ARE ANY SPECIES UNIFORM?

Or Should the Assumption of "Pure" Species be Discarded and Diversity Recognized as the Normal Evolutionary Condition?

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AN ADDRESS by Professor Bradley Moore Davis on "Species, Pure and Impure," published in Science for February 3, 1922, presents the case of "impure" species very effectively, while the "pure" species are treated only by definitions that lead, as Professor Davis says, to "what is almost an abstraction." That so little should be said of the "pure" species appears the more significant if we consider that species are not merely definitions or abstract assumptions, but natural groups of organic individuals, affording the veritable subject-matter of the biological sciences.

Species are maintained by processes of sexual reproduction, with continual crossing of the individual lines of descent, so that each species forms a network of lines of descent. The question of uniformity bears upon the nature of the specific network. Are there reasons for assuming that members of the same species are uniform, identical or homozygous? Or should we think of the members of species as normally diverse, with multifarious germinal constitutions represented among the different individuals and lines of descent that are woven together?

THE NETWORK OF DESCENT

The network of descent is not to be dismissed as an abstraction or mere figure of speech. Though more difficult to describe or to define by arbitrary standards, the species as a whole is not less real than the individual "lines" of descent that are followed in genetic or genealogical studies. It is usual to deal with separately propagated lines in the study of inheritance of particular characters, or for agricultural purposes, but an individual line of descent does not constitute a species. We get only partial views of heredity and evolution if the coherent, reticular constitution of species, the normal condition of crossing and weaving together of the different individual lines of descent, is left out of account. Our understanding of species governs inevitably our interpretation of the nature and causes of evolution. To think clearly about evolution is essential to constructive investigation, as well as to the development of practical applications of biology.

There would seem to be no doubt of the existence of diverse, heterozygous, or "impure," species, as Professor Davis calls them. The doubt is whether there are any "pure," uniform, species, or any tangible reasons for maintaining the assumption of uniform species, if not supported by facts. Examples of identical germinal constitutions are found in twins and in plants propagated by cuttings or by self-fertilization, but these do not constitute species. Some investigators have believed in "pure lines" that would remain constant, but "mutations" continue to appear in self-fertilized or line-bred stocks. Even with vegetative propagation, definite differences arise through the "bud mutations" that are now known to occur in many plants. Mutation in parthenogenetic generations of aphids has also been announced recently.[1]

For purposes of description, species are supposed to be uniform, but taxonomic ideals of uniformity, however useful in the study of classification, should not be allowed to bring confusion into evolutionary ideas. The ob-

[1] Baker, A. C. *Journ. Washington Academy of Sciences*, 12:320.

jects and methods of taxonomy are entirely different from those of evolutionary and genetic study. Though taxonomists disregard individual diversities and seek for the most constant or general characters, the difficulty of finding definitely diagnostic differences is well known, and is a testimony that diversity is a normal and universal condition of species.

DIVERSITY UNIVERSALLY FOUND

Close and careful observation of any natural species shows not merely infinitesimal diversity, but appreciable heritable differences. The art of breeding improved varieties is based on the recognition of differences. Skill and practice may be necessary to detect differences readily in unfamiliar species, but persistent search is always rewarded. The diversity of the human species is our most familiar example. Other species appear more uniform because less familiar, but shepherds know their individual sheep, and garden experts see individual differences in plants. Many travellers have noted their first impression that native Africans, Malays, or Chinese, were all alike, and their later surprise in finding the same people as different individually as Europeans. The framing of definite race characters is as difficult as writing satisfactory diagnoses of species.

An ideal taxonomic character is one that is shared by all the members of a species, and is not shared by any other species. Such a character must have arisen in the species and become established through the whole network of descent. On the other hand, large numbers of hereditary differences exist as forms of diversity, without becoming standardized or established as uniform diagnostic characters of species, but continuing to appear as parallel variations in many related species, or even in distinct genera. Thus many species or genera may respond in the same way to natural selection as a standardizing agency, if any change of the environment gives a more definite survival value to a particular character or combination of characters already represented in the networks of descent. Cases of parallel development may be taken to prove that evolution is mechanically directed, but less confidence is placed in the theory of orthogenesis when account is taken of the frequency of parallel variations.

THE EXISTENCE OF UNIFORM SPECIES UNPROVED

To "prove" that no species is uniform, or "pure," is beyond the logical range, like other universal negatives. Though diversities have been found in thousands of species, there are thousands more that have not been inspected for diversity or bred artificially to see whether they are heterozygous or not. The custom of many writers is to treat differences as variations and assume environmental causes. Or genetic diversity may be recognized but confused with hybridism. Tendencies to vary may be admitted, but uniformity claimed as a result of natural selection. According to a recent paper by Professor Osborn, " . . . Nature is constantly standardizing her machines through individual competition and producing flocks of birds and shoals of fishes which are so precisely alike that animals of the same age, sex, environment and heredity *show no perceptible variation* . . . " Thus the pure species assumption is carefully preserved, notwithstanding the confusion that it brings into general evolutionary ideas. Selection would need to be effective in rejecting all forms of diversity, if it were to keep the members of species "precisely alike." But why should we invoke natural selection or any other agency to explain a condition of uniformity that probably does not exist, and certainly has not been demonstrated?

Evolution no doubt is controlled by natural selection, to the extent that the adaptive characters may be favored by restricting the non-adaptive, but the special Darwinian doctrine of natural selection as the cause and explanation

of evolution is largely discredited. Changes are not confined to useful characters. Many useless, non-adaptive differences are developed, and useful features are specialized beyond the point of utility. Even serious defects are transmitted in latent form, out of reach of natural selection, but adding to the complexity of descent. A tendency to spontaneous variation must be assumed, even in cases where characters are increased under artificial selection, as recognized by Castle.[2]

With a belief in normal uniformity accepted, it is logical to argue that changes in the characters of species must require external agencies of the environment or internal "mechanisms of heredity," and such external or internal "causes of evolution" continue to be sought by many investigators. A different conception of evolution, requiring no such assumptions of special causes or mechanisms, becomes possible when the diversity that seems everywhere to exist among the members of species is reckoned as a normal condition of heredity, and of evolutionary progress.[3]

THE EVOLUTION OF SPECIES

In order to think clearly and effectively about evolution we must form practical conceptions of the changes that go on in species, as representing the evolutionary process. Species do not differ as mutations or pure lines differ, but in more general and less definite ways, on account of individual diversity. Evolution is to be thought of not merely as change of individual characters, or of characters of individual lines of descent, but as change in characters of species, modifying eventually the whole network of descent so that the members of a species can be recognized as distinct from members of the nearest related species. When this stage has been reached, an evolution of "new" species has been accomplished, by a process as gradual and indefinite but no less real than the development of a "new" language.

As a new word does not make a new language, so new characters do not constitute new species, unless the characters are preserved and established in networks of descent. Many writers go astray in assuming that evolution is merely originating new characters, or is some special form of character-origination, so that many scientific works do not convey a clear conception of the evolutionary process. Professor Bateson recently has misled Mr. Bryan into supposing that evolution is discredited in the scientific world. The mistake has arisen because both are looking for something that probably never occurs, and should not be expected to occur, a sudden transformation of one species into another. Darwin carefully considered and definitely rejected the idea of species originating abruptly, and this judgment rests as more firmly established by the efforts that have been made to displace it.

It is not in the nature of species as networks of descent to originate by definite, sudden changes of characters, just as it is not in the nature of languages to be formed or changed suddenly. The Latin language was not abruptly discarded or displaced in Italy, Spain, or France, but local forms of Latin developed gradually, and eventually were recognized as distinct languages. Mule-bred languages have been elaborated and "new plant creations" have been produced and propagated artificially, but such devices are in contrast with normal development. Diversity in words and forms of expression is universal in languages, like diversity of characters in species, and the relation of diversity to progress, in furnishing the material of continued evolutionary change, is a further analogy.

[2] *Journal of the Washington Academy of Sciences*, 7:387, June 19, 1917.

[3] Evolution not the Origin of Species, *Popular Science Monthly*, March 1904; The Nature of Evolution, *Science*, N. S., Sept. 7, 1906; Methods and Causes of Evolution, *Bul. 136*, Bureau of Plant Industry, October 1908; Pure Strains as Artifacts of Breeding, *The American Naturalist*, April 1909.

A EUGENIC COROLLARY

The most powerful educative agents of the vegetative apparatus of a human being are the other human beings around him, and they comprise the most powerful of the external effectors of education, for better, for worse. The training and education of the endocrine-vegetative system is the basis of all social rules (Habit, Custom, Law, Conscience). An unresolved discord, a continued conflict among the parts of the vegetative system, in spite of such education, is the foundation of the unhappiness of the acute and chronic misfits and maladjusted, the neurotic and the psychotic.

(LOUIS BERMAN, M.D., *the Glands Regulating personality*, p. 194)

Children Need Fathers

Is there any success that can pay a father for not knowing his child? If no amount of success could repay the child for neglect on the part of the mother, how much can make up for neglect on the part of the father? I have been teaching young men and women of college age for ten years and I am convinced that the greatest need of American children to-day is greater care from their fathers, greater feeling of responsibility for the upbringing of the children on the part of the fathers. A child needs a father's guidance just as much as a mother's. It is not a question of a mother's shielding the father and watching over the children while the father—free to forget them—makes name and fame. No. The best in both the father and mother should go into the care of the children. Then let him who can, make a career for himself "with equal rights for all and special privileges for none."

LOUISE DUDLEY, *The Atlantic Monthly*, June, 1922.

The Development of the Child

THE PHYSICAL GROWTH OF CHILDREN FROM BIRTH TO MATURITY, by Bird T. Baldwin. University of Iowa Studies in Child Welfare, Vol. I, No. 1, pp. 411, pub. by the University, Iowa City, 1921.

Here, in concise form, is a mass of well-digested material which must serve as a work of reference for all who are interested in the question, "How does a child grow?" The original data cover thousands of children; a series of easily compared tables gives certain facts about more than five million others; while an annotated bibliography of 911 titles puts the reader in touch with other authorities. The concepts of anatomical age and physiological age are developed in an interesting way. Little material bearing directly on problems of heredity is presented, but it is announced that special studies, covering all the members of certain families, are being made which will illustrate the parent-offspring correlation. The fraternal correlation is dealt with in this volume particularly in the cases of twins.—P.P.