

a difference which has arisen at some time through a variation? We can determine characters only by comparing related organisms and noting their differences. To say that all characters are alike, then, is to say that all variations are alike, which Sir Archdall Reid himself admits is not the case.

Perhaps an experimental instance will make this clearer. Some years ago a fasciated specimen of an *Oenothera* was sent to me. The plant was in seed; the stem was about 2 in. wide at the widest part and as flat as a ribbon. It was, of course, impossible to say with certainty, from inspection, whether this character would be inherited or not, although the probabilities were somewhat against it. I sowed the seeds, large numbers of them, and they all gave rise to perfectly normal plants with round stems. The character was therefore non-inherited in this particular case. It is, of course, well known that fasciations may be produced by excessive nutrition, and that the peculiarity is then, as a rule at least, not inherited.

But there are other instances in which this character is inherited. For example, in the common cockscomb of gardens, *Celosia cristata*, fasciation is one of the specific characters, distinguishing it from such species as *Celosia plumosa*, in which the stems do not fasciate under ordinary conditions of cultivation. I have often grown these two species in quantity side by side in the greenhouse, and compared the extreme fasciation of *C. cristata* with the ordinary branched character of the other species. It should be mentioned, however, that *C. plumosa* does sometimes show slight fasciation at the tips of the branches, and this can be exaggerated by growing the plants under conditions of very high temperature and moisture. But it never approaches the degree of fasciation found constantly as a specific (and therefore inherited) character in *C. cristata*.

The same character, fasciation, is therefore clearly inherited in *C. cristata*, but it was not inherited in the particular instance in *Oenothera* which I tested. It is also clear that the fasciated *Celosia* must have originated at some time as a variation from plants with normal stems. Innumerable similar instances will be known to experimental biologists, and it is such cases which they have in mind when they speak of characters as of two kinds, inherited and non-inherited. When a particular new character appears as the result of a variation no one can predict with certainty whether it will be inherited or not until the organism which shows it is tested. But, of course, probabilities may be stated by comparison with similar characters the hereditary behaviour of which is already known. In the face of such experimental facts, which are well known to all geneticists, it is futile to state that all characters are equally acquired and equally inherited.

When Sir Archdall Reid implies that combs and corns are equally inherited he forgets a whole class of experimental facts such as those above cited. One must refuse to consider corns as inherited, because there always remains the possibility that a case may arise where, through a germinal change, they are inherited without any special stimulus to produce them. The inherited condition known as keratosis is, indeed, an epidermal thickening of similar character. It seems clear that moles are not usually inherited, but if the writer in *NATURE* is correct (see *NATURE*, January 19, p. 78), then there may be instances in which even a mole is inherited in the legitimate sense in which the term "inheritance" is customarily used by biologists.

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SIR ARCHDALL REID'S letter in *NATURE* of January 26 will render considerable service if it induces students of evolutionary phenomena accurately and precisely to define their terms.

If one may, at the beginning, set forth two general statements, the ground will be cleared for a discussion of Sir Archdall Reid's points:—

(1) Genes or factors are inherited, characters are not.

(2) A gene conditions the appearance in the organism of a character or group of characters.

(3) The effect produced by a gene in the organism depends on the environmental conditions which prevail during the life-history of the organism and on the other genes which the organism possesses.

To show that characters are not inherited, the example of "abnormal abdomen" in *Drosophila* may be cited.

The gene for "abnormal abdomen" causes the condition in moist cultures only. In dry cultures the flies hatch out normal in appearance.

The statement that rose comb and single comb are not more inheritable than corns on oarsmen's hands is obviously correct. Any capacity for reacting to a stimulus may be considered as being represented in the chromosomes by a gene or genes. In this case we may assume that the capacity for responding to the frictional stimulus of the oar by forming a mass of proliferated tissue on the palms of the hands is inherited.

Certain other points raised by Sir Archdall Reid may be dealt with briefly:

(1) The impure dominant does not inherit any trait. It inherits the recessive gene from one parent which may or may not interact with environment and with other genes to produce an effect. The terms "dominant" and "recessive" are purely arbitrary, and used only for convenience.

(2) The pure extracted recessive inherits a recessive gene from one parent and a similar recessive gene from the other. The germ-cells of an impure dominant carry either the dominant or the recessive gene.

(3) The ancestral condition obtained in some pigeon crosses is due to the interaction of the two sets of genes contributed by the two parents.

The interaction of genes may be illustrated by an example from the cow-pea. A red cow-pea crossed with a white may give a black in the first hybrid generation. White possesses a gene for black which is without effect except in the presence of the gene for red present in the red parent. At least eight different genes in the cow-pea are known to depend for their expression on a single colour-conditioning gene.

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[Sir Archdall Reid began this correspondence with a letter in *NATURE* of November 25, 1920; and we have now invited him to close it.—EDITOR.]

The Radiant Spectrum.

DR. HARTRIDGE'S objections to my explanation of this phenomenon (*NATURE*, September 1, p. 12, and December 8, 1921, p. 467) seem to be based on an imperfect appreciation of Brewster's observations on the subject. Brewster brings out two facts clearly in his paper: First, when a very small and intense source of white light is viewed directly by the eye it appears surrounded by a system of radiating streamers which appear to diverge directly from it; secondly, when a prism of small dispersive power is interposed in front of the eye the streamers are deviated and now appear to diverge from a point lying beyond the violet end of the spectrum into