BIOLOGICAL LECTURES DELIVERED AT THE MARINE BIOLOGICAL LABORATORY OF WOOD'S HOLL 1896-1897

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VARIOUS

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FIRST LECTURE.

THE VARIATIONS AND MUTATIONS OF THE INTRODUCED SPARROW. *PASSER DOMESTICUS.*

(*A SECOND CONTRIBUTION TO THE STUDY OF VARIATION.*)

HERMON C. BUMPUS.

IN the preface to the second volume of these Lectures it is stated that one of the leading objects of the course is "to bring forward the *unsettled* problems of the day, and to discuss them freely." The question of the adequacy of natural selection is one that at the present time still divides two schools of speculative biology, and is a question that can be solved only by those inductive methods which it is the function of a Biological Laboratory to suggest, adopt, and execute.

The principle of "Panmixia," or the "suspension of the preserving influence of natural selection," has formed an integral part of the speculative writings of Weismann, and, as part of his theory of "the continuity of the germ-plasm," is presumed to explain adequately the reduction of useless organs, and the occurrence, especially among domesticated animals, of "the greater number of those variations which are usually attributed to the direct influence of the external conditions of life."

This view of the regressive power of natural selection was, at the time of the original presentation of Weismann's essay ('83), not entirely new to science. Lankester ('90) calls attention to the fact that, eleven years earlier, in 1872, Darwin, in the sixth edition of the *Origin of Species*, had the identical principle in mind when he wrote: "If under changed conditions of life a structure before useful becomes less useful, its diminution will be favored, for it will profit the individual not to have its nutriment wasted in building up a useless structure." Shortly after this Romanes advanced a not totally dissimilar idea in his theory of the "Cessation of Selection" ('**74**).

In 1890 Romanes revised his earlier views, calling especial attention to the points in which they differed from those of Darwin and Weismann, and in 1895, in his posthumous work, the salient features of his theory are again indicated. Cope carried the application from structures to species when he wrote ('**96**): "In other cases it is to be supposed that extremely favorable conditions of food, with absence of enemies, would have occurred, in which the struggle would have been *nil*. Degeneracy would follow this condition also."

But, without entering into the conflicting claims of originality and of priority, all the disputants are agreed that the withdrawal of the supporting influence of natural selection from an adapted organ or organism must or may, directly or indirectly, lead to a condition of degeneration. That the arguments, however, are too speculative in character is generally admitted, and there is consequently demand for inductive evidence to prove:

(1) That in a specific case, and in respect to certain characters, the operation of natural selection has been suspended.

(2) That, when the operation of natural selection has been suspended, increased variation occurs.

(3) That, on the occurrence of (1) and (2), there is a departure from a previously maintained and presumably high standard, and

(4) That, unless a new equilibrium is established by adaptation to the new environment, degeneration and perhaps final elimination ensues.

It would also be of incidental interest to learn from observed facts whether the suspension of the action of natural selection is felt immediately by an organ or organism; whether there is any indication of "self-adaptation" tending to the establishment of a new equilibrium; and whether this self-adaptation, if detected, follows one or several definite lines. Of course, if the evidence can be gathered from animals in a state of nature, and if it can be checked by a large number of examples, so much the better.

In 1850 the first house sparrows of Europe were introduced into this country, and from that time to 1870 upwards of 1500 birds are said to have been brought from the Old World (Merriam-Barrows, '89). To these introduced birds the environment has been novel. They have found abundant food, convenient and safe nesting places, practically no natural enemies, and unrivaled means of dispersal. Aside from an early and brief period of fostering care, they have been left to shift for themselves; natural agencies have since been at work, and in the relatively short space of forty years a continent has been, not merely invaded, but inundated by an animal which, in its native habitat, has been fairly subservient to the regulations imposed by competing life.

It seems to the speaker that here is an excellent example of the suspension of natural selection, for here, at least as far as certain external factors of selection are concerned, Nature does not select. Nearly all the young birds reach maturity; variations in color and structure, unless most extreme, are apparently not disadvantageous to their possessor; and if these variations are heritable, they do not seriously handicap the individuals of the next generation. A considerable departure in nesting and breeding habits does not jeopardize the domestic interests, and the simple mode of life permits even the weak individuals to endure. We conclude, then, that there is evidence to prove the first proposition, *viz.*, in a specific case and in respect to certain characters, the operation of natural selection has been suspended.

For a proper discussion of propositions 2, 3, and 4, it was my first purpose to collect a large number of the American birds and compare them directly with an equal number collected in England; but the labor and expense involved made this procedure inexpedient. The egg of the bird, however, is easy to secure, readily preserved, and can be purchased from European dealers for a relatively small price. It presents a remarkable range of variation, both in shape, size, and color, and offers certain fixed and readily measurable features which are not presented by the bird itself. Moreover, my observations lead me to think that it is a structure which indicates departures from "normality" in a remarkable way. At all events, the variations, though they may present greater amplitude, are of the same inductive value, qualitatively, as variations of the skeleton, feathers, or other adult structures. The egg may be taken, then, as a convenient and inexpensive means for the solution of at least some of the questions bearing on the subject of Panmixia.

At first, one hundred eggs, imported from an English dealer, were compared with an equal number collected in Providence, R. I. The dissimilarity in the two lots of eggs was so striking that I felt there must be some mistake, and at once imported another hundred from a different locality, collecting in the meantime a second hundred of American specimens. On comparing the two enlarged collections, such interesting variations were found that I ordered all the English eggs that could be procured, and collected extensively from certain localities at home. At the close of the summer, 1896, I had 1736 eggs, one half of which were European, the other half American. These eggs, 868 foreign and 868 native, were compared (*a*) with respect to length, (*b*) ratio of length to breadth, (*c*) general shape, and (*d*) color. These comparisons ought to reveal any tendency towards increase of variation on the withdrawal of natural selection, that is, they ought to yield evidence in support of the second proposition. The data may be conveniently arranged in "curves of frequency."

If we erect on a base line (Diagram I), extending from 18 mm., which represents the shortest egg, to 26 mm., which represents the longest egg, a series of ordinates representing in sequence the added increment of ½ mm., and arrange on these ordinates the eggs that measure respectively 18 mm., 18.5 mm., 19 mm., 19.5 mm., etc., it is evident that the mean ordinates will be occupied by a considerably larger number of specimens than the extreme, and that the ascending and descending curve will indicate the general plan of the distribution of variation around the mean. Now if a species or structure is stable and shows only a slight tendency to vary, the base of the curve obviously will be short. If, on the con-

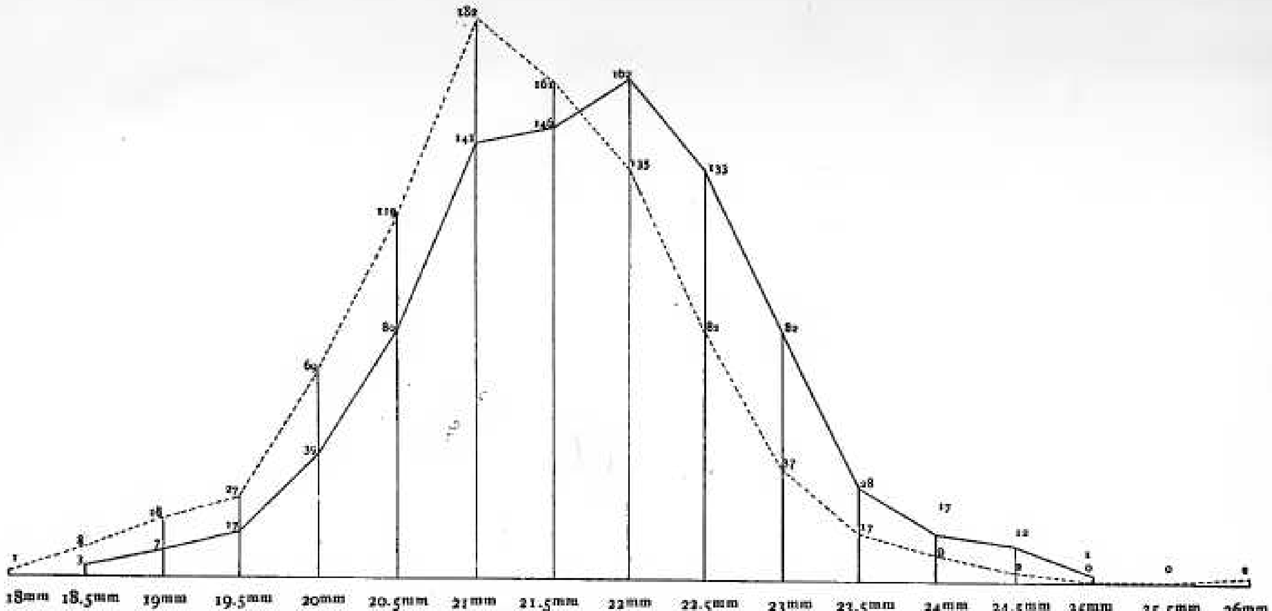

DIAGRAM I. *Curves of Absolute Lengths.*—The distribution of the American eggs is represented by the broken line; that of the British eggs by the unbroken line. The short eggs are at the left, the long eggs at the right. The number of specimens of each length is represented by the height of the respective ordinate; thus there are 80 British and 119 American eggs which have a length of 20.5 mm.