

respectively; J. E. Trevor, professor of thermodynamics. In the Medical College in New York City: O. H. Schultze, assistant professor of pathological anatomy; J. S. Ferguson, assistant professor of histology; W. J. Elser, assistant professor of bacteriology. S. H. Gage was made professor of histology and embryology, emeritus, and James Law professor of the principles and practice of veterinary medicine, emeritus. Professors Gage and Law retire this year, as has been already announced, according to the provisions of the Carnegie Foundation.

THE trustees of Princeton University have made the following appointments: Mr. Henry Jones Ford, of Baltimore, professor of politics, to succeed Professor Harry A. Garfield, who begins his administration as President of Williams College, his alma mater, next autumn; Henry Norris Russell '97 and Raymond Smith Dugan, assistant professors of astronomy; Gilbert Van Ingen, assistant professor of geology; John Gale Hun, Charles Ranald MacInnes and Carl Eben Stromquist, preceptors in mathematics; John Havron, Jr., instructor in civil engineering, and Frank Irwin, instructor in mathematics.

C. E. PORTER has been appointed professor of botany at the University of Santiago de Chile.

AT University College, London, Mr. H. Deans has been reappointed to lecture on railway engineering; Mr. A. T. Walmisley to lecture on waterways, docks and maritime engineering; and Mr. W. N. Blair to lecture on roads, street-paving and tramways, during the session 1908-09. Dr. C. Spearman has been reappointed reader in experimental psychology.

MR. RICHARD NOEL GERROD THOMAS has been appointed to a lectureship in physical chemistry at Balliol College, Oxford.

M. RAOUL BRICARD has been appointed professor of applied geometry in the Paris Observatoire des Arts et Métiers.

#### DISCUSSION AND CORRESPONDENCE

##### THE MENDELIAN INHERITANCE OF MUTATIONS

THE revival of Mendel's writings and the

extensive elaboration of the group of facts he discovered seem to have resulted in a corresponding neglect of the works of Darwin. A large amount of recent literature of Mendelism and mutation can be read without meeting any intimation that Darwin also studied and interpreted phenomena of the same kind. Darwin lacked, of course, the technical vocabulary of the modern Mendelian cult, but he made many observations and experiments, and collected a large series of pertinent facts from the records of earlier investigators. The conclusions he reached are very definite, and have not been refuted.

Darwin's fundamental discovery was that normal, constructive evolution is a gradual process. He did not fail to see that abrupt variations and Mendelian inheritance are not in accord with the idea of continuous changes in the characters of species, but he decided that such facts are not of primary importance in evolution. He understood that the characters of mutations are not necessarily new, and was aware that no complete inventory of the characters transmitted by a plant or animal can be made from the pedigrees of a few close-bred generations. He associated mutations with reversions and other monstrosities, and reckoned the Mendelian inheritance of mutations as a further evidence of abnormality.

When a character which has been lost in a breed reappears after a great number of generations, the most probable hypothesis is, not that one individual suddenly takes after an ancestor removed by some hundred generations, but that in each successive generation the character in question has been lying latent, and at last, under unknown favorable conditions, is developed.<sup>1</sup>

All the characters above enumerated, which are

<sup>1</sup> "Origin of Species," Chapter V. In the first edition (p. 160) the words of the sentence are somewhat different, but the same idea of persistent transmission and ultimate reappearance of ancestral characters is clearly conveyed: "... When a character which has been lost in a breed, reappears after a great number of generations, the most probable hypothesis is, not that the offspring suddenly takes after an ancestor some hundred generations distant, but that in

transmitted in a perfect state to some of the offspring and not to others—such as distinct colors, nakedness of skin, smoothness of leaves, absence of horns or tail, additional toes, pelorism, dwarfed structure, etc.—have all been known to appear suddenly in individual animals and plants. From this fact, and from the several slight, aggregated differences which distinguish domestic races and species from one another, not being liable to this peculiar form of transmission, we may conclude that it is in some way connected with the sudden appearance of the characters in question.

. . . Some few characters, however, are incapable of fusion, but these are unimportant, as they are often of a semi-monstrous nature and have appeared suddenly.<sup>2</sup>

Writers on Mendelism have charitably assumed that only the accidental oversight of Mendel's writings kept Darwin from appreciating the new "principles of heredity." But in reality Darwin was acquainted with a much larger range of Mendelian facts than Mendel himself. Even the Mendelian proportions in the representation of the parental characters were not unknown to Darwin. Thus he found that reciprocal crosses between symmetrical and unsymmetrical snapdragons yielded only the ordinary unsymmetrical types of flowers in the first generation, while in about one quarter of the next generation (37 plants out of 127) the symmetrical character returned to expression.

Whether Darwin supposed that such proportions would remain regular in particular cases, does not appear, but there is no reason to believe that more knowledge on this point would have altered his conclusions, for he had facts to show that a general diversity of proportions attends "this peculiar form of transmission."

The proportions in which the parental characters are shown in Mendelian hybrids are not more exact than in the inheritance of sexual characters. Sex-inheritance is each successive generation there has been a tendency to reproduce the character in question, which at last, under unknown favorable conditions, gains an ascendancy."

<sup>2</sup>"The Variation of Animals and Plants under Domestication," Chapters XV. and XIX.

tainly a form of alternative expression, for the secondary characters of one sex are known in many instances to have been transmitted through the opposite sex. Characteristics of one sex can even be brought to expression in the other sex, as a result of castration, parasitism and disease. In sex-inheritance the contrasted characters of the parents secure expression in equal numbers of the offspring. In typical Mendelian inheritance the proportions are three to one, but the percentages are variable and are connected by intermediate numbers.

Mendelism is not a general phenomenon in nature, nor is it confined to distinct groups of animals or plants, or to particular kinds of characters. The Mendelian proportions simply mark one condition or stage of adjustment of variable physiological functions whose results can be traced from ordinary graded and blended expressions of parental differences, through many degrees of alternative expression, until they reach the highly specialized form of inheritance shown in sexual characters.<sup>3</sup>

Transmission is distinct from expression, just as the imprinting of an invisible image on a photographic plate by the light is distinct from the subsequent development of a visible image by solutions of chemicals. With organisms, as with photographs, different methods and conditions of development can bring different results from the same beginnings. The differences arise from the relations that govern expression, instead of from differences in the characters or in the methods of transmission. Reversions, mutations, sexual and Mendelian differences, and even the so-called environmental variations, can all be understood as varied combinations and degrees of expression of characters equally and impartially transmitted.<sup>4</sup>

Alternation in the expression of characters is an elective alternation, a choice among the transmitted characters of those that are

<sup>3</sup>"Mendelism and Other Methods of Descent," *Proc. Washington Acad. Sci.*, 9: 189-240.

<sup>4</sup>"Transmission Inheritance Distinct from Expression Inheritance," *SCIENCE*, N. S., 25: 911, 1907.

brought into expression. The Mendelian hypothesis of alternative transmission involves the idea of exclusion, of the formation of germ-cells which are "pure," in the sense that the protoplasmic rudiments of some of the parental characters are supposed to be omitted from some of the germ-cells. For the existence of such incomplete germ-cells only arithmetical reasons have been advanced.

If Mendel could have read the works of Darwin the hypothesis of *alternative transmission* might have been spared. His facts could have been associated with the many other instances of *alternative expression* enumerated by Darwin. Mendelism, as a theory of *alternative transmission* of characters, is still as lacking in a biological basis as in the days of Darwin. The conception of *alternative expression* of characters accommodates the facts better than the Mendelian conception of alternative transmission.

To represent the theories of mutation and Mendelism as emendations of Darwinism necessitated by the discovery of new facts is misleading. In reality these doctrines are fundamentally opposed to the Darwinian conception of evolution by gradual change in the characters of species. Darwinians have often gone too far in claiming that natural selection is the cause of evolution, but the theory of mutation departs as far from the truth in the opposite direction, in ascribing evolution to sudden jumps from one species to another, without any relation to selection.

There is no reason to suppose that sudden individual variations in uniform varieties represent new characters, except as symptoms of degeneration. Uniform varieties are special products of artificial selection or of isolation in nature. A series of mutants arising from the same uniform stock shows a range of individual diversity corresponding to that of the members of a natural, broad-bred species, though the mutants differ from the members of a normal species in frequent evidences of degeneration. Thus the mutations of a narrow-bred variety can be understood as representing the return to expression of char-

acters transmitted from ancestors of much greater and more normal diversity.

O. F. COOK

WASHINGTON,  
April 24, 1908

#### BIOTYPES OF CORN

TO THE EDITOR OF SCIENCE: In my recent article, SCIENCE, June 5, I stated that Dr. Shull, in his investigations of the elementary species of corn, had been led to think that no biotype of corn had twelve rows, but that he had found those which tended to produce ten and fourteen rows. I further stated that Dr. East had been led, from his investigations, to believe that a type existed having twelve rows. This statement was made after having heard a fragmentary discussion between these gentlemen at the recent meeting of the American Breeders' Association.

Recent correspondence with both of these gentlemen shows that the point of discussion between them was as follows: Dr. East, in discussing Dr. Shull's paper, stated that he thinks there is a physiological reason for the ideal number of rows in corn biotypes to be in multiples of 4; and that therefore more biotypes will be found having 8, 12, 16, etc., rows than those having 10, 14, 18, etc., rows. Dr. Shull replied that in his work he had found no evidence that the multiples of 4 are more favored than the other multiples of 2.

W. J. SPILLMAN

U. S. DEPARTMENT OF AGRICULTURE

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#### QUOTATIONS

##### THE COLLEGE GRINDSTONE

THE recently published "Life and Letters of Sir Richard Jebb" must fill the occupants of academic chairs in America with envious despair. This picture of the life of a college professor in Great Britain is far different from that of the college professor in America. It is different, of course, from that of the average university teacher in England; for Jebb was a man of exceptional parts; he was able to do large amounts of various kinds of work—teaching, investigating, lecturing and