

18 February 1932.

Major L. Darwin, Sc.D.,
Cripps's Corner,
Forest Row,
Sussex.

Dear Major Darwin:

I am sorry that I have delayed in returning your typescript on Evolution and Eugenics. I have written in a few verbal suggestions, none being of any importance, in fact I should have written before if I had not found myself in such full agreement with almost everything you say.

The whole contrast you open up between the rapid changes which can be postulated when one or more gene substitutions offer a definite and universal advantage, and the much slower process which you suggest, if I have taken you right, when the advantage is fluctuating and contingent upon a considerable complexity of other conditions, genetic or environmental, is one which I much want to get my own head clearer about. I think you may have formulated it as well as is possible, but there may be other ideas unexpressed which I could take hold of as a stronger clue.

I am not quite sure if it is safe to class the great differences between orders and classes entirely in the group of differences which have arisen very slowly. Of course I agree in the sense that the bats have been so long differentiated from terrestrial mammals that, whatever very slow changes are at work in their organisation have had time to modify them considerably, and that these changes, being principally or wholly adaptations to their peculiar way of life, will characterise all or nearly all the order, and so be among those characteristics of the order to which a systematist might attach importance. But I should like to keep a mind open to the possibility that what might be called the primary features of the differentiation of the group, the development of the wings and the habit of preying on insects in flight, might have been developed quite rapidly, if we take an evolutionary scale of time.

Existing differences between species of the same genus must often have taken a million generations in their evolution, so that any great change taking place in say 100,000 generations would be from an evolutionary, or from a geological standpoint, extremely sudden, and I much hesitate to say what could not happen in this time, if the environmental conditions imposed a powerful selection in any one direction.

I do not know what are the morphological relationships of hair, but I suppose it is homologous either with scales, or with some structure of the skin between the scales, either in existing reptiles, or at least in those from which the mammals descended. Supposing such rudiments to have existed in an animal in which it was occasionally of great importance not to lose heat rapidly, I cannot convince myself that it would not have a very good pelt inside a hundred thousand generations, or that during this same time, if activity during chilly times of the day or year continued to be important, it would not have gone a long way in reorganising its circulatory system, and worked in a number of mechanisms for regulating its temperature. But even if you say that a hundred times longer would be needed for developing the primary distinctions of mammals, the paleontologists would still find that the group arose with great suddenness in the history of the rocks.

I think this must be partly because the evidence is based solely on bones, so that it is after all only a guess if we decide to think that the dinosaurs were cold-blooded, and not protected by something like hair. With this limitation of material one is forced to attach inordinate importance to any osteological feature which is exceptionally constant in a whole range of species. But that constancy I suspect is most often due to its being ordinarily so unimportant,

or so equally suitable to a great diversity of associated structure, that it has never been materially modified, not to its being at all remarkably difficult to modify. I may be wrong, but I should be inclined to guess that it would take no longer to breed a marsupial without the characteristic inflexion of its lower jaw-bone than it has taken to produce a bull-dog.

Now if osteologists are forced to base their principle conclusions chiefly on features of this kind, which happen to have characterised from the first the parents of great radiating groups, they must often be stressing features which have arisen quite rapidly, and in a sense casually, in the sense of being slightly useful to the parent species at a time when its food happened to have some peculiarity, not in the least representative of the types of food prevailing among its descendants. In fact if a fragment of an animal were discovered in the ancestry of the mammals, which in its major physiological adaptations was really a reptile, I imagine it might be described as unquestionably a mammal from osteological features^{of}/exclusively taxonomic importance.

So you see that, from being so far a heretic on the fossil evidence, I am debarred from relying on it in support of what I certainly think may be true, i.e. the rapid origination of the primary distinctions of great

classes.

I believe there is a fly whose larvae burrow in human skin, which lays its eggs not on its victims, but along the long legs of a gnat, which it catches for the purpose; with the result that the gnat runs the risk of being swatted, and the larvae, stimulated perhaps by the warmth and moisture of the human victim, rapidly hatch out and burrow into his skin. I suppose this group of instinctive and physiological modifications may have been elaborated in the last half million years. Whatever brought that about should find no great difficulty in a little problem like adapting a small mammal for flight! However one's judgment is weak about ^{int}intensities, and rhetoric is no substitute.

Yours sincerely,