WHAT IS HEREDITY?

THE discussion in SCIENCE[1] precipitated by the statement of Professor Dice, that "the characters of man that are inherited include not only his anatomical features, but also his physiology and his psychology," has served to emphasize the need of clarification of the concept of heredity. Expressions like "inherited skin color" or "inherited behavior" are figures of speech which are misleading if taken literally. The relations between heredity and characters or traits of the developing organism are dynamic. Heredity does not transmit skin colors or behaviors; it determines the responses, the norm of reaction, of the organism to its environment. The same heredity in different environments may give rise to different skin colors and behaviors. Diabetes mellitus is inherited, but injections of insulin remove the manifestations of this physiological disorder. Insulin obviously does not "cure" or alter the defective heredity; but this heredity responds to an environment which contains insulin by normal carbohydrate metabolism. Now, it is not too much to suppose that a diabetic will in some cases behave differently from a non-diabetic. The former is likely to adhere to a certain regimen which might, for example, limit his social activities. He may be reluctant to embark on a journey in parts where he is not sure to find a supply of insulin. His whole personality may acquire a special cast which in the last analysis is due to the possession of genes for diabetes. A Negro, or for that matter anybody having a highly pigmented skin, may be diffident or aggressive in a social environment in which his pigmentation subjects him to discrimination and handicaps. This "psychology" may correctly be called inherited, just as the skin color is called inherited, although in some people the skin color is greatly changed by exposure to sunlight. Heredity which causes the skin to be black and behavior self-conscious may result in a quite different behavior in an environment where discrimination is absent.

Non-geneticists may feel disinclined to regard as hereditary a trait so plastic that it appears in some environments but not in others. Yet, all degrees of environmental plasticity occur. For example, the A–a^B–a blood group genes produce the same "character" in all known environments. The outward manifestation of the genes for eye color slightly changes with age. The environmental dependence of stature, weight and skin color is obvious. Behavior is influenced so much by environmental variables, particularly training, social conditions and accumulated experience, that the genetic variable is frequently masked. The designation "hereditary" can not be restricted to traits which show a certain degree of constancy of expression. The degree of constancy is itself inconstant; introduction of insulin treatments made the expression of the genes for diabetes much more labile than it was. It may seem trite to remind that genes influence the development through chains of physiological reactions. The possibilities of controlling the gene manifestation will be greatly increased when these reactions become known. Theoretically, the action of any gene may be controlled. To say that man's psychology is inherited does not, by any stretch of imagination, mean that it is fixed and unalterable. We can not change our heredity directly, but heredity is not implacable destiny to which one must submit in resignation. We should seek for ourselves, and contrive for others, environments in which our heredities respond most favorably. If the genotypes of all men responded to every given environment by producing the same "psychology," we could say that psychic characters are not inherited. This, I take it, is not contended even by most confirmed environmentalists. On the other hand, the assertion that psychic characters are inherited does not preclude the possibility that we can, by proper manipulation of the environment, eventually achieve a complete control over them. Existence of inherited "race psychology" is a wholly separate problem. Races are defined as populations differing from each other in the incidence of certain genes. Physical characters suggest that there are all degrees of racial subdivision, beginning with social isolates, local populations and up to the major races the reality of which is not impaired by intermediate or doubtful groups. Theoretically, it is possible that, although genetic variation in psychic characters exists from individual to individual, the incidence of all the variants in the several races is alike. Secondly, it is possible that races differ in the incidence of some of these variants but that the differences are purely quantitative. Finally, it is possible that the differences are qualitative, and all individuals of one race possess certain genes which are always lacking in the other race, and *vice versa*. Not being a specialist, the writer can only say that a second-hand familiarity with the available evidence suggests that the evidence is quite insufficient and that the problem is best left open. But whatever its solution will prove to be, the environmental plasticity of psychic characters is so great that average differences between races will certainly be smaller than the amplitude of the intra-racial differences.

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[1] SCIENCE, 99: 457–461, 1944; *ibid.*, 100: 50–51; *ibid.*, 100: 146–147; *ibid.*, 100: 246–247.