14th March 1934

Professor Haldane,
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W.C.1.

Dear Haldane,

In your case 3 c with equal frequencies and random mating among the two different kinds of double heterozygote, suppose a family has c double recessives, b single recessives, and a non-recessives then one can give such a family a value

$$k = (a - 3b + 9c)^2 - (a + 9b + 81c)$$

and the statistic obtained by averaging all the families observed will be efficient in the limit for loose linkage. If in practice some of the families are unobservable, e.g. those in which there is neither a double recessive nor both kinds of single recessive, the same coefficient can be used, but the result must be equated to a different function of the recombination value.

When all types of family are observable this gives $I_o = \frac{32}{81} \wedge (5-1)$ Which should serve to check up the efficiency of other methods such as

Bernsteins'. I do not know how these results can best be proved, as I muddled them out rather clumsily in view of their real simplicity as a commonsense method for comparison, since $a - 3b + 9c$ is an efficient test of significant linkage in a single family. I tried, before knowing the real result,

$$\eta = (a - 3b + 9c)^2 - 9(a + b + c)$$

in the case $s = 4$ where it elicits 128/47 instead of 128/27 units of information respecting s, so that guess was pretty inefficient.

I am enclosing your note.

Yours sincerely,