

August
7th
1928

Dear Major Darwin,

What do you think of saying something like "I asked F for an estimate as near as ^{our} ~~other~~ present incomplete data would allow, of the number etc. F's estimate, which he has arrived at by a method which should certainly not give an over-estimate, is that about $\frac{1}{3}$ of a million of each sex, or $\frac{1}{60}$ of the total population would have to be promoted annually"

I think, in fact I am sure, that we have very much the same picture of evolution in our minds, but the picture in my mind has been changing of late, not in any way in principle, but, by groping after approximate magnitudes, in the proportion of the different parts.

I see three senses in which one mutation B may be said to be "on top" of another A. (i) A and B are mutually additive in their morphological or functional effects, as the ^{factors} ~~features~~ affecting body size in man are cumulative. This situation seems to be the really essential one for progressive evolution. (ii) The frequency of the mutation B is greater in the genotype which already contains A, than in those which contain the ~~xxxxx~~ non mutant predecessor of A (say α). (iii) B is a further mutation of the gene A itself, which cannot arise from α .

There is no evidence that (iii) occurs at all, though of course it may.

The cotton case shows that (ii) occurs, and so one must regard mutation rates as drifting, probably quite unguidedly, as the species genotype is modified.

My suggestion about dominance makes ~~one~~^{one} think of mutation rates as changing rather slowly, since the mutations which have become recessive in this way must have been very persistent. If then there is a possible but exceedingly rare mutation which is slowly increasing in frequency, then it may take if it happens to occur and happens also to get a good start, at an evolutionary stage at which it happens to be beneficial. But I suspect now that its usefulness to the species will change just as rapidly as its mutation rate can be expected to do. That is why I feel that the situation of the species waiting for the lucky mutation to occur may be quite an unreal one. I am inclining to the idea that the main work of evolution lies in the discovery by trial of perhaps rare combinations of its existing variants, which work better than the commoner combinations. A slight increase in the number of individuals bearing such a favourable combination will then set up selection in favour of all the genes in the combination, with marked evolutionary results. Many of these genes would have been previously rare mutant types (not necessarily rare mutations) unfavourable to survival.

I think of the species not as dragged along laboriously by selection like a barge in treacle, but as responding extremely sensitively whenever a perceptible selective difference is established. All simple characters, like body size, must be always very near the optimum, so much so that the average body sizes of two alternative genes must be balanced on either side of the optimum, selection always tending to eliminate the rarer

because it is further from the optimum. The selection in this case is proportional to the square of the magnitude of the effect of the gene, and a species affected by mutations making it large and ^{mutations} ~~selections~~ making it smaller will select persistently against both lots and make them both recessive. If now an increase in size becomes desirable, a number of the recessive enlargers will triumph, and the recessive diminishers will remain as rare recessives. So that the prevailing bias of dominance (enlargers being more often dominant than diminishers) will reveal the direction of the prevailing selection of the recent past. I should like to know if intelligence is less dominant to stupidity among Englishmen than among (say) Afghans.

Is not the case of poultry queer? There must be 8 or 10 factors in domestic breeds, non-lethal and dominant to the apparently wild-like characters. I do not feel it personally as a difficulty to my theory of dominance, because on any view one would want to know why poultry should behave ^{differently} from other beasts and birds, to say nothing of plants; and to this we have no clue. That species crosses have occurred is likely, and though all possible species have, I believe, single combs, they may, as you suggest, genetically unlike single combs, which on combination might give Rose and Pea. Is any form of unintentional human selection possible? Were hens only kept at one stage, constantly outcrossed with wild cocks, and so only dominant novelties selected?

probably some
cocks also

Yours sincerely,

(sgd) R. A. Fisher

I believe this works. The primitive fanciers would have to be always selecting heterozygotes from wild type birds in the same brood, and would therefore be constantly increasing the contrast. Dominance of several of these fowl dominants is very variable in its completeness in different breeds. How is that!

From MAJOR L. DARWIN, Crippa's Corner, Forest Row, Sussex.

I am sending you a French
periodical, I believe because I
cannot bear to read it myself.
Don't curse me, and don't read it
yourself unless you want to.

Throw away when done

I have not got back M^{rs} H's letter
of appointment, I suspect because of
holiday. I am glad she is going
on a holiday, but I regret she will
come back. [7 August 1928] L. D.