1911. It has been estimated that more than 55% of cattle now arrive at market by truck transport.

**Systems of Production**

Systems of production have consistently been altered to include animals at younger age and heavier weights. The utilization of grass has become common of all types of cows and feeding animals. Steer production at the national markets are largely made up of animals weighing under 1100 pounds grading choice or better.

The step toward the use of younger more efficient animals is converting rangeland into beef.

**Progress in Animal Breeding**

**Walter H. Smith**

The Trend of the Purebred Livestock Industry.

The purebred livestock industry was well established in the United States 50 years ago. Breeding records were active in promoting breeds and maintaining pedigrees. Livestock shows were well established in the early 1900's and have continued, with breeders relying on placing animals in shows for guidance in livestock selection. More recently, livestock shows have been increased and the discrimination has increased against excess external carcass fat as upreared in both sire slaughter animals and their ancestors.

During the last 50 years the purebred segment of the United States livestock industry has increased proportionally and considerably. "Grading up" has been accomplished in the larger commercial cattle herds and beef and pork. Many type changes have taken place, particularly in cattle and swine, and some breed comparisons have been made. It appears that the major objective of all purebred meat animal breeding has been to develop breeds more essentially efficient in production and to breed more closely to the consumer. Many of the major livestock breed associations have adopted herd-breeding programs in the measurement of production traits, including carcass size. It appears that breeders have received and applied these plans with sufficient interest to assure future effort in that direction.

Developing New Breeds.

Some new breeds of livestock devoted to meat production have been established. In the main, they have been developed from breeds and species crosses. It appears that the major objectives of this effort have involved improved environmental adaptability and increased productivity, commonly measured in terms of growth rate, in our existing livestock. Many of the new breeds have survived commercial preference well; however, only annual, evaluative research has been accomplished to date. Many of the general purposes and genetic principles involved do not differ widely from the fundamentals of crossbreeding.

**Applying Genetics to Animal Breeding**

The principles of Mendelian genetics were rediscovered at the beginning of the 20th century. Applying genetic principles to animal breeding has been slow but progressive. Most of the early efforts devoted to research on animal genetics concerned the simple inherited qualitative traits, such as color markings and abnormalities such as leghorns and whiteface. Considerable work has continued in this area as circumstances have required, as pollination in beef cattle has increased. The area of quantitative inheritance is not closed to research; however, the main efforts devoted to animal genetics research is in quantitative inheritance, which includes the conventional production traits of farm livestock.

Methods of measuring the genetic relationship between animals and the degree of inbreeding possessed by individual animals were discovered in the 1920's. Statistical techniques to analyze quantitative inheritance were formulated during the 1930's. Methods to measure performance traits in livestock were evaluated during those periods. These areas of research provided the basis of livestock selection procedures, which have been progressively developed since about 1940.

**Studies of Animal Breeding**

Studies of Animal Breeding Plan.

Basically there are two animal breeding plans, outcrossing and inbreeding. Outcrossing by crossbreeding has been widely adopted in the commercial swine and beef industry. The practice is not new; however, research on the subject is fairly recent. Some heterosis or hybrid vigor has been observed with regard to most production traits. Crossbreeding tends to be superior to the parental average, while certain breeds of the new born and increased reproductive efficiency seem to be among the important advantages. Studies devised to research inbreeding in beef cattle are in progress but findings to date are preliminary and inconclusive. It appears that outcrossing will play an important role in the production of future meat animals.

Technological research studies on the effects and feasibility of the use of inbreeding have been in progress since the 1930's. The development of inbred lines of livestock is expensive and time consuming. Limited commercial use of inbred swine, cattle, or sheep has been made to date, nevertheless, research to evaluate the feasibility of the development and use of inbred lines of livestock will continue.

**Studies on the Inheritance of Performance Traits**

Estimation of heritability values for nearly all the production traits of meat animals have been reported by research workers during the last 20 years. Heritability is generally defined as the proportion of the differences measured or observed between animals that is transmitted to their offspring. Simple estimates of heritability are subject to considerable error. Through information is available now to justify reference to average heritability values for production traits by the use of selection procedures.

Research has also been done on genetic and phenotypic relationships between production traits. Many research selection projects are currently in progress to further evaluate that area of animal genetics.

**Selecting Meat Animals**

Selection in meat animals is complicated by numerous production traits. The traits of high economic value and heritability should be emphasized in selection programs. Selection indices that give two or more production traits for the various meat-producing species used to be developed. Additional information regarding heritability values and phenotypic correlations and genetic correlations for production is needed. Simple ways to measure some production traits, especially those involving the animal carcass, should be developed. Most of the factual information available on these problems has been reported in the last 20 years, yet this is still a very active area of animal breeding research.

Selecting cattle has been accomplished on the basis of selection. Progeny testing appears to be an important technique in genetic improvement of beef traits and other production traits of meat animals which are economically important but low in heritability.