

29 June 1945

Dear Fryer,

I enclose a new note on the proposed Department or Unit or Institute at Cambridge, and two old notes on Animal Genetics and Livestock Improvement which may have come your way, but which perhaps have not yet done so.

Yours sincerely,

29.6.45

[Centre for Agricultural Research Statistics at Cambridge]

The functions foreseen for a statistical centre supported by the Agricultural Research Council in Cambridge are:

- (1) Fundamental research in mathematical statistics, including the development of appropriate and adequate methods in any field in which difficulties have arisen,
- (2) Advising various A.R.C. committees on the design of their experimental programs and the examination, as required, of the experimental data obtained, and
- (3) Maintenance of contact with statisticians in other centres of agricultural research with a view to putting improved methods at their disposal, discussing new types of problem as they arise, and undertaking a fuller examination of special bodies of data, when these seem to require it.

In these respects it is presumed that the functions are similar to those of the existing Department at Rothamsted and of the proposed centre at Edinburgh. As between these three centres, however, it will probably be convenient to allocate fields of special interest in which each is to be primarily concerned. In view of the present activity of Rothamsted in the fields of plant nutrition and of large-scale sample surveys, it is probable that the Cambridge centre need do little in this type of work. A very great deal of statistical work is, however, required in

veterinary research, including the biological assay of accessory food factors, virulence, vaccine-potency, etc. In view of the small unit already built up in Cambridge for work of this type, it would seem suitable, and I should be glad, if this work were handed over from the inception to the Cambridge Institute.

Secondly, I enclose with this memorandum two papers previously submitted, on Research in Animal Genetics and the Improvement of Livestock. Whether it is thought most suitable for the statistical researches required in this line of development to be carried out at Cambridge or at Edinburgh, I should like to stress the importance of handing over this statistical aspect of the livestock improvement programme to a special unit of qualified statisticians working in close touch with, but independently of, the other problems of livestock improvement. In a matter of the technical difficulty to be expected, the success of any livestock program undertaken must, it seems to me, be assessed objectively and by persons independent of those responsible for its development and control.

Thirdly, I should like to raise the question of Agricultural Meteorology (crop-weather relations) and of climatological studies needed for agricultural development. While at Rothamsted, I did a good deal of work of this kind and projected much more. I do not know what plans are at present being made for the reconstruction

of studies in agricultural meteorology, but in this field also there will certainly be a need of a nucleus of qualified statisticians with as much experience as possible of meteorological data, to whom questions of current interest can be referred.

In all these fields it will be difficult to find men with adequate experience of the subjects to which statistical methods are to be applied. Some able young mathematicians with statistical knowledge could certainly be found, and among them some with theoretical knowledge, at least of the principles of experimental design and perhaps of biological assay. Generally speaking, we must look to the experience to build up gradually a competent acquaintance with veterinary, genetic, or meteorological problems. Institutes or Departments such as the A.S.C. has in view should, however, be particularly critical in giving men of adequate statistical background the type of experience and the intellectual contacts needed to mature their abilities.

29 June 1945

RESEARCH IN ANIMAL GENETICS

The amount of institutional space, time and expenditure given to genetics in this country in the past has been so meagre that it is somewhat embarrassing to be asked for a programme touching on the application of genetic research to the breeding of animals of economic importance. It is like being asked for a programme for the development of the chemical industry in a country where the majority of compounds and elements are unknown and laboratories do not exist in which they can be recognised or prepared.

For any species of animal or plant to the improvement of which it is hoped that genetics should contribute the first necessity is a centre, or series of centres, at which the species can be maintained for experimental breeding and quantitative and qualitative testing. It is quite true that the early geneticists were unduly optimistic as to the practical application of the small amount of information so far gathered about hereditary factors in each species. Naturally, the early work was confined to factors acting unconditionally on conspicuous characteristics, and these were not of themselves necessarily or usually of practical value. This was, however, the only beginning which could be made and it supplies a foundation which is not the less necessary because we now realise that the study of quantitative characters is far more difficult, requiring more elaborate methods, and has been avoided by professed geneticists only by reason of its difficulties and not because its importance, both practical and theoretical, was not obvious.

It seems to me essential that a centre for genetical research on any species should collect and maintain all the factors known in that species, apart from factors of purely pathological interest, difficult to maintain in normal stocks. Such material is, I believe, ideally maintained in segregating inbred lines such as, working unsystematically, I have shown to be possible with mice. An adequate selection of such lines appears to me indispensable for expeditiously analysing new material in respect of all known factors as a preliminary to locating and studying any new genetic peculiarities it may possess. The advantages for academic genetic research of this procedure are:

(1) It is only in segregating inbred lines that the effects of specific characters can be manifested without disturbance due to other genetic differences. They are therefore indispensable for the teaching of students, and the preparation of museum material demonstrating such differences.

(2) They provide the basis of analysing or synthesis of unknown genetic composition.

(3) They provide perpetual standards of comparison available for quantitative studies.

I stress this point of the maintenance of known factors because there seems to be a danger that the realization of the inadequacy of the point of view of the earlier geneticists should lead to neglect to use what they have in fact accomplished.

With respect to applications of economic or other practical importance, it is for geneticists to maintain material and equip themselves with adequate methods, rather than to find the problems, which will always depend on the circumstances of practical husbandry, changes in which can be no more foreseen by geneticists than by any other class. It may be foreseen, however, that facilities for testing quantitatively the performance of individuals in numbers will be essential in any field, and one would like to look forward to a stage at which the maintenance, testing, and selective improvement of elite stock of each species should be the care of geneticists. The existence of elite stock showing superior performance in objective quantitative tests is the prime necessity in any programme of the improvement of farm animals, whether this improvement is effected by the sale of superior sires or through the medium of an organization for artificial insemination. Neither method would improve the livestock of the country unless the pedigree material used in its improvement is genuinely and objectively superior for the purposes and in the conditions in which the stock is utilised. I should above all emphasize the importance of developing performance tests, and in these an aspect not to be neglected concerns performance in conditions which are diverse and far from optimal.

I. Livestock Performance Tests Laboratory

This should be a biometrical laboratory charged with the study and improvement of performance tests, intended to compare and assess the value of farm animals.

Improvement here means an increase in the precision with which each set of observations measures

(a) the economic value of the individual animal in the practical conditions of animal husbandry for which it is designed

(b) the genetic value of the animal as breeding stock.

Data for such study should be obtained from (a) the existing body of published researches and later additions to this, and from (b) provisional standard tests made on elite material maintained at Livestock Selection Centres, and drawn up in consultation with those centres.

II. Livestock Selection Centres

These should be charged with the maintenance and improvement of sources of elite stock suitable for the needs of the areas they serve. Their policy should not be controlled by the Performance Test Laboratory, but they should owe the duty to record the observations and perform the tests required by the latter. They should also maintain such standard stocks, known genetic factors, inbred lines, etc. as the Performance Test Laboratory may need for the assessment of the success of any selection programs adopted, and for the study of

means to its improvement. They should be responsible for specifying and carrying out their selection procedure with experimental precision, irrespective of commercial profit, and for supplying their records for study to the Performance Tests Laboratory.

Such centres may handle one type of animal only, or more than one, according to the facilities available and the needs of their areas. They should, where possible, be associated with centres for agricultural education, with veterinary research, or with artificial insemination units, but they should in any case have an independent personnel. It is important that the stock should come under the observation of a qualified geneticist, but until more such are available, it would be useless to require such a qualification in the director.

Presumably about twenty such Centres will be required. Provision must be made in advance for the regular expansion of each over an initial period of fifteen years, by which time they could be properly staffed and capable of taking advantage both of theoretical genetic knowledge, and of the practical experience needed for its application, which the initial period is intended to provide.