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A NEW FACTOR IN EVOLUTION

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In several recent publications I have developped, from different points of view, some considerations which tend to bring out a certain influence at work in organic evolution which I venture to call "a new factor". I give below a list of references¹ to these publications and shall refer to them by number as this paper proceeds. The object of the present paper is to gather into one sketch an outline of the view of the process of development which these different publications have hinged upon.

The problems involved in a theory of organic development may be gathered up under three great heads: Ontogeny, Phylogeny, Heredity. The general consideration, the "factor" which I propose to bring out, is operative in the first instance, in the field of *Ontogeny* ; I shall consequently speak first of the problem of Ontogeny, then of that of Phylogeny, in so far as the topic dealt with makes it necessary, then of that of Heredity, under the same limitation, and finally, give some definitions and conclusion.

¹References:

- (1). *Imitation: a Chapter in the Natyural History of Consciousness, Mind* (London), Jan. 1894. Citations from earlier papers will be found in this article and in the next reference.
- (2). *Mental Developpment in the Child and the Race* (1st. ed., April, 1895; 2nd. ed., Oct., 1895; Macmillan & Co. The present paper expands an additionnal chapter (Chap. XVII) added in the German and French editions and to be incorporated in the third English edition.
- (3). *Consciousness and Evolution, Science*, N. Y., August 23, 1895 ; reprinted printed in the AMERICAN NATURALIST, April, 1896.
- (4). *Heredity and Instinct* (I), *Science*, March 20, 1896. Discussion before N. Y. Acad. of Sci., Jan. 31, 1896.
- (5). *Heredity and Instinct* (I), *Science*, April 10, 1896.
- (6). *Physical and Social Heredity, Amer. Naturalist*, May, 1896.
- (7). *Consciousness and Evolution, Psychol. Review*, May, 1896. Discussion before Amer. Psychol. Association, Dec. 28, 1895.

I.

Ontogeny : “*Organic Selection*” (see ref. 2, chap. vii) — The series of facts which investigation in this field has to deal with are those of the individual’s creature’s development ; and two sorts of facts may be distinguished from the point of view of the *function which an organism performs in the course of his life history*. There is, in the first place, the development of his heredity impulse, the unfolding of his heredity in the forms and functions which characterize the particular individual — the phylogenetic variations, which are constitutional to him ; and there is, in the second place, the series of functions, acts, etc., *which he learns to do himself in the course of his life*. All of these latter, the *special modifications which an organism undergoes during its ontogeny*, thrown together, have been called “acquired characters”, and we may use that expression or adopt one recently suggested by Osborn ², “ontogenic variations” (except that I should prefer the form “ontogenetic variations”), if the word variations seems appropriate at all.

Assuming that there are such new or modified functions, in the first instance, and such “acquired characters”, arising by the law of “use and disuse” from these new functions, our farther question is about them. And the question is this: how does an organism come to be modified during his life history ?

In answer to this question we find that there are three different sorts of ontogenic agencies which should be distinguished — each of which works to produce ontogenetic modifications, adaptations, or variations. These are: first, the physical agencies and influences in the environment which work upon the organism to produce modifications of its form and functions. They include all chemical agents, strains, contacts, hindrance to growth, temperature changes, etc. As far as these forces work changes in the organism, the changes may be considered largely “fortuitus” or accidental. Considering the forces which produce them I propose to call them “physico-genetic”. Spencer’s theory of ontogenetic development rests largely upon the occurrence of lucky movements brought out by such accidental influences. Second, there is a class of modifications which arise from the spontaneous activities of the organism itself in the carrying out of its normal congenital functions. These variations and adaptations are seen in a remarkable way in plants, in unicellular creatures, in very young children. There seems to be a readiness and capacity on the part of the organism to “rise of the occasion”, as it were, and make gain out of the circumstances of its life. The facts have been put in evidence (for plants) by Henslow, Pfeffer, Sachs; (for micro-organism), by Binet, Bunge; (in human pathology) by Bernheim, Janet; (in children) by Baldwin (ref. 2, chap vi) (See citations in ref. 2, chap. ix, and in Orr, *Theory of Development*, chap. iv). These changes I propose to call “neuro-genetic”, laying emphasis on what is called by Romanes, Morgan and others, the “selective property” of the nervous system, and of life generally. Third, there is the great series of adaptations secured by conscious agency, which we may throw together as “psycho-genetic”. The processes involved here are all classed broadly under the term “intelligent”, i.e. imitation, gregarious influence, maternal instruction, the lessons of pleasure and pain, and of experience generally, and reasoning from means to ends, etc.

²Reported in *Science*, April 3rd.; also used by him before N. Y. Acad. of Sci., April 13th. there is some confusion between the two terminations “genic” and ‘genetic’ I think the proper distinction is that which reserves the former, ‘genic’, for application in cases in which the word to which it is affixed qualifies a term used *actively*, while the other, “genetic”, conveys similarly a *passive* signification ; thus agencies, causes, influences, etc., and “ontogenic phylogenetic, etc.” while effects consequences, etc., and “ontogenetic, phylogenetic, etc.”.

We reach, therefore, the following scheme:

Ontogenetic Modifications *Ontogenic Agencies*

- | | |
|--------------------|----------------|
| 1. Physico-genetic | 1. Mechanicam |
| 2. Neuro-genetic | 2. Nervous |
| 3. Psycho-genetic | 3. Intelligent |

Imitation

Pleasure and pain

Reasoning

Now it is evident that there are two very distinct questions which come up as soon as we admit modifications of function and of structure in ontogenic development: first, there is the question as to how these modifications can come to be adaptative in the life of the individual creature. Or in other words: What is the method of the individual's growth and adaptation as shown in the well known law of "use and disuse"? Looked at functionally, we see that the organism manages somehow to accommodate itself to conditions which are favorable, to repeat movements which are adaptative, and so to grow by the principle of use. This involves some sort of selection, from the actual ontogenetic variations, of certain ones – certain functions, etc. Certain other possible and actual functions and structure decay from disuse. Whatever the method of doing this may be, we may simply, at this point, claim the law of use and disuse, as applicable in ontogenic development, and apply the phrase, "Organic Selection", to the organism's behavior in acquiring new modes or modifications of adaptative function which its influence of structure. The question of the method of "Organic Selection" is taken up below (IV); here, I may repeat, we simply assume what every one admits in some form, that such adaptation of function – "accommodations" the psychologist calls them, the processes of learning new movements, etc. – *do occur*. We then reach another question, second; what place these adaptations have in the general of development.

Effects of Organic Selection. – First, we may note the results of this principle in the creature's own private life.

1. *By securing adaptations, accommodations, in special circumstances the creature is kept alive* (ref? 2, 1st ed., pp. 172 ff.). This is true in all the three spheres of ontogenic variation distinguished in the table above. The creatures which can stand the "storm and stress" of the physical influence of the environment, and of the changes which occur in the environment, *by undergoing modifications of their congenital functions or of the structures which they get congenitally – these creatures will live; while those which cannot, will not.* In the sphere of neurogenetic variations we find a superb series of adaptations by lower as well as higher organism during the course of ontogenic development (ref. 2, chap. ix). And in the highest sphere, that of intelligence (including the phenomena of consciousness of all kinds, experience of pleasure and pain, imitation, etc.), we find individual accommodations of the tremendous scale which culminates in the skilful performances of human volition, invention, etc. The progress of the child in all the learning processes which lead him on to be a man, just illustrate this higher form of ontogenic adaptation (ref. 2, chap. x-xiii).

All these instances are associated in the higher organisms, and all of them unite to *keep the creature alive.*

2. *By this means those congenital or phylogenetic variations are kept in existence, which lend themselves to intelligent, imitative, adaptative, and mechanical modification during the lifetime of the*

creature which have them. Other congenital variations are not thus kept in existence. So there arises a more or less widespread series of *determinate variations in each generation's ontogenesis* (ref. 3, 4, 5)³.

The further applications of the principle lead us over into the field of our second question, i.e., phylogeny.

II.

³"It is necessary to consider further how certain reactions of one single organism can be selected so as to adapt the organism better and give it a life history. Let us at the outset call this process "Organic Selection" in contrast with the Natural Selection of whole organism. [...] If this (natural selection) worked alone, every change in the environment would weed out all life except those organism, which by accidental variation reacted already in the way demanded by the changed conditions – in every case new organism showing variations, not, in any case, new element of life-history in the old organism. In order to the latter we would have to conceive [...] some modification of the old reactions in an organism through the influence of new conditions. [...] We are, accordingly, left to the view that the new stimulations brought by changes in the environment themselves modify the reactions of an organism. [...] The facts show that individual organism do acquire new adaptations in their lifetime, and that is our first problem. If in solving we find a principle which may also serve as a principle of race-development, then we may possibly use it against the 'all sufficiency of natural selection' or in its support. " (ref. 2, 1st ed., pp. 175–6