# BREEDING METHODS IN LIVESTOCK IMPROVEMENT

PROBABLY at no time during the past hundred years has there been so much current of changed attitudes and values sweeping through the minds of stockbreeders. While the general public may have noted the effects of the war-time food policies on milk production and on the sheep, pig and poultry populations, it is fair to suggest that only those who face the practical aspects of the British livestock industry recognize the multiplicity of problems that the war situation, added to the general trends, has left. The recent years have thrust many changes upon this branch of British agriculture—not the least of which may be those of thought regarding the aims, methods and responsibilities of the different sections of the industry. It may be significant, in one sense, that, throughout the whole of the meetings on February 26 and 27 of the British Society of Animal Production, the well-known and still hardy phrase 'the stud farm of the world' was not once used. There was no lack of opportunity, since breeding methods, techniques and aims were the main items under discussion.

The situation in poultry breeding adumbrates also some of the major problems of improvement in the larger farm animals. As Mr. Michael Pease defined it, the empirical methods of the past have more or less rapidly raised production to a level or ceiling beyond which progress is slow or impossible—the practical problem now is not grading up but seeking enhanced production within 'improved' stocks. His work at Cambridge and Reaseheath represents one approach to the problem in poultry, that of Dr. A. W. Greenwood at Edinburgh another, and complementary, attack. The former utilizes inbreeding to develop lines, which may or may not be of the same productivity as the control stocks, but which may be combined to give more productive outbred lines within the pure breed. This procedure, deliberately pursued, is new to practical stockbreeding in Great Britain; and the investigations now in hand, involving 'top crossing' inbred lines, are designed to discover the part that cross-breeding can play in improving performance and whether it can produce as good stock as does out-breeding. Within the White Leghorn breed and under the specific conditions of these experiments, there has been no significant increase of egg production so far, but the results are sufficiently encouraging to warrant continuance of the work.

The Edinburgh investigations also use the inbreeding technique, but in different degrees, and to the different end of studying the physiological components of egg production. A series of selected inbred lines of Brown Leghorns has been established under as uniform as possible conditions of feeding and management, each line being distinguished by one particular attribute, such as intensity of laying, persistency, small egg size, large eggs, body size, etc. Concentration on a single productive characteristic in one line has enabled not only the genetic basis of that character to be studied but also the significance of other important conditions, such as mortality, livability, and resistance or susceptibility to tumours, to be recognized and analysed in relation to the practical requirements of high production, vigour and stamina.

The larger farm animals cannot usually be kept in numbers under uniform conditions, so that differential responses to environment are important in practice. 'Suitability to environment' has been given lip-service as a breeding aim, yet the recession of the breeding centres, which follows, perhaps inevitably, the phase of widening influence and distribution of improved types, emphasizes the significance of adaptability of type to environment. Moreover, the ways in which a breed population is built up, in relatively small units, with possibly different breeding systems and standards in these units, point to the necessity that breeding policies should relate to the breed as a whole. The ultimate problem is that of the frequency of desirable, or undesirable, genes within the breed; it is one of population genetics.

However, as Dr. J. E. Nichols was careful to point out in introducing the topic, economic, or performance, characters are greatly influenced by feeding and management; their heritability is relatively low. Therefore the general question is one of discriminating between how much progress is attributable to genetic improvement, and how much is due to environment. The first, and probably the easiest, steps upwards from low average performance-levels can no doubt often be made by improved husbandry, but the real genetic gains can only be achieved by appropriate selection and breeding methods. The discussion revealed doubts as to whether in the British dairy cattle breeding industry, for example, the necessary performance data have yet been acquired, or those available used enough, to enable modern selection procedures to be widely applied. Future progress will depend upon suitable arrangements for the collection, analysis and interpretation of adequate data to provide standards of selective registration upon which the breeders can base their breeding policies.

A particular tool which may be used is artificial insemination, and a series of papers gave opportunity for a searching review of its practical application and problems.

Following an account of developments in Denmark, Canada and the United States, Mr. Twinch stated the essential requirements for comparing progress with artificial insemination—uniformity and simplicity in the systems of recording the relevant data, and agreement on methods of assessing the final results. Mr. D. L. Stewart described the organisation and administration of a centre, based upon experience at Reading, and directed attention to the need for all heifer offspring to be marked and afterwards recorded if the full benefits of the technique were to be estimated. Mr. L. S. Rowson proved that proper care and management of bulls at centres involved more than control of nutrition and husbandry; inferior performance in service and failure of sex drive are largely attributable to mishandling of the animals owing to lack of knowledge of the psychological processes involved in the sexual act. The scope for observations on behaviour in this respect is immense; and such studies at the Cambridge centre show that the field for research is widened far beyond that of the physiology and biochemistry of reproduction. On the latter, Dr. Arthur Walton contributed an excellent historical summary together with a critical account of recent investigations, including those of the various fractions of egg-yolk medium in relation to their effects in sperm dilution and storage.

Dr. Walton's lesson that organisation must not be allowed to outrun knowledge, and that provision for fundamental research is essential, was fully supported

by considerations raised by speakers concerned with the actual technique in its practical application. Thus, even with the necessary density of cow population within reasonable distance, the successful operation of an insemination centre depends upon a satisfactory recognition of the administrative, economic, and technical problems, in themselves and in their inter-relations. For example, if artificial insemination is to be used as a means for milch cattle improvement, a centre must clearly be able to supply semen from proved superior bulls. How can these sires be chosen with sufficient certainty? Are such bulls available in sufficient numbers and at a reasonable cost? The cost of inseminations must be made competitive with that of natural services; the results in terms of service efficiency, or conception-rates, must be comparable with natural matings, and those in terms of the performance of progeny must be demonstrably advantageous, so that farmers are encouraged to use the centres. Further, the centres must have definite long-term breeding policies.

A full report of the proceedings will be published.

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## NATIONAL ACADEMY OF PEIPING AND ITS WAR-TIME ACTIVITIES

THE National Academy of Peiping was founded by the National Government of China on September 9, 1929, with Dr. Li Yu-Ying as president and Dr. Li Shu-Hua as vice-president. It consisted originally of nine separate departments, the Institutes of Physics, Radium, Chemistry, Materia Medica, Physiology, Zoology, Botany, Geology, and Historical Studies and Archæology. The new Academy flourished and in a few years had made valuable contributions to many different fields of research. By 1935–36, however, the political situation in the northern provinces of China made necessary the evacuation of several institutes to safer areas. On the outbreak of war in 1937, Peiping was immediately taken over by the Japanese, and the Academy was forced to abandon all its remaining activities there. Despite the confusion, some books and equipment were moved southward and eventually, despite immense practical difficulties, the Academy was able to resume much of its work at Kunming. During the War, the policy of the Academy has been to devote its attention largely, but not exclusively, to the immediate needs of the nation.

In the Institute of Physics research work was originally devoted largely to problems in photography, spectroscopy, piezo-electricity, and geophysics. After the evacuation to Kunming, attention was turned mainly to practical problems, particularly the manufacture of optical instruments. A great variety of optical parts are now produced; 500 microscopes have been built as well as 150 sets of optical parts for surveying instruments. The optical division also repaired apparatus for the American Air Force in Kunming. The Institute prepared 1,000 piezo-electric quartz plates for stabilizing transmission from numerous low-power radio stations established throughout Free China. The Institute's geophysical surveys led to discoveries of great economic importance.

In Peiping the Institute of Radium consisted of three laboratories for studying chemistry, radioactivity, and X-rays. The radioactivity of protoactinium was closely investigated, as well as the radioactive and chemical properties of many Chinese minerals. On the outbreak of war, this Institute moved to Shanghai, where work was carried out on the absorption coefficients of $\beta$-rays, certain colour effects of $\beta$- and $\gamma$-rays on glass, and the analysis of alloys by X-ray methods. When conditions in Shanghai became impossible, Dr. Choong, who had been engaged in spectroscopic investigations, made his way to Kunming and resumed work there, primarily on the fine structure of quartz. The Shanghai laboratories continued to work, under Dr. Lu, but were isolated for more than three years.

Since its evacuation to Kunming, the Institute of Chemistry has largely concerned itself with practical problems such as the extraction of dyes from local plants, the preparation of medicines and the manufacture of industrial alcohol. Time has also been found for some purely academic research, including synthesis of substances related to vitamin K and to rotenone, investigations of pinacol rearrangements, and the study of Grignard compounds and cobaltammine complexes.

Extensive research on Chinese drugs was done before the War at the Institute of Materia Medica, but this was twice interrupted by evacuation, first to Shanghai and later, in part, to Kunming. Dr. Chuang has made notable contributions to the chemistry of hormones, and, despite great difficulties, has continued this work since his arrival in Kunming in 1944. Intensive search has been made for new synthetic antimalarials. Drugs such as ephedrine and vitamin $B_1$ have been prepared on a commercial scale.

Before evacuating to Kunming, the Institute of Physiology carried out investigations in experimental biology, cytology, and physiology. At Kunming some applied research was started, but lack of staff compelled the abandonment of all research in 1943.

The main work of the Institute of Zoology has been ecological studies throughout China. After evacuation to Kunming a detailed study was made of the freshwater fauna, reptiles, and spiders of Yunnan.

The Institute of Botany has worked mainly on the taxonomy of Chinese plants. Since the evacuation to Shensi Province, the work has continued with the plants of north-west China, particular attention being given to plants of economic importance; extensive collecting expeditions have been organised.

While in Peiping, the Institute of Geology co-operated with the Geological Survey of China and made many important contributions to knowledge of China's geological history. One of its best-known discoveries was that of the remains of *Sinanthropus pekinensis* (Peking man). Much time was given to palæontological research. In 1935 the greater part of this Institute moved to Nanking. In 1937 a further move was made to Beipei, near Chungking, where, despite these setbacks, extensive field and laboratory studies, particularly of mineral deposits, have been vigorously pursued.

The Institute of Historical Studies and Archæology was formally founded in 1937 from an existing Committee of Historical Studies. Before the War much work of exploration and discovery was carried out in all parts of China, but particularly round Peiping, with fruitful results. Since its evacuation to Kunming, study has largely been confined to ancient Chinese history, the classification of material from excavations in Shensi, and the collection of material relating to aboriginals of regions bordering China.