students of geographical distribution.

The philosophers of evolution must depend on observers and experimenters. In one sense their conclusions are negligible, for these are temporary and variable. A theory or working hypothesis becomes a part of science when its rival hypotheses have ceased to work. Organic evolution by this means has become a part of science. The extension of our knowledge of the factors that lie behind it has now become, in a sense, more important than the theory itself.

As to these causal factors, it may be noted that the broader the view the less the accuracy in detail. The "hodmen of science" may console themselves with the words of Linnaeus, "The tyro makes classes, the master makes species"; or better with Darwin's warning that "no one should discuss species at all who has not minutely compared and described many of them."

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SOLAR VARIATION AND THE WEATHER

I AM strongly interested in the papers of Professors Marvin and Kimball which recently appeared in the *Monthly Weather Review* for July. Being about to