PROFESSOR R. A. FISHER, Sc.D., F.R.S.
MRS V. F. LEONARD Assistant Geneticist
K. WILLIAMS, A.L.A. Secretary

UNIVERSITY OF CAMBRIDGE
DEPARTMENT OF GENETICS

Whittingehame Lodge,
44 Storey's Way,
~~DEPARTMENT OF ZOOLOGY~~
~~DOWNING STREET~~
CAMBRIDGE
Tel. 55822

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Dear Gray,

After consulting Powell at Caius, I think a usefully constructive suggestion may be that, parallel with and alternative to the present course in Mechanics, there should be one in Elementary Statistics and Combinatorial Theory. Such a course will need a bit of framing ; I am sure it should not be elementary statistics only, but that a number of the ideas of pure mathematics, for example, partitions, groups and matrices, should be made familiar to mathematically-minded students taking biology, if only we can persuade the mathematicians to treat them lightly enough. The main point is gained if the student is put in a position not to be paralysed by the mere mention of such things, but, while recognising them as intricate and perhaps somewhat mysterious, ~~feels~~ to feel that they are inherently rational and manageable, and that if he encounters them he will be in a position to find out at need what to do about them. I should not like the mathematical faculty to think that the needs of biologists are more exclusively "applied" than those of physicists(they are really less so), or that because the better mathematicians are and will be for some time attracted preferentially into the non-biological sciences, therefore the needs of biologists are not worth troubling greatly about.

The enclosed was drafted largely to clear my own mind, but I hope it may supply material for discussion.

Yours sincerely,

R. A. Fisher

(a) <u>Superficial combinatorial analysis</u>.

Enumerations, e.g. those connected with the multinomial expansion. Differences of powers of zero. Notion of a partition (not all about them); summation over all partitions of a number or over all with a given number of parts. Generating functions of probabilities.

(Nothing like the whole theory of finite groups.) Structural notion of groups and sub-groups. Permutation groups as a means of classifying and enumerating combinatorial arrangements.

Idea of a matrix. Repeated linear transformation. Inconsistent, superfluous and insufficient linear equations related to matrix properties (as in Levy's <u>Algebra</u>).

(b) <u>Elementary statistics</u>

Poisson, Binomial and Normal distributions.

Formulae by which they are represented; simple properties. Experimental conditions of occurrence. Statistical methods of recognising their occurrence.

Tests of significance <u>χ^2, t and z</u>; connections with the distributions above. Relations with analysis of variance.

A good deal of illustrative material under (b) is to be found in <u>Statistical Methods</u>; some under (a) in <u>Design of Experiments</u>. To illustrate further the kind of problem which arises in biology, I append a few problems.

1. A square divided into 25 equal squares is laid on a plant association and found to contain _n_ individuals(of a particular species). If these are distributed at random,

(1) what is the average number of empty squares ?

(2) what is the probability of at least _k_ squares being empty?

(3) what is the probability of exactly _k_ squares being empty ?

2. _k_ kinds of flowers being available, in how many ways can a bunch of _n_ be made up ?

3. If _n_ different kinds of animals are bred in equal numbers, what is the probability of getting a complete set in the first _s_?

What is the average number which will need to be bred(one by one) to get a complete set ?

4. If _n_ different kinds of each sex are bred in equal numbers, and each animal is an eligible mate for only one kind of the opposite sex, what is the probability of getting an eligible mating in the first _s_ ?

What is the average number which will need to be bred ?