

MASSACHUSETTS  
AGRICULTURAL EXPERIMENT STATION

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## Poultry Flock Improvement

By J. C. Graham

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Many commercial poultrymen in the State are anxious to develop a high degree of efficiency in their flocks but hesitate to undertake pedigree breeding. This project was, therefore, planned to determine whether it is possible to build up and maintain desirable characters in a poultry flock without pedigreeing, but through the annual introduction of males from superior stock.

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MASSACHUSETTS STATE COLLEGE  
AMHERST, MASS.

# POULTRY FLOCK IMPROVEMENT

By J. C. Graham, Professor of Poultry Husbandry

The purpose of this bulletin is to set forth the results to date of the Flock Improvement Project inaugurated in 1930, together with certain interpretations and conclusions. As it was necessary to carry on the work at a very moderate cost, the size of the project was limited. However, the number of birds involved was large enough to show definite trends.

This is termed a "flock improvement project" to distinguish it from pedigree breeding. In the former the flock is treated as a unit; in the latter the individual bird or family becomes the unit. In general practice this project does not necessitate trapnesting.

The purpose of the project was to determine whether it is possible to maintain or improve body weight, feather color, egg production factors, hatchability, and size, shape, and color of eggs without pedigreeing but through the annual introduction of new blood from reliable sources.

There is a very large group of commercial poultrymen, reproducing their own flocks and selling hatching eggs and baby chicks, who would like to retain or develop the above characteristics in their flocks and maintain them at as high a point of efficiency as possible, but who do not wish to resort to the technical methods required in pedigree breeding or even to maintain selected breeding pens for cockerel production. As the majority of layers in the State comes from these flocks, the more efficient they become the better for the industry.

With the results of this project decidedly positive, its general adoption would mean a great saving in the production of good chicks by this group of poultrymen, many of whom are now trapping a portion of their flocks without adequate returns. Furthermore, pedigree breeders who furnish the hatching eggs or breeding cockerels under this plan will be rewarded to a degree at least for the large expenditure of time, money, and energy they are putting into their breeding program.

## General Plan

Hatching eggs were purchased for three successive years (cockerels the fourth year), from which enough breeding males were produced for the entire breeding flock. The pullets from these eggs were housed separately and their performance recorded as a check on their flock brothers. Well-selected eggs, pullets' 25-ounce, hens' 27-ounce, were stipulated when ordering. The eggs received were from trapped flock matings, the \$15 to \$18 per 100 grade.

The eggs were secured from reliable breeders who were known to be following an approved breeding program and whose stock was giving a good account of itself either at egg-laying contests or in the hands of their clients, or both.

The new blood was secured from a different source each year, in order to take advantage of hybrid vigor.

No hens and cocks were used, but the foundation pullets the first year and the hybrid pullets thereafter were mated to the new-blood males.

### General Managerial Practices

#### *Hatching Period*

A glance at Table 2 shows that the hatching period each year extended over a period of several weeks. This permitted a more careful selection of eggs than would have been possible with only one or two hatches, but made it more difficult to compare early maturity in each generation.

#### *Rearing*

All birds used in this project were brooded in colony houses and grown on a good grass range. The brooding and rearing units were reasonably small and the grass was good throughout the season. Growing shelters were used for the overflow from the brooder houses. From the close of the brooding period, cracked corn and mash were kept in open hoppers, accessible to the chicks at all times.

#### *Housing*

The adult birds were housed in pens 9 by 14 feet, with an opening 5 by 5 feet for each pen. The houses, therefore, were far from being comfortable in the coldest weather. During the breeding season, doors between pens were thrown open allowing freedom of mating for both males and females.

#### *Feeding*

The birds were allowed to balance their own rations from hoppers containing whole corn, whole oats, and mash.

#### *Elimination*

As this project does not entail trapnesting, the following methods were used to eliminate from the flock undesirable specimens, those that would not be suitable for the reproduction of the flock. All pullets on the range were carefully handled and only the choicest specimens were placed in the laying houses. In most cases this included about 75 to 80 percent of the pullets raised. All small or backward pullets and those which were not good representatives of the flock were discarded.

*Maturity.*— All birds were either toe punched or banded, and those not showing evidence of laying or not being about ready to lay at 210 days of age were eliminated from the flock, as this was the only method whereby early maturity could be determined and maintained.

*Body Weight.*— For the first two years, each bird was weighed the first of each month from October 1 to May 1; but the last two years it was felt that not very much could be gained by continuing the weighing after the birds were mated. All birds not weighing over 5½ pounds or nearly 6 pounds at sexual maturity or soon thereafter were eliminated from the flock. It is interesting to note that the numbers eliminated under body weight and under maturity requirements were about equal.

The last two years nearly all birds that did not show a gradual gain in body weight from the time they were housed until the breeding season, and especially those that had lost one half pound or more during any month, were eliminated from the flock.

*Cessation of Production.*— Birds that stopped laying for any great length of time for any cause whatever were not allowed to remain in the flock.

*Broodiness.*— No broodiness was shown in any of these flocks; but had it made its appearance, the broody birds would have been removed before or during the hatching season.

*General Appearance.*— From the time the pullets were housed in the fall until the close of the breeding season, specimens not meeting the standards on general appearance were removed from the flock. This included birds showing unusual fading in feather color, injuries, and the lack of those qualities associated with thrift and vigor. However, very few birds were removed for these causes.

#### *Weighing Eggs*

All eggs from the flock for the first three days of each month were weighed and the average computed. This has proved experimentally to be a fair measure of egg size in a flock, provided the percentage production is normal during these periods.

#### *Mortality*

Definite records were not kept for mortality and its causes throughout the period, as this was not considered to be one of the main factors at the beginning of the work. It can be said, however, that the mortality in this flock was probably not so great as the general average for the entire college flock. Cannibalism did not break out in any of these flocks except the first one, when four or five birds were lost one day.

#### *Selection of Males*

At broiler age about three times the number of males needed for the breeding pens were reserved, attention being given to size, type, vigor, color, and general uniformity. The elimination of undesirable specimens was continued throughout the growing season and fall months. Those finally placed in the breeding pens weighed from 8½ to 9½ pounds. The use of males above that weight was avoided in order to keep away from the meat or beefy class. Uniformity in type, color, and general appearance was adhered to closely.

#### *Selection of Hatching Eggs*

Eggs were set weekly, and size, shape, and color were the bases of selection. In most instances not more than 75 to 80 percent of the eggs gathered were placed in the incubator. The past two years the average weight of eggs on the incubator trays was close to 27 ounces to the dozen. As all small birds and in most instances those of medium size had been removed from the flock, but few small eggs were produced.

### Discussion and Results

Chart 1 gives the set-up for the four-year period. This shows the number of pullets housed each year, the number mated, the number of eggs (new blood) purchased each year, the number of males mated, and the number of sisters tested. The new blood flocks are designated as A, B, C, and D<sup>1</sup> for the four years, respectively, and are referred to as such.

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<sup>1</sup>D = Experiment Station flock.

The 55 original pullets were from the experiment station flock, discarded because of family size, egg size, and possible deficiencies in other characteristics — in general, a fairly good commercial flock in all respects except egg size.

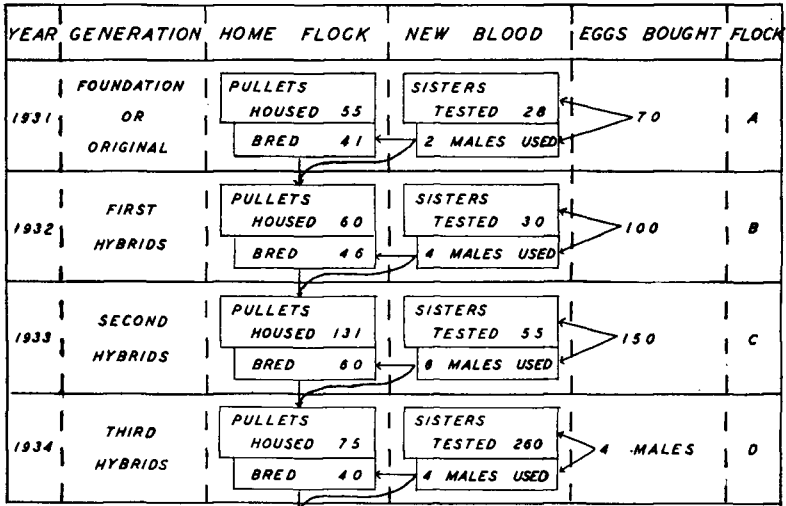


Chart 1. The General Plan.

*Sister Performance*

Each year the flock sisters of the males reserved for breeding were housed separately and a record of their performance kept. Table 1 gives these data: number of pullets, body weight and egg weight taken the first of each month from housing time till the birds were mated, and monthly production.

The performance of the sisters is a good index of the quality of the flock selected for new blood. A and B were selected for egg size, a weakness in the foundation pullets, and also with the view of maintaining production. Following the use of these males, the weakest point in the flock was color, and Flock C was chosen particularly for the purpose of improving this characteristic. Although this flock did not average so high as A and B in all respects, being low in early maturity, intensity, and hatchability as was suspected, yet the pullets from these males mated to the second hybrid generation gave a good account of themselves. It must be borne in mind that Flock C pullets were tested during the very severe fall and winter of 1933-34.

Table 1 shows also progress made from year to year in the three important factors recorded: body weight, egg weight, and production. Had the project been started with a flock of moderate or low quality, very material gains would have been anticipated; but as the foundation flock was made up of experiment station birds that had been carefully bred for nearly 20 generations, merely maintaining the level of the main factors and increasing egg size would have been

TABLE 1.—PERFORMANCE RECORDS.

Month	Year Hatched	Generation	Original Flock and Hybrids				New Blood Sisters					
			Average Weight			Production		Flock	Number of Birds	Body Weight Pounds	Egg Weight Ounces per Dozen	Percent Production
			Number of Birds	Body Weight Pounds	Egg Weight Ounces per Dozen	Number of Birds	Percent Production					
October.....	1931	Foundation flock	55	....	....	....	54	A	28	....	....	31
	1932	First hybrids	60	5.73	20.9	60	42	B	30	5.81	21.6	66
	1933	Second hybrids	132	5.83	21.8	131	51	C	53	5.07	21.0	26
	1934	Third hybrids	73	5.40	22.1	72	44	D	260	5.73	22.1	69
November...	1931	Foundation flock	52	5.97	21.3	52	67	A	28	5.81	20.8	59
	1932	First hybrids	48	6.05	22.4	48	74	B	25	6.51	23.0	78
	1933	Second hybrids	130	6.37	23.1	86	57	C	52	5.61	22.5	38
	1934	Third hybrids	72	6.10	23.1	50	69	D	255	6.10	23.2	69
December....	1931	Foundation flock	47	6.16	22.6	47	64	A	28	6.27	22.7	67
	1932	First hybrids	48	6.35	23.5	47	72	B	25	6.84	23.9	60
	1933	Second hybrids	86	6.69	23.9	84	55	C	42	5.77	23.4	52
	1934	Third hybrids	50	6.90	24.2	49	63	D	248	6.40	24.1	61
January.....	1931	Foundation flock	47	6.14	23.3	47	60	A	28	6.27	23.7	70
	1932	First hybrids	47	6.51	24.2	46	66	B	25	6.88	24.3	63
	1933	Second hybrids	83	6.68	25.4	62	45	C	29	6.03	24.8	58
	1934	Third hybrids	49	6.90	24.7	47	58	D	243	6.44	....	53
February....	1931	Foundation flock	41	6.27	23.7	41	49	A	26	6.30	23.4	58
	1932	First hybrids	46	6.56	24.6	46	64	B	25	6.94	24.6	53
	1933	Second hybrids	62	....	26.2	60	56	C	28	....	25.0	49
	1934	Third hybrids	41	....	25.2	41	34	D	..	....	....	..
March.....	1931	Foundation flock	40	6.55	24.2	40	66	A	25	6.35	24.5	73
	1932	First hybrids	45	6.56	24.9	44	76	B	24	7.10	24.8	77
	1933	Second hybrids	....	....	....	60	60	C	....	....	....	63
	1934	Third hybrids	....	....	....	41	47	D	....	....	....	..

highly satisfactory. However, the records show a steady advance in body and egg weights. With the exception of lower production in the second hybrid generation, which was influenced very greatly by unfavorable weather conditions during the fall and winter of 1933-34, fecundity was very satisfactory.

#### Hatchability

Experimentation has shown that hybridizing with strains as well as with breeds gives a decided improvement in hatchability. But in order to show definitely the difference in hatchability between the flock sisters of the males used and the foundation or hybrid flocks each year, a number of flock sisters were placed with the hybrid females so that they would be served by the same males. It was necessary to trapnest the females during the breeding season in order to keep the eggs separate. Table 2 shows that the hybrid eggs hatched much better than the pure-strain eggs except in the 1935 flock when hatchability was adversely affected by an outbreak of coryza. As the average hatchability at the college plant in 1935 was 55 percent, a 75 percent hatchability for the hybrid eggs is evidence of vigor and high hatching power. These hatchability results for 1935 are presented in order that the data may be complete; but from an experimental point of view they are valueless on account of the coryza influence.

TABLE 2.—HATCHING DATA—PERCENTAGE OF FERTILE EGGS.

Hatching Date	1932		1933		1934		1935	
	A Males		B Males		C Males		D Males	
	Founda- tion Females	A Sisters	First Hybrid Females	B Sisters	Second Hybrid Females	C Sisters	Third Hybrid Females	D Sisters
3/1	....	100.0	86.0	81.0	....	....	....	....
3/8	....	70.0	95.0	65.0	92.0	46.1	....	....
3/15	....	68.9	95.0	70.0	92.3	50.0	71.4	77.7
3/22	90.6	75.0	91.0	82.0	88.7	65.2	76.2	57.0
3/29	81.1	77.7	95.0	87.0	83.0	64.0	81.8	71.4
4/5	88.5	90.0	....	89.0	84.3	73.0	76.4	100.0
4/12	94.5	80.0	....	....	89.2	83.0	70.8	83.3
4/19	89.1	93.3	....	....	....	....	72.7	88.8
4/26	89.8	78.6	....	....	....	....	76.4	83.3
5/1	....	....	....	....	....	....	84.2	42.8
Average	88.9	81.5	92.4	79.0	88.25	63.55	75.7	75.5
<b>Experiment Station Flock</b>			<b>1933</b>		<b>1934</b>		<b>1935</b>	
3/5	....	....	76.0	....	70.8	....	73.3	....
3/12	....	....	79.0	....	72.9	....	77.2	....
3/19	....	....	77.0	....	79.2	....	81.7	....
3/26	....	....	82.0	....	83.3	....	81.5	....
4/2	....	....	86.0	....	82.1	....	81.8	....
4/9	....	....	81.0	....	79.3	....	83.8	....
4/16	....	....	83.0	....	80.6	....	83.7	....
4/23	....	....	86.0	....	81.7	....	81.9	....
Average	....	....	81.2	....	79.6	....	81.3	....

#### Evidence of Hybrid Vigor

It is reasonable to expect less hybrid vigor in the crossing of strains than in the crossing of breeds; likewise less in the crossing of strains that have been bred along similar lines than in those produced under breeding programs where aims and practices are more divergent. Although all flocks involved in this

project, with the exception of Flock C, were produced under almost identical breeding programs, yet definite evidence of hybrid vigor is found.

In the case of body weight and egg size, based upon November and December weights, the hybrid flocks in every instance showed a gain over the average of the parents, the sisters' average being taken as a measure for the sires. Even the January weights, after rigid selection had taken place, indicated hybrid vigor in two cases out of the three in both body weight and egg size.

In the consideration of hatchability there is no question as to the part played by hybrid vigor, for the hybrid flocks were consistent in the production of eggs having a higher hatchability than those produced by pure lines, and their eggs hatched from 10 to 15 percent better than those from the sires' flock sisters, with the exception of Flock D where coryza greatly influenced hatchability. These data indicate that a hatchability of 79 to 82 percent is about normal for the pure strains used. However, in a project of this kind one cannot be too careful in drawing conclusions as there are two factors that may cause error: first, variations in breeding programs for these flocks; and second, the practical methods used in eliminating undesirable specimens from housing time until the breeding season.

### Summary

It appears that production qualities and hatchability can be built up or maintained in a flock by the annual introduction of new blood from reliable sources. Success will depend upon the following factors:

1. The care with which the foundation flock is selected.

Only flocks with satisfactory records of performance should be selected for this purpose.

2. The ability to obtain new blood that will raise the level of the factors sought.

This should come from breeders who are known to be following an approved breeding program and whose stock is giving a good account of itself either at egg laying contests or in the hands of their clients or both.

3. The elimination of undesirables before the breeding season begins.

4. The persistency with which the details of the program are followed.

Hybrid vigor made its appearance in egg weights, bird size, hatchability, and possibly in production if an accurate measure could have been used. It was not of great significance in bird and egg weights, but of much importance in hatchability.

The cost of this method of flock improvement is insignificant compared with the cost of pedigree breeding, as 300 eggs purchased annually will supply breeding males for a flock of 750 females and will also add a possible 100 to 125 quality pullets to the flock.