AIMS IN LIVESTOCK BREEDING AND THE GENETIC AND PHENOTYPIC LIMITS TO PERFORMANCE

S.K. Stephenson

Department of Animal Science, University of New England,

Armidale, N.S.W. 2351

Predictions of gains from industry breeding programs have, in the past, been made using measured genetic parameters (heritabilities and genetic correlations) together with known selection intensities to derive an estimate of the rate of genetic change in the population. Evidence is accumulating, however, which suggests that the mean phenotypic value of a population may not respond in the expected manner. Poultry selected for egg production in United States breeding work have shown little positive response for the past decade although additive genetic variation remains in the population. Sheep selected for wool production in Australia have shown responses which depend on the nutritional environment and it is likely that, as well as the inherent genotypic values of individuals in the population, the intake and availability of sulphur containing amino acids provides a critical limitation.

Milk production in dairy cattle and growth rate in meat animals do not yet appear to have reached any phenotypic limits, although there have been considerable changes to the animals' metabolism and the partitioning of energy intake. Provided that nutrition is optimal and is improved to match the requirements of "improving" genotypes modern livestock breeding can be said to have increased overall animal efficiency through a reduction in maintenance costs relative to the output of product, a reduction in costs for the development of unproductive young stock and a re-direction of food constituents into the type of product that meets consumer demands. The major costs of achieving these gains have been the need to increase the quantity and often the quality of the diet. Consequently it has been necessary to increase the fossil fuel and human energy inputs needed to sustain the system.

For the future it seems necessary to consider whether it is desirable to continue the drive towards genotypes that give more efficient production under good conditions, but may be inferior in a poorer environment. This aspect is particularly relevant where livestock are raised under a variety of grazing systems and total fitness is as important as quantity of product.

We are rapidly acquiring the genetic, nutritional and physiological knowledge needed for evaluating options and developing optimal strategies. A clearer definition of selection objectives and a multi-disciplinary approach seem essential for real herd and flock improvement.

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