## Natural Selection

IN NATURE of November 21, Prof. E. W. MacBride states that "Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited". He bases this statement on the work of Johannsen on pure lines of beans, and of Agar and Jennings on clones of *Simocephalus* and *Paramecium*. He does not mention the fact that Johannsen[1] found clear evidence that such variations are inherited within a mixed population of beans.

Variations of human stature "can be graphically represented on a 'curve of error' ". So can those of human intelligence as measured by the intelligence quotient. Most geneticists are convinced by the work of Pearson and others that such variations are to a large extent inherited. If, as Prof. MacBride holds, they "are certainly not inherited" there can, of course, be no objections to the breeding of the feeble-minded.

If Prof. MacBride is unconvinced by the work of Pearson and Johannsen, I fear that it is futile to ask him to consider that of Gonsalez[2] and Timoféeff-Ressovsky[3], both of whom have described mutant forms of *Drosophila* which are more viable than the normal type in the environments studied by them. Others, however, may take the work of these authors more seriously.

Prof. MacBride goes on to state that "The common flowering plant *Calceolaria* is a native of Mexico and produces bright yellow flowers. As all are aware, gorgeously coloured varieties of this flower are cultivated". A distinguished botanical colleague informs me that 173 species of the genus *Calceolaria* are listed in the "Index Kewensis", of which the great majority are not found in Mexico. They include species with yellow, white and purple flowers. Most, if not all, of the garden varieties have arisen by hybridization. There is no record of mutation within the genus. Hence the fact that, when garden varieties escaped from cultivation in India, only yellow-flowered forms survived, is entirely irrelevant to the topic of mutation. It may be an example of the universally admitted fact that some species of a large genus are better adapted than others to a given environment.

I should be the first to admit that a strong case may be stated against the evolutionary efficacy of natural selection. But such a case must, if it is to be effective, be based on a full acquaintance with the facts.

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[1] "Elemente der exakten Erblichkeitslehre", p. 156 (1913).
[2] *Amer. Nat.*, **57**, 289 (1923).
[3] *Z. indukt. Abstamm. u. Vererb.*, **66**, 318 (1934).

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IN NATURE for November 21, there appears a letter from Prof. E. W. MacBride in which he attempts to demonstrate that natural selection is not an agent in the evolution of mimetic resemblances. It is perhaps open to question how far statements of personal opinion on evolutionary mechanisms are worth making or answering, unless they are sufficiently detailed to include an analysis of the evidence and reasoning upon which they are based. However, Prof. MacBride's letter contains certain definite errors and misconceptions relating to genetics, and these require correction lest they should gain credence among readers not versed in that subject.

In the first place, it is not correct to state that "Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited". Even on the most superficial consideration, probably few would agree that the offspring of short or of tall parents may expect to attain the same average stature : and human height in a reasonably homogeneous population is an excellent example of variation falling within a normal curve of error. The fallacy of such a contention can, however, be demonstrated conclusively, for a positive correlation is found to exist between the heights of parents and offspring. Furthermore, the substantial equality of the correlation between the heights of the progeny and of their male and female parents respectively, demonstrates that the inheritance here involved is bi-parental. Finally, the important fact that the $F_2$ is more variable than the $F_1$ generation in such a cross shows that we are dealing with particulate, that is Mendelian, inheritance ; not with a blending system. The human species cannot, of course, be used to establish this latter point. Reference may, however, be made to much work on such characters in other forms, as that of Castle (1922)[1] on weight, or ear-length, in rabbits.

It is remarkable that Prof. MacBride supports his contention, that "fluctuating variations" are not inherited, by reference to a series of experiments which prove the contrary with particular clearness. This is the work of Johannsen on "pure lines" in beans. Two components may, of course, control the variation of an organism : the hereditary material and the environment. That due to the former is said to be genotypic ; that due to the latter, phenotypic. By interbreeding for a number of generations, a "pure line" can be established, in which genotypic variation is practically eliminated. Selection for any characters within such a line is therefore unavailing, since almost all the variation is environmental. It is to this fact, presumably, that Prof. MacBride refers. He has, however, failed to inform his readers that Johannsen was able to establish *a number of distinct pure lines having different average seed weights* (the character which he investigated) : thus clearly establishing that the fluctuating variation concerned is under hereditary as well as environmental control in the species which he studied.

Several other points in Prof. MacBride's letter require comment. We now distinguish between the terms 'sports' and 'mutations'. A mutation is the inception of an heritable variation. A sport is any deviation from the normal. This may be due to mutation, or to other causes such as a rare recombination of factors. An overwhelming majority of mutations are disadvantageous : but this does not bar the very types which we study in genetic experiments from representing the kind of changes used in evolutionary progress. Indeed it is precisely what we should expect on this view. Even the more lowly organisms must in reality be rather delicately adjusted. Any random change in their control will consequently very rarely result in harmonious working. Occasionally, however, we may expect it to do so, and this is what we find : as the chromosome doubling which gives fertility to a sterile hybrid (Haldane, 1932)[2], or the single dominant in the moth *Gonodontis bidentata* Cl., which produces a melanic form hardier, and capable of emerging at a lower temperature, than the typical insect (Bowater, 1914)[3].

Mutations may be induced by heat and X-rays, from which Prof. MacBride deduces that they are