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TRANSMITTING ABILITY OF DAIRY SIRES

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The milk yield of any given cow is the product of two contributing factors *Heredity* and *Environment*. Environment is directly responsible for the expression of production, but the potential ability to produce a given yield is unquestionably due to the influence of heredity. If Mendel's laws of heredity had been accepted and used at the time of their discovery as they were after their rediscovery half a century later, it might not be necessary to admit at the outset, as we are now obliged to do, that our knowledge of the influence of environment as affecting production has far outstripped our understanding of the influence of heredity.

Inheritance Studies—Methods In Use

Aside from some three or four hybridization experiments the majority of the inheritance studies which have been made on yield of milk have centered around the influence of the sire and the effect which he has had on the production of his daughters. From an economic standpoint such studies were undoubtedly merited, as the effect of the sire in the long run appears to be equivalent to the combined influence of all the cows with which he is mated. The common method used for the evaluation of the influence exerted by the sire, however, may well be scrutinized.

It has been the practice of investigators in evaluating the effect of a sire upon the production of his daughters, to compare the records of the daughters with those of their dams expressed in terms of pounds of milk or fat, or both, and conclude that the difference either up or down was due to the influence of the sire. Obviously such a method has certain disadvantages, for instance:

1. The physiological limits of production are determined not so much by the number of pounds of milk or fat as by the energy required to produce a given yield of solids, the water being incidental in the process of secretion.
2. Assuming that such a method does yield accurate information in the case of a bull when mated to cows all of which possess a given transmitting

ability, it does not yield reliable information as to what might be expected of the same bull when mated to cows of an entirely different productive capacity.

3. Such a method does not set a definite value for the transmitting ability of a sire regardless of the reproductive capacity of the cows with which he is mated, but gives merely a relative value which is expressed in terms of the production of the dams of the daughters.

This paper is, therefore, intended more as the report of the development of a method for determining the transmitting ability of dairy sires than to stand as a record of results obtained by the application of such method.

Suggested New Method

It seemed desirable and necessary at the outset of this study, in order to obtain maximum uniformity, to correct for two variable factors which are highly influential in determining the amount of production and for which we are most fortunately in possession of correction factors, these are:

1. For differences due to age.
2. For the influence of per cent fat content of milk.

Correction factors used for the former have been supplied by Gowen¹ in the case of the Holstein-Jersey and Guernsey breeds and for the latter by Gaines and Davidson² who by their equation $.4M + 15 F$ correct for the influence of fat content to the physiological equivalent of 4 per cent milk. By the use of these two correction factors it was possible to obtain for each cow one value, namely the yield of 4 per cent milk.

The average production for the daughters of a given sire thus obtained was then compared with the average production of their dams, but instead of using the difference as the measure of the transmitting ability of the sire the following equation was developed:

$$X = 2a - b$$

When X = transmitting ability of sire expressed in terms of 4 per cent milk.

a = yield of milk of daughter corrected to 4 per cent equivalent.

b = production record of dam expressed in terms of 4 per cent milk.

¹ Report of Progress on Animal Husbandry Investigations in 1919, Maine Agricultural Experiment Station Bulletin 283.

² Gaines and Davidson—Relation between Percentage Fat Content and Yield of Milk, Illinois Bulletin (1923), 245.

Illinois Bulletin (1923), 245.

The necessity for the use of this equation is the stimulating or suppressing influence of the dam. For instance, if a sire when mated to cows whose average reproductive capacity was 15,000 pounds of 4 per cent milk produced daughters that averaged exactly 15,000 pounds of 4 per cent milk, but when mated to cows whose average reproductive capacity was 10,000 pounds produced daughters whose average production was 12,500 pounds milk the depression would be regarded as due to the influence of the dams. In other words the average difference in the production of the daughters of a bull as compared to the production of their dams is increased or decreased by one-half over or under what it would have been had that sire been mated to cows exactly his equal in transmitting ability.

The value obtained by the above equation is, therefore, the amounts of 4 per cent milk the capacity for the production of which a sire might be expected to transmit to his daughters when they are producing under the same environmental conditions—*provided* that he be mated with cows exactly his equal in transmitting ability.

In order to obtain a definite standard by which to measure a sire this value should be further compared to the mean production of cows in general and the latter considered as 100 per cent transmitting ability. This result when expressed in per cent gives the estimated ability of the sire to transmit production to his daughters expressed in terms of the general average.

SOME PHASES OF WOOL INHERITANCE IN F_1 GENERATION

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In a study of data obtained from a crossbreeding experiment with Hampshires and Rambouillets now in progress at the Wyoming Station, some very interesting facts were brought out in a study of fineness and density in the parents and in the F_1

¹The writer wishes to acknowledge many helpful suggestions by Dean J. A. Hill, who planned the experiment, and measurements of a number of samples made by A. G. Hutton and H. F. Eaton, formerly in this department.