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HEREDITY AND ITS VARIABILITY

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THE ESSENCE OF HEREDITY

In all textbooks and manuals on genetics heredity is usually taken to mean only the reproduction by living organisms of beings similar to themselves. Such a definition, in my opinion, contributes little to an understanding of the phenomenon of heredity. From time immemorial people have known that from wheat seeds you get wheat, from millet, millet, etc. This makes it possible for practical farming to propagate a particular species or variety of plant, or animal breed. No deeper conception of the phenomenon of heredity can be derived from the above definition.

Exponents of modern genetics (the science which studies the phenomena of heredity), who take as their premise the definition that heredity is only the reproduction of likes by organisms, have been studying heredity by ways and means which do not permit the investigator to find out anything about the essence of the heredity of any particular living body. What they study is not the

phenomenon of heredity but the ultimate differences between organisms that differ in heredity.

The method employed in genetics to study heredity is to take two breeds, two organisms known to differ in heredity and to blend them by cross-breeding. There are those who want to find out things about the heredity of organisms they are investigating or the heredity of their characters from the diversity of the progeny obtained. All one can find out in this way is how many offspring resemble the one parent or the other. But one cannot determine, from the data furnished by such experiments, what the essence of the heredity of either parent consists in.

Our definition of the phenomenon of heredity differs from that which has hitherto been accepted in genetics. By heredity we mean *the property of a living body to require definite conditions for its life and development and to respond in a definite way to various conditions.* By heredity we mean the nature of the living body. We are therefore of the opinion that "the nature of the living body" and "the heredity of the living body" are about the same thing. For example, why do wheat plants differ from rice plants? Because these plants differ in their natures. Similarly it may be said that wheat differs from rice because wheat has a different heredity from that of rice. To study the heredity of an organism means to study its nature.

The nature of a living body differs in principle from the nature of a nonliving body. The more a nonliving body is isolated from the action of or interaction with environmental conditions, the longer it will remain what it is. A living body, on the other hand, absolutely requires definite environmental conditions in order to be alive. If a living body is isolated from the external conditions it requires, it ceases to be alive, ceases to be what it is. Precisely herein lies the difference in principle between a living and nonliving body.

Different living bodies require different environmental conditions. We therefore know that they differ in nature, in heredity. Knowledge of the conditions required by a living body and of its responses to the operation of various conditions means knowledge of heredity properties of that body. Consequently, *to ascertain the environmental conditions required by a living body (organism) for the development of particular characters or properties is tantamount to studying the nature, i.e., the heredity of these particular characters or properties.*

A study of the heredity (nature) of a given living body does not require the crossing of that plant or animal with one possessing another heredity. The real purpose of studying heredity is to determine the relation of an organism of a given nature to its environmental conditions. But after

crossing, the offspring obtained do not possess the nature that it is desired to study. When studying heredity various crosses are needed only when one wants to determine the potency, or stability, of one heredity in comparison with another or others.

A knowledge of the natural requirements and relation of an organism to environmental conditions makes it possible to govern the life and development of this organism. More. Such knowledge may serve as the basis for changing the heredity of organisms in a definite direction.

To take heredity to mean—as has been done hitherto in genetics—only the reproduction of likes, without going into a study of the ways and the material (conditions) from which the body reproduces itself, is tantamount to barring one's own way to mastering this important and interesting phenomenon of living nature.

It has been pointed out above that according to the line formerly followed in genetics, in order to study the heredity of a given character one must take a plant possessing this character and another plant absolutely different in nature, in heredity, from the given character. After crossing them the offspring of these two parents are examined to determine how many descendant plants have the character peculiar to the one parent and how many have the character observed

in the other. Such a study, however, will not show in what the heredity of either of the parents taken for the investigation consists.

The difference between our approach to the study of heredity and the methods of the Mendelist-Morganist geneticists can be illustrated by the following example. The property of winter or spring habit is doubtlessly inheritable. In their repeated studies of the heredity of these properties the geneticists took plants of the winter variety and crossed them with plants of the spring variety. They then determined in the offspring how many winter plants, i.e., plants similar, as regards this character, to the one parent, were obtained, and how many spring plants, i.e., plants similar to the other parent. In some experiments they arrived at the conclusion that the hereditary properties of the winter habit differ from the hereditary properties of the spring habit by 1, 2, 3, etc., genes, granules of some unknown substance of the living body presumably contained in the chromosomes of cells of the winter or spring plants. However, what the essence itself, i.e., the nature of the winter or spring property of cereals, consists in, how to control the development of these properties, does not appear at all from the above study. But if the heredity of an organism or of separate properties or characters of it is characterized by the environmental conditions

required for the development of these properties and characters, there is revealed to us the essential nature of the given properties or characters.

Thus, on studying the causes of the failure of winter cereals to ear when sown in spring we ascertained that one of the processes of development of winter plants now called the stage of vernalization requires, in addition to the food, moisture and air existing in the fields in spring, a relatively lengthy period of time of low temperature, 0-10°C. above zero. The absence of a lengthy period of low temperature in the fields in spring is the very reason why the process of vernalization fails to take place, and hence why all further development is retarded, why there is no earing and fruiting.

With the discovery of the nature of the vernalization stage it has become possible to compel any winter grain sown in spring to ear and bear fruit. For that purpose properly moistened seeds are kept in the field before sowing for a definite time under relatively low temperatures (vernalization). Thus the inherited requirements for transition (development) through the indicated process are satisfied. After its completion at the growing point of the young plant or in the embryo of the seed all further inherited requirements are satisfied by the existing field conditions when such seeds are sown in the field in spring and de-

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velopment continues normally until it is completed, i.e., until the plants ripen. This is the kind of study we engage in to determine the essence of the heredity of the winter habit.

Upon studying a considerable assortment it appeared that some varieties of bread grains possess greater winter habit, i.e., require a longer period of low temperatures, while others possess less winter habit, require a shorter period of low temperatures. Varieties that, according to their nature, can undergo the process of vernalization under the usual spring and summer conditions are called spring varieties in practical farming.

We, on studying heredity, ascertain the conditions of life, the conditions of development, required by the organism or by separate processes, and also the relation of the organism or separate processes of it to various environmental conditions. We thus arrive at a comprehension of the essence of heredity. The geneticists, on the other hand, do not study the essence of heredity. All they find out is how many offspring resemble the one parent with regard to a particular character and how many the other.

It is well known that a living body builds itself from the conditions of its environment, from its food in the broad sense of the word. It is likewise well known that the embryos of different

breeds, for instance, of particular varieties of plants living in the same environment, build their bodies differently; hence different organisms are obtained.

Each organism develops, builds its body, according to its nature, its heredity. For example, you can feed a calf and a lamb the same hay. But while they assimilate the same hay, the lamb, following its nature, will develop and grow into a sheep and the calf into a cow. Everybody knows that not only do sheep and cows differ sharply as organisms but also that the quality and properties of mutton and beef differ in many respects, though both types of flesh are derived from the same fodder, in the case stated, from the same hay.

Such examples go to prove that every living body builds itself from the environmental conditions in its own fashion and in accordance with its own nature, its own heredity.

One can also readily notice—and people knew this long ago—that as a rule each generation of plants or animals develops in many respects like its ancestors, especially its nearest ones. This accounts for the definition accepted by genetics that heredity is the property of reproducing beings similar to oneself. *But reproduction of likes is a characteristic trait common to all living bodies.* Hence the mere statement of the

above-mentioned common property of living bodies, a property long known to all, cannot characterize to any extent the concrete heredity of a given living body. A study of concrete heredity requires that one follow the course of development of the organism possessing the given heredity, and determine the conditions necessary for its development as well as the reaction of the organism to the influence of its environment.

It is not only the organism as a whole that can reproduce bodies similar to itself. Every cell of the organism, every granule of a living body can reproduce its likes. For example, a cell of a young stem will reproduce stem cells, a cell of a leaf will reproduce leaf cells, a cell of a rootlet will reproduce rootlet cells. Every organism grows by its various cells reproducing cells similar to themselves.

THE ESSENCE OF VARIABILITY. GROWTH AND DEVELOPMENT

While it is known that an organism and also its individual cells and the various particles of them reproduce bodies similar to themselves, one must not forget another aspect of this property of the living body, namely, that the organism as a whole as well as the separate parts of its

body reproduce, in some measure or other, bodies dissimilar to themselves. For instance, an egg or a zygote, after a definite interval of time and under suitable conditions, reproduces many thousands and even millions of cells wholly dissimilar to the first, original cell, i.e., the zygote from which they sprang. The case of a bit of begonia leaf developing into a full-grown plant may also be instanced. Here begonia leaf cells reproduce root and stem cells, i.e., cells unlike those from which they originate.

Consequently, although it is characteristic of the nature of a living body to reproduce bodies similar to itself, yet simultaneously cells and specific particles that enter into their contents are capable, in some measure or degree, of reproducing also bodies dissimilar to themselves.

The ability of the separate cells of an organism to reproduce not only likes but also unlikes has never been questioned in science. What has been disputed, and for centuries at that, was the fact that an organism as such can reproduce organisms not only similar to itself but also differing from itself. The point involved is the variability or invariability of the nature of living beings.

When Darwinism made its appearance short shrift was given to the unchangeability of living

nature. Today no scientist of reputation anywhere on earth will assert that living nature does not change. The variability of living nature and the possibility that it may change are admitted. But up to now the causes of changes in the nature of organisms and the concrete ways in which these changes take place are not sufficiently known to science to make it possible to alter the heredity of an organism at will in any definite direction. Therefore modern genetics, while abstractly recognizing that living nature is variable, in practice conducts its investigations, makes its deductions and draws its conclusions on the assumption that the heredity of an organism cannot be changed by the conditions of its life. Such a science therefore maintains that it is impossible for the conditions of life to influence the variability of the nature of plants and animals in a desired direction.

Our Soviet science, the Michurin trend in science, gives a clear understanding of the way to change the nature of an organism.

Our conception of the phenomena of heredity, the changes in these phenomena and the regulation of heredity is based on the following premise:

Every living body builds itself out of nonliving material, in other words, out of food, out of the environmental conditions. The organism picks

from the environment the conditions it needs; but this choosing of conditions is dependent upon the heredity of the given organism. Whenever an organism finds in its environment the conditions which it needs and which are suitable to its nature, its development proceeds in the same way as it proceeded in previous generations of the same breed (of the same heredity). When, however, organisms do not find the conditions they require and are forced to assimilate environmental conditions which, in one degree or another, do not accord with their nature, organisms or parts of their bodies result which are more or less different from the preceding generation.

If the altered part of the body is the starting point for a new generation, the latter will differ from the preceding generations in its requirements and nature. From the biological point of view we can find out the difference between these generations. It will consist of a difference in the requirement of environmental conditions. The particular conditions were unsuitable for the preceding generation and the body assimilated them of necessity, perforce, as it were. But if it imbibed them, assimilated them, a body with new properties, with a new nature, was obtained. These conditions will now be requisite for it. Thus *the cause of change in the nature of a living body is*

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