

scheinlich durch die Entstehung des Flusses erklären lassen, weswegen wir an dieser Stelle einiges über ihn berichten wollen.

Der Tosna-Fluss mündet als linker Nebenfluss der Newa, 30 km vom Ursprung derselben, in sie ein und entspringt dem Sumpfe Glazvrik im nordwestlichen Teile des Gouvernements Novgorod. Im oberen Laufe fließt er durch Sümpfe und Wälder und hat flache Ufer. Seine Gesamtlänge ist 117 km, seine Breite wechselt von 6 bis 80 m bei einer Tiefe von 0,60 bis 3 m; flößbar ist eine Strecke von 106 km und die letzten 9 km sind der Schifffahrt zugänglich. Zuerst ist das Flussbett schlammig, dann aber wird der Grund sandig und steinig; das Wasser selbst enthält viel pflanzlichen Detritus. Die Planktonprobe wurde $1\frac{1}{2}$ km aufwärts von der Mündung dem Flusse entnommen. Die Anwesenheit der oben aufgezählten Formen in seinem Plankton — wenigstens einiger von ihnen, wie *Anuraea serrulata*, *Notholea striata* und *Coelopus tenuior*, welche von uns nur noch im Raivola-Fluss, der nachweislich sein Wasser aus einem Torfmoor empfängt, gefunden wurden — müssen wir durch den Ursprung des Flusses aus einem der zahlreichen, das Gouv. Novgorod bedeckenden, Torfmoore erklären.

Wie dem nun auch sei, aber ein so scharfer Unterschied in der Zusammensetzung und dem Charakter des Planktons der Newa und Tosna, welche so nahe voneinander fließen und einem Bassin angehören, ist ein sehr interessantes Faktum bei der Beurteilung der Frage über das Flussplankton (sogen. Potamoplankton) überhaupt.

(Schluss folgt.)

Heredity and the Cause of Variation¹⁾

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The phenomena of heredity and genetic variation appertain to the germ-cells, that is to say, they are germinal in nature. As all ancestry passes through a continuous line of germ-cells, in the sense of a handing-on of anything there is no such thing as heredity. The individual is merely a lateral offshoot. Since existing theories either assume an intangible germplasm, or make the line of descent pass through the individuals, with the exception of Galton's „stirp“ they have no sort of identity with the „Understudy Theory of Heredity“ set up by the author as one result of the discovery of a morphological continuity of germ-cells. Given in a certain life-history the period of formation of the primary germ-cells, and, for simplicity, let there be of these but two. On

1) Abstract of a paper, read before the Royal Society, Edinburgh on Feb. 8th 1904. For the full text see: A Morphological Continuity of Germ-Cells as the Basis of Heredity and Variation, in: Review Neurology and Psychiatry, Vol. II, p. 1—34, 114—142, 185—217, Edinburgh, 1904.

one will fall the lot of developing into an embryo, while the other will furnish the sexual products of this. The two cells are in all respects similar and equivalent, so much so, that if both form embryos these are identical twins. In the ancestry neither cell had ever been a higher animal, neither they nor their ancestors had ever formed parts of an animal body. But this ancestry is continuous with a long line of germ-cells, and at regular intervals these were exactly like certain sister-cells, which did develop and form individuals. Although one of the two does not develop, it retains for itself and also for all its immediate progeny in the meantime all the properties or characters of the other, which were it or any of its progeny to develop would make it or them identical twins with the other. This is the greatest wonder in embryology! As Wallace has said, the foundation of the Darwinian Theory is the variability of species. It does not attempt to explain the cause of variation, but starts from the fact of its existence. Under this theory resulting from the struggle for existence there is a survival of the fittest. But the existence of factors far more potent for the elimination of individuals than natural selection may be insisted upon. Thus, it can be shown, that of the male individuals of the human race certainly one-third, and probably very nearly one-half, are eliminated before birth. The only adequate cause of variation yet suggested is Weismann's germinal selection. This is purely a mental concept, in its nature it is very complicated, and being quite without connection with any known phenomenon or epoch of the development, it hangs entirely in the air. As defined by Weismann, the process would furnish a very great variety of gametes or conjugating cells, and these would be so varied in their characters or qualities, that the resemblances rather than the differences among the progeny would require explanation. Germinal selection, as conceived of by Weismann, is too hypothetical and at the same time proves too much. The problem of the cause of genetic variation belongs to embryology. For various reasons every egg or sperm must be regarded as containing one complete set of all the characters or qualities necessary to form an individual of the species. At fertilisation two sets of these are somewhat loosely joined together. In the developing embryo only one complete set of characters is made use of, and, while the other corresponding qualities remain more or less dormant in its cells, that set or pack actually employed may be made up of any characters taken from either of the two packs, but so as to make up one complete pack. Turning then to the germ-cells, each of these possesses the duplicated set, and later on at the so-called „reduction“ i. e., at the final division of the oogonia into oocytes, and of the spermatogonia into spermatocytes, prior to the formation of conjugating cells or gametes, the twofold set becomes diminished to one pack only by the elimination of one complete pack. The true meaning of the reduction of chromosomes is the elimination of one set of characters or qualities, such that if among

those of the original sets there be any unsuitable ones these are rejected. The union of two sets of characters at conjugation is in animals retained by the germ-cells, until the period of the reduction, by the embryonic cell, until the commencement of its development, when it becomes latent, and in plants during the whole life-period of the flowering plant. The two sets cannot be identical at the start. As living entities they must be influenced by the total environment, nutrition, climate, disease, toxins, etc. To all these influences they will react. The effect of all the factors will be a different one on the differently constituted characters. Some it will favour, and these will flourish and increase in import. Others will be unfavourably influenced or neglected, and these will diminish. At the reduction there will be a settling-up, and if the environment have not been a constant one, some of the characters will have become better than other corresponding ones, a new pack will be chosen, and the less favourable characters will be rejected. This elimination of characters may on occasion become an elimination of complete individualities, or what is the same thing as a casting out of „ancestors“. Moreover, because the two sets have been conjoined under the influences of the environment, and have reacted to this, the process becomes a self-adjusting mechanism, the up and down oscillations of the characters of the two sets endeavouring to follow and compensate the changes in the environment, and the result must be genetic variation. This process may be defined as germinal election and elimination in adaptation to the environment. The Darwinian Theory is undoubtedly largely based upon the analogy of artificial selection. Nature is supposed by natural selection, resulting from the struggle for existence, to eliminate all the unsuitable individuals, and thereby to select those for the continuance of the race, which are most or more suitable for the environment. Even if she did this, its results would be as nothing compared with those of germinal election and elimination of unsuitable characters, which at its basis is also a weeding-out of unsuitable individualities. A selection of individuals can give no certain result for either natural or artificial selection. Nature goes to the root of the matter, she makes no selection of individuals, for about these she cares nothing. She can exert her choice, and she does it, among the germ-cells, and not merely in these, but among the characters or qualities the germ-cells possess. In this it would be futile to attempt to bind her down by cast-iron laws of inheritance, to dictate that „the average contribution“ of a father should be so much, of a grandfather so much, and so on. This may hold good in cases, but only with a constant environment. When the latter obtain, if all the characters or qualities be equally good, then, as in the Mendelian experiments in inter-crossing peas, the election and elimination may be left to the mathematical laws of probability; they may be taken apparently at random, and in this way it may become possible to speak of sexual reproduction as sometimes

an „amphimixis“ or mingling of characters, and to set up laws of inheritance by average contribution. With a constant environment or with what is assumed to be such, man first rejects (individuals of) certain varieties, and in this way favours (individuals of) some particular variety. By closely intercrossing these he accentuates particular points, because, of course, even in the characters of germ-cells suited to a particular environment there may be degrees. In this man takes a course the reverse of that adopted by Nature. Her method may be slower, but it is sure. When she causes variation, she initiates it by altering the environment. While some one or more varieties of a species may be able to adapt themselves to the new conditions, others will fail in this, and these will be eliminated either as individuals, or even if fertile with the favourable variety or varieties then by germinal elimination. Germinal election and elimination appear to offer adequate and simple explanations of all the phenomena, at any rate the author has encountered no real difficulties. They throw light upon the Mendelian cases of intercrossing peas, etc., on mimicry, protective coloration, bud-variation, and the loss of organs, such as the hind limb of the Greenland whale, for which latter cases Weismann found it necessary to call in a new principle, that of „panmixie“ or the cessation of natural selection. They explain why the giraffe, for example, has a long neck; this is not because as the Lamarckians assert, it was in the habit of stretching its neck, the effects of this being handed on by the inheritance of acquired characters; and again, not because, as the Darwinians maintain, by natural selection Nature picked out those individuals whose necks tended to be long, and destroyed those with shorter necks; but simply because Nature eliminated in the germ-cells those characters, which tended to the production of a short neck, while she fostered and preserved those other characters of the other parental line, which tended to the formation of a longer neck, and she increased the value of these characters from generation to generation. The principle resulting in the self-regulating mechanism offers a simple construction of all the phenomena of genetic variation, an ultimate and a far more natural one than „natural selection“ or the „germinal selection“ of Weismann. Indeed, under it there is no necessity to invoke these: by germinal election and elimination their positions are completely and decisively outflanked, and rendered untenable! As like other zoologists Weismann has not recognised the existence of a germinal elimination, the real import of the environment under his views is the weeding-out of certain individuals and the selection of others owing to the struggle for existence and the survival of the fittest. Darwin and Wallace attached little import to the influence of the environment as a factor, but for Buffon and Lamarck, as in recent years for Semper, Thiselton-Dyer, and Ewart it was one of immense gravity, and for the followers of Lamarck it has been the only factor in inducing variation. The reality of a struggle for existence is not denied, but it is not

so clear that only the fit should survive, for as others have insisted, chance comes in. In any case the result is not one, which can induce variation, or produce varieties, or give rise to new species. By the self-regulating mechanism of germinal elimination, etc. Nature must in all sexual reproduction eliminate half of the groups of characters, half of the individualities. In its magnitude this is appalling, and it results in an election beside which natural selection is as nothing. Of the individual Galton long ago said, that it was the trustee of the germ-cells. In the light of present results how true this is! In our social life the parent is made answerable, more or less, for the education and well-being of his children. Of this responsibility nothing whatever is assigned for the little insignificant, but for good and ill immensely potent, entities, the germ-cells! While for the state, for the commonwealth it may be — it is not said that it is — a matter of indifference under what environment the individual pass his span of life, for the good of the race it can only be of the utmost moment, that, as the germ-cells are the seed of the stock, contained in individuals, the total environment should be made, so far as it is possible, of the healthiest and best description for the latter. The weekly or yearly table of death-rate is no sure index of national improvement or deterioration, for even degeneration and longevity may go hand in hand. The recent report of the Royal Commission on Physical Training (Scotland) furnishes matter for serious consideration, and it reflects the all-powerful influence of the conditions of natural existence, to him who can read between its lines, in as clear a fashion as do the facts of mimicry. In considering the welfare of the race, it would not be wise to lay stress on the fact, that where necessary Nature eliminates the unfit, for to permit of this it must be possible to prevent the mating of the unfit with the unfit. Rather, let it be borne in mind, that in the words of H. G. Wells „Nature is a reckless coupler — and she slays“, and that on occasion she may remorselessly destroy not merely the total individuals of a variety but even of a species. With the wealthy scarcely less than with the poor reform is urgently called for. The higher classes of society are not recruited to any great extent from among themselves, but from those, the middle classes, beneath them. A most significant fact! The population of cities is recruited from the country, just as the middle classes reinforce the aristocracy. The rural and middle classes are and must be the mainstay of a nation, for with them are the best attempts at adaptation to the environment. But the poor we have always with us, and the great problem for the city-rulers, ay, for the statesman, is how to make their total environment such, that instead of deteriorating in them the stock shall improve. Fortunate the race which breeds statesmen capable of solving such a problem, for beyond measure is the greatness of him, who shall achieve success in this task!

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