The Blindness of Cave-Animals.

It is with much diffidence that I take up my pen to reply to the letter of Sir Ray Lankester, which appears in Nature of November 21. I have been brought up to venerate Sir Ray as the leader of British zoology, and if I cannot claim him as my zoological parent, I can at least regard him as my zoological uncle, for between him and my teacher and friend Adam Sedgwick there always reigned complete sympathy and co-operation.

Sir Ray blames me for having, in a chapter entitled "Zoology" in a book on "Evolution in the Light of Modern Knowledge," come to the conclusion that the inheritance of the results of use and disuse has been the main factor in evolution. He says that this idea is not modern but was put forward by Lamarck a hundred years ago. He also says that he thinks that judgment on the value of Kammerer's experiments should be suspended until they have been repeated, for, as he goes on to say, J. B. S. Haldane points out, that in the past critical repetition of similar experiments has been fatal to the conclusions drawn from them.

Sir Ray then goes on to criticise the theory of inherited disuse as applied to the explanation of the blindness of cave-animals, and to put forward a theory of his own in place of it.

Now I should like to say at once, with reference to Mr. Haldane, that when he thinks fit to publish his criticisms in a recognised scientific journal, instead of in the "Annual of the Rationalist Press Association," which no scientific man is bound to consult and which I, for one, never see, it will give me the greatest pleasure to criticise his criticisms.

As I have pointed out in a review which appears in Nature of November 28, it is not the lack of evidence which has prevented Lamarckian experiments from bringing conviction, but it is the obsession of minds with the Weismannian complex which has stood in the way and which has caused any attempt, however flimsy, to explain Lamarckian results away, to be accepted as disproving them. For a recent example of this spirit I may refer readers of Nature to the issue of June 2, 1923, in which a leading English Mendelian, in endeavouring to discredit the evidential value of Kammerer's celebrated specimen of Alytes with the horny pad, says: "but on the palm of Alytes they [the horny callosities] would be as unexpected as a growth of hair on the palm of a man." My comment on this statement is that I have preserved in my laboratory the fore-arms of four male frogs—the first four that I looked at—all of which show the extension of the pad to the palmar surface of the hand.

As Sir Ray Lankester, perhaps, has scarcely been able to keep up with the recent literature bearing on this controversy, he is probably unaware that Kammerer's critical experiments, namely, the handing on to posterity of the effects of the reaction of the skin to coloured surroundings, have been repeated by Durkhen on totally different animals, with the most meticulous care, and that Durkhen's results entirely confirm Kammerer's conclusions. Durkhen's work again has been repeated by Fr. Brecher of Vienna and confirmed.

I am sure that Sir Ray would agree with me that the evidence for evolution is mainly derived from three sources, namely, systematic zoology, palæontology, and embryology. I find that the most distinguished systematists and palæontologists are openly accepting the Lamarckian view; as an embryologist, I myself have been driven to it; and when the experiments just alluded to are taken into account, would Sir Ray not admit that the most modern knowledge on the subject of evolution favoured Lamarck's hypothesis even though that theory was put forward a hundred years ago?

I now come to the special case of the blindness of cave-animals. I am well acquainted with the hypothesis which Sir Ray advances to explain this blindness, namely, that animals with congenital eye-defects stayed in the dark whilst their more gifted brethren escaped into the light. Did I not derive a large part of my early attraction to zoology from Sir Ray's inspiring writings? Nevertheless, I consider Sir Ray's hypothesis unsatisfactory for the following reasons :

(1) The only case in which the cause of blindness in a cave-animal has been analysed is that of the cave-newt, Proteus. Here, as Kammerer has shown, the cause of blindness is not congenital defect, but lack of stimulus to growth, for Proteus can, under proper conditions, produce a perfectly normal eye. Whatever hesitation may remain about accepting Kammerer's results in other matters, there can be no dubiety about his results on Proteus. In common with other zoologists who attended the special meeting of the Linnean Society in May 1923, I saw these large-eyed specimens of Proteus, the most wonderful specimens in my judgment which have ever been exhibited to a zoological meeting.

(2) Congenital eye defects, of course, occur, and I believe that before long we shall discover the causes of them. But they are correlated with general weakness and sickliness of constitution. Microphthalmic rodents, for example, rarely survive. It is most unlikely that such weakly specimens would give rise to a new species.

Sir Ray says that there is no evidence that the eyes of animals bred in the dark diminish in size, and he cites experiments by Payne quoted by Haldane. Payne bred Drosophila for 75 generations in the dark and observed no effect : 75 generations of Drosophila would occupy a little over two years. In an article on "The Inheritance of Acquired Characters," contributed to *Science Progress* in 1921, I showed that there was evidence that the eyes of gammarids, which had lived in pools in deserted salt mines in Austria for two hundred years, had undergone definite reduction, and that this reduction was totally unlike what was met with in congenital eye defect. E. W. MacBride.

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Carnot's Cycle and Efficiency of Heat-Engines.

The cycle proposed by Dr. J. S. Haldane (Nature, August 29, p. 326) as a standard of comparison for steam engine performance can be shown quite readily on a temperature-entropy chart, and thus be directly compared with the Carnot cycle and also with the Rankine-Clausius saturated steam cycle, and the relative efficiencies of the three cycles can be viewed at a glance.

Starting first with water at the lower temperature T_2, heat is added until all the water has been evaporated into steam at a temperature T_1, and in a closed space. This process is shown on the chart (Fig. 1) as the constant volume line *abc*, and the heat added is shown by the area *fabce*. Then follows adiabatic expansion represented by *cd* down to the lower temperature T_2, and finally isothermal condensation along *da*, with rejection of heat measured by the area *edaf*.

The efficiency of the cycle is therefore

$$\frac{\text{area } abcd}{\text{area } fabce} = \frac{A}{A + B}.$$