

## INVESTIGATIONS RELATING TO BREEDING FOR INCREASING EGG PRODUCTION IN HENS.\*

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In breeding poultry such wonderful changes have been made in form and feather that it seems to have been demonstrated that the laws of inheritance and transmission are as true with poultry as with cattle, sheep, and horses. Many attempts have been made to improve egg production by breeding. This work has, for the most part, been by flocks rather than by individuals, much the same as if we should attempt to improve the milk production of the herd by basing the breeding upon the milk or butter production of the herd without reference to the milk of the individual animal.

Our work is based upon *individual* records obtained by the use of trap nests devised by us. The houses are specially constructed for the purpose, and, while numerous problems have arisen in connection with the work, and other side questions have been studied, nothing has been allowed to interfere with the original proposition of breeding for increased egg production. At the time we began this work, we were carrying three breeds, Barred Plymouth Rocks, White Wyandottes, and Light Brahmas. With the particular strains that we had of these breeds, the Barred Plymouth Rock seemed the more promising and the work here reported is with this breed. As the New England market demands large dark-brown eggs, only birds laying such eggs have been used in the breeding.

In order to select good producing hens for foundation breeding stock, we constructed 52 trap nests and placed them in the laying pens where 140 April- and May-hatched pullets commenced using them November 1, 1898.

In one year forward from that date the 140 birds laid an average of 120 eggs each. Twenty-four laid over 160 each, and twenty-two less than 100 each. Hen No. 36 laid 201 eggs; No. 101 laid 204, and No. 286 laid 206 eggs. As the eggs of No. 36 were light in color, she was rejected.

As from the start we had 2 birds that laid over 200 eggs, large dark-brown ones, in their first laying year, we have in our special breeding used no females that have laid less than 200 eggs in the first laying year, and in the breeding for general stock since the first year, only females that have laid from 160 to 200 large brown eggs in their first laying year.

At the commencement of the next breeding season (1900) hens Nos. 101 and 286 were mated with males that were unrelated to them, or to each other. The cockerels raised from the eggs of these two birds were the first males produced for use in this work. In the early spring of 1901 several sons of one of these hens raised

\*The Maine Agricultural Experiment Station has been breeding poultry since 1896. The work is under the immediate charge of Prof. G. M. Gowell, who coöperated in the preparation of this paper.

the previous year were mated with the twenty-four two-year-old hens that laid 160 eggs or over each during 1899, and twenty-five others that laid 160 or over during the 1900 test.

That season hen No. 303 who had laid 208 eggs during 1900 was bred to a son of 286. Hen 326 had laid 211 during 1900 and she was bred to a son of No. 286 also.

No. 318 had laid 237 good brown eggs in 1900. After she had laid 200 eggs, the next twelve she laid weighed 1 pound, 11½ ounces. She was bred to a son of No. 101 that season.

The sons of Nos. 101 and 286 were in service only during the year 1901.

In 1902 one hundred pullets were tested for additional foundation stock. They yielded an average of 132 eggs each. Twelve birds laid over 200 eggs each, the highest number being 251 eggs laid by hen No. 617. In the same pens were six others that laid only from 23 to 70 eggs each. Thirty-seven laid over 160 each. No hens were used as breeders that had not laid above 160 eggs, and all, as in the previous years, were bred to males whose dams had yielded over 200 eggs.

Males were raised in 1902 for the male breeding pens of the next year from hens No. 630, with a record of 213 eggs, and No. 676, with a record of 209 eggs. The eggs from both of these hens were very large and dark brown. They were mated to sons of No. 318, before spoken of. Males for the pullet breeding pens of the next year were bred from other matings of hens that had produced 200 eggs, with males whose mothers had yielded over 200 eggs.

That year (1902) we were crowded for room and could accommodate only 53 pullets for testing. They were the first pullets that we tested that were sired by males bred from 200 egg-producing hens and show the first results of the breeding practised. They had been laying quite heavily out in their summer quarters during September and October, although they were not hatched until April and May.

The 53 birds laid 7952 eggs in the year forward from November 1, 1902, a little better than 150 eggs each. Could they have been in quarters where their eggs could have been traced to them a month earlier, when they were laying so well, they would have shown a better year's work, as the twelfth month of their testing was really the thirteenth month of their laying, and the record sheets show it to be nearly bare of eggs. As it was, however, seven of the fifty-three show records of from 201 to 240 eggs each in the year, and 23 of the 53 laid over 160 eggs each.

During the breeding season of 1903 hens No. 1001, record 213 eggs, No. 1003, record 240 eggs, No. 1005, record 222 eggs, and No. 1140, record 211 eggs, were bred to male birds raised the year before whose dams had yielded over 220 eggs each, for the purpose of procuring males for the male breeding pens of 1904. No two of these females were bred to the same male or to brothers.

All pullets raised that year (1903) were, as in the preceding three years, out of hens that had laid over 160 eggs in a year and

they had the advantage over their predecessors, in that their dams and maternal granddams were sired by males from over 200-egg-yielding mothers, as they themselves also were.

That year (1903), 160 pullets were tested in the trap nests. They laid 21,202 eggs, an average of 132 each. Forty-four laid over 160 eggs each; nine laid 200 or over, viz., 200, 205, 210, 217, 220, 220, 221, 222, 225. We have not to seek far for an excuse for the lower yield than of the last preceding year. The pullets were hatched in April and May, and thinking to have them mostly in readiness for laying early in November, we fed them rather more beef scrap than usual during the growing season while they were out on the range, and before we were aware of their development they were laying in August. They were nearly all laying heavily during September, October and November. They were splendid birds but almost every one of them moulted completely in December and we got very few eggs from them for more than two months. The most of the eggs secured from them were laid after the middle of January. Could the records have commenced September 1 and continued for a year, the showing would have been much better.

The breeding season of 1904 opened with 170 yearling hens in our houses that had laid above 160 eggs each the year before; 80 pullets and hens whose mothers had laid over 200 eggs per year; and 28 hens that had themselves laid over 200 eggs per year. These birds were in 24 different pens, and they were bred to selected cockerels whose mothers had yielded above 200 large brown eggs per year.

Among the pullets tested during the last preceding year (1903), were found the following: No. 263 yielded 220 eggs; No. 225, 220 eggs; No. 22a, 221 eggs; No. 224a, 222 eggs; No. 205a, 225 eggs. These birds were mated during 1904 to different cockerels raised in 1903, and from 220-egg-producing mothers whose other sons were never used in our breeding operations. The matings of these five pairs of birds were to secure cockerels for our next year's breeding operations.

At the usual time for the commencement of the yearly test of 1904, viz., October 31, 1903, we had 300 good pullets that were laying well out on the range. The construction of the building being erected for their quarters was interfered with by a question of labor, and they remained out in their small summer homes during a wet, cold fall and early winter until December 6, when they were moved in. This more than a month's delay and exposure cut into the year's work heavily and the average production of the 300 birds was reduced to 131 eggs each for 11 months. Nine birds yielded above 200 eggs each before the close of the following October.

All of the females carried in 1903-04 were tested hens that had laid from 160 to 251 eggs in a year, and 150 pullets and hens whose mothers produced 200 eggs or over per year. The father or fathers, and the grandfathers of these two classes had mothers that laid 200 eggs, or over, per year.

This season (1904-05), 600 pullets out of hens that have laid over 160 eggs per year, and whose father, grandfathers, and great

grandfathers were out of hens that yielded above 200 eggs per year are being tested by the trap nests for additional breeding stock. All of the mothers of these pullets had fathers and grandfathers that had 200-egg-producing mothers.

The stock is strong and vigorous and but few chickens that hatch are lost. The hardihood of the stock is shown by the fact that many cockerels have been sold to farmers and poultrymen in and out of the State in the last two years, and this fall many of them have ordered again, with the frequent comment that their pullets are laying earlier in the season and giving better eggs than they have ever done before.

The numbers of the breeding stock now secured makes practicable the avoidance of inbreeding and this is strictly guarded against, as is it doubtful if the inbred hen has sufficient constitution to enable her to withstand the demands of heavy egg-yielding. During only one season have birds as closely related as first cousins been bred together. Line breeding is followed, the matings being now only with distantly-related birds.

These breeding investigations have been in progress six years. The first year was consumed in testing pullets to find foundation stock. The second year cockerels were raised from the large-laying hens for future breeding, and the third year the first lots of pullets were raised from the selected stock so that we have only the last three years in which to note results, and these three years can only show first changes that have taken place. The stock that we commenced with was pure and well-bred, as flocks go. The hens were averaging about 120 good brown eggs a year, and had been doing so for several years. Two years ago they averaged 150 eggs and this year, and last, with the great setbacks caused as above indicated, which were no faults of the stock, the average was  $131\frac{1}{2}$  eggs.

As the housing, treatment and food, have been as nearly alike as we could make it during the last five years, there seems to be reason for assuming that the flock yields of 1902, 1903, and 1904 over those of previous years are the results of the breeding practised.

Again, during 1902 about 1 hen in every 7 laid above 200 eggs, while taking the three preceding years together but 1 hen in 28 laid 200, and the first year only 1 hen in 47 laid 200. It must be borne in mind that 1902 was the first year that we had pullets from the 200-egg stock to collect eggs from.

In the records only the eggs laid in the nests are accounted for. Had those found on the floor been reckoned in, the average per bird would have been slightly increased.

Sufficient time has not yet elapsed since the beginning of these breeding tests to establish claims of increased productiveness, but the outlook is certainly very encouraging.

The plans on which we are working are based on every day common sense. We are rejecting the drones, and breeding producers together to secure producers. It is known that the laws of inheritance and transmission are as true with birds as with cattle, sheep, and horses, and, when we consider the wonderful changes that have

been made in the form, feather and egg production of hens since their domestication commenced, there is ample reason for assuming that a higher average egg production than the present can be secured by breeding only from those birds that are themselves great producers.

The purpose of this work should not be misunderstood. We are not trying to breed stock that shall average to yield 200 eggs per year. If the average yields of the hens of the breed should be increased to the extent of a dozen eggs per bird, the value of this work would be many fold its cost.

### BREEDING FOR RESISTANCE OR IMMUNITY TO DISEASE. -

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It is now established that immunity to disease exists in most varieties of plants, or may be developed, especially among the more stable farm and garden crops. The physiological reasons for the existence of this quality are not wholly understood nor are the processes of obtaining the purified type of immune seed well known. The plant physiologist and pathologist can do no less than to make plain the probable lines of natural action and to outline the processes along which the agriculturist, commercial growers, and farmers may proceed. My experiments have taught me that really resistant and immune strains of plants can be obtained by applying the principle of the survival of the fittest in the way indicated. While the method of procedure has undoubtedly a much wider application than simply breeding for disease resistance, time necessitates that I cite but one example of its successful use along that line, *flax-wilt*, the cause of *flax-sick* soil.

#### THE FLAX-WILT DISEASE.

There is a diseased condition of flax soil which has long been known to farmers in flax-producing regions as flax-sick soil. If flax is sowed rather continuously for a number of years upon the same soil, this disease tends thoroughly to infect the soil so that flax growing becomes no longer profitable. The disease may be spread by means of seed flax. The plants attacked die at all ages as if attacked by wilt; hence I have called the disease the flax-wilt disease. The direct cause is a minute fungus parasite (*Fusarium Lin.*, Bolley) which grows on the inside of the flax plant, starting either from the seed, or by attacking the roots of older plants, if the soil has previously been infected. There are many ways in which the infection might reach new fields but the chief one is by way of the seed. When the soil is once infected, no way is known to rid it of the parasite. The fungus is able to live there for many years without the presence of a flax crop to feed upon. The disease