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## Processes of Organic Evolution

ONE of the difficulties about organic evolution is that it has not been and probably cannot be demonstrated in a strict sense, and although the indirect lines of evidence converge with such unanimity upon the probability of the theory that the scientifically trained mind is convinced, a loophole for doubt remains to the multitudes who must rely upon the dictum of authority one way or the other.

The evolutionist who rests upon his oars, convinced that the stream is running with him, misjudges the set of at any rate one considerable part of the current. "Le problème de l'Évolution paraissait plus près de sa solution, il y a quarante ans, que maintenant", wrote Prof. Caullery, and the critical examination of "le Transformisme" is a noticeable activity of French thought at the moment. In America the anti-evolution or Fundamentalist position is well entrenched. There in June the monthly magazine *Evolution*, described as "A Journal of Nature; For Popular Education in Natural Science, to Develop the Open Mind", reappeared after a lapse of five years due apparently to lack of supporters interested in open minds; and the editor, after interviewing 20,000 persons, says, "I am more convinced that there is a need and a real field for *Evolution* than I was before I started." He was advised if he wished to make a commercial success of his journal to change *Evolution* to some "less offensive" name. In Great Britain the feeling against evolution lies rather under the surface, but it exists, and we recall the surprise with which we listened to the announcement of a University student that she did not propose to answer any examination question upon evolution, because neither she nor her parents believed in it!

When, therefore, Sir Edward Poulton in the course of his charmingly reminiscent presidential address to the British Association on "The History of Evolutionary Thought, as recorded in Meetings of the British Association", which is printed in the Supplement to this issue of *NATURE*, passed lightly over "the subject of organic evolution itself, as generally accepted" (our italics), he spoke truly of his scientifically minded audience, for he recalled only one example of opposition to a belief in organic evolution, and that was at the first meeting he attended, in 1881. But the swamping of two thousand scientific workers by a week-end influx of trippers during the Blackpool meeting gave perhaps a rough indication of the number of believers to the masses who do not understand evolution, who do not care, or who are actively or passively opposed. The position, however, is gradually changing. The idea of evolution, as understood to-day, is comparatively new, and the natural death of prejudice, together with the diffusion of knowledge in school and college, and particularly through the far-reaching voice of the radio, are paving the way for the general recognition of a process the idea of which has become a commonplace of scientific thought.

Evolution rests upon two primary or basic factors: the vital characteristic of organisms to produce variations, and the heredity which makes possible the establishment or perpetuation of these variations. Both aspects have been discussed at meetings of the British Association, but the tendency has been for debate to centre upon the secondary or guiding factors, the means by which the course of evolution has been directed. Here there has been controversy enough since natural selection took the field, and particularly since that

discussion in 1887 at Manchester upon "The Hereditary Transmission of Acquired Characters" in which Weismann took part, who all but strangled the idea of the inheritance of acquired characters at its resuscitation.

Into this controversy, Sir Edward Poulton in his address threw himself with gusto and with many recollections of the great debaters of the past, for he himself during the last fifty years has been in the forefront of the battle. Having nailed his colours to the mast, he picked here and there from the meetings of the last half-century opinions or evidences in favour of the efficacy of natural selection, notably from Prof. Alfred Newton and Canon Tristram, and against the inheritance of acquired characters by Ray Lankester.

The recalling of these contentions is a reminder of the difficulty of adducing real proof of any theory of evolutionism, and of the assumptions which the early followers of Darwin permitted themselves. Take the quoted case of Canon Tristram's larks of North Africa, where a sandy area has a long-billed, and a rocky district a short-billed species. The assumption made was that "the shorter-billed birds would be at a disadvantage in obtaining food from sandy areas but at an advantage among the rocks where strength is required". A plausible assumption, but, unbacked by a thorough analysis of the food consumed and the food available, no more than an assumption.

Compare Tristram's evidence with the more complete observation of bill structure made by Joseph Grinnell in Lower California, where in a peculiar area of meagre rainfall and high atmospheric humidity (a humid desert) he found that lesser size of bill was a common feature of birds as different as flycatchers, finches and woodpeckers. It is difficult, but not impossible, to assume that birds of feeding habits so diverse could all benefit by exactly the same kind of modification, so that, for each, environment should select similar variations. It is even more difficult to make the assumption, since other common modifications occur in all these birds, such as deeper coloration and certain proportions of wing and tail. What seems to be clear is that environment has been at work, and has induced the living organism to respond in similar manner, no matter that the stocks were of different pedigree. But does that imply the inheritance of acquired characters? Even here more evidence about food and habits is necessary before any valid conclusion can be drawn.

So it is, unfortunately, with most of the observations adduced in support of particular means of evolutionary progress. Sir Edward Poulton mentioned the work of Weldon and Thompson on the influence of impurities in the sea at Plymouth upon the frontal width of the common shore crab, which, it was suggested, ensured that the water flowing over the respiratory surface was more efficiently filtered. But these observations and experiments, beautifully convincing as they appear to be at first sight, have been criticized so reasonably and ably that the conclusions cannot be accepted with any confidence.

The fact of the matter is that the story of evolutionary thought shows, as regards the processes of evolution, that the first flush of enthusiasm, with its easy evidences and somewhat uncritical observations, has passed, and that science will be satisfied only with careful records or controlled experiments safeguarded so as to convince the open but critical mind. To this new evidence the naturalist, as well as the experimenter, must make his contribution; but for the naturalist also the conditions become more stringent, and, to take another example, the statistical analysis in relation to protective patterns of food taken by a bat will be regarded as valid only when viewed in relation to the abundance of the food items and their availability at the time and place of the bat's collecting; and that is no simple series of observations.

In another way, investigation into the modes of evolutionary progress is likely to undergo modification. Few biologists, nowadays, doubt that natural selection has played a great part in guiding that progress; it is taken to be, as Bateson took it, self-evident. But natural selection merely plays with variations created by the organism; the vital problem lies deeper. Does the vitality of the organism, a thing of wondrous properties, really express itself in non-significant variations left entirely for Nature to carve into line, or does it respond more directly to the environment in such a way that subsequent generations share in the response, or does it even more directly handle its own fate by striking out in determinate lines of its own—it being postulated, of course, that whatever the source of the variations they must afterwards come under the pruning hook of natural selection? There seem to lie the evolutionary problems of the immediate future for the eager student of biology.