SELECTION PROBLEMS IN ANIMAL BREEDING*

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ALTHOUGH ARTIFICIAL SELECTION for the improvement of domestic animals has been practiced from ancient times, there are many problems on which the information available is extremely scanty. As a result, much of the breeding rationale in use is based on purely empirical observations. One of the most important questions which needs further study is that of determining the limits of selection for characters whose variation is controlled by many gene differences with very small individual effects. Experiments on selection have demonstrated that progress may continue beyond the limits anticipated on the basis of a priori assumptions of blending inheritance. Among such experiments are those of Goodale, who selected for increased body weight in mice in one experiment and for the number of white hairs on foreheads in the same species in another.

There are many conditions limiting the progress to be expected under selection. These may be classified in four categories:

1. Difficulties in evaluation of genotypes, which may be considered in terms of:
   - *a*) Incomplete heritability,
   - *b*) Maternal effects,
   - *c*) Non-additive gene interactions, such as dominance and epistatic effects,
   - *d*) Interaction between genotypic and phenotypic variability.
2. Limitations due to the immense number of gene combinations possible, and lack of control over them. These may be discussed in terms of:
   - *a*) Number of gene differences involved,
   - *b*) The frequencies of different alleles at each locus in a given population,
   - *c*) The elimination of alleles through inbreeding, and the consequent imposition of homozygosity.
   - *d*) Restrictions on recombinations due to linkage.
3. The practical necessity of selection for several characters at the same time.
4. The eventual approach to extremes producing possible physiological incompatibilities.

These difficulties can be overcome in some measure by such means as progeny testing, enforced maintenance of heterozygosity, culling on the basis of a properly constructed index, and other breeding techniques. However, it is obvious that in the selection of domestic animals full utilization of the genetic variability in a given population has not been realized. In order to achieve this result, it is necessary to obtain more definite information on many of the points

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