The influence of certain methods of management on egg production
I. Their influence on winter egg production
H. D. Goodale
Mount Hope Farm, Williamstown, Massachusetts

Considerable time and effort has been spent by various students of egg production in attempting to influence the number of eggs laid by changing the methods of feeding or of managing the birds in various ways. Out of it have come certain practices now regarded as standard. More recently it has been shown that production can be increased through artificial illumination and extra feeding during the season of short days. The feeding of milk has been followed in some experiments by increased annual production. On the other hand, it is known that Leghorns are adversely influenced by cold weather as compared with the American breeds, possibly because of the large highly vascular naked head appendages which may have a surface area in some instances of at least 17 square inches, and thus conceivably may act like the radiator of an automobile. The amount of heat lost through these appendages is unknown, but some food must be required to make good this loss in body heat. The food so used must be diverted from egg production, which may be true, even though the carbohydrates are in excess in the ration. In addition, Leghorns often suffer from a cold weather haemophilia of the comb, sometimes resulting in death, while the large size of the head appendages renders them subject to frost-bite.

The experiments described in this article were set up to test several ideas relative to the factors mentioned in the preceding paragraph. Will increased illumination be as effective on birds bred to lay as on ordinary stock? Can increased production be secured by removing the comb and wattles? Will the addition of milk or cod-liver oil to the rations be of value? To answer these questions, an experiment was set up with the following five groups: (1) Standard rations with artificial lengthening of the day during the winter. (2) The same with cod-liver oil added to the ration. (3) The rations altered by removing half the meat scrap from the ration and substituting semi-solid butter-milk ad libitum. No lights. (4) Standard rations, no lights,
comb and wattles removed. (5) Check lot, standard rations, no lights.

The present article reports the results of the experiments to March 1. A second will report later results.

MATERIAL AND METHODS

Twenty houses, identical in design and construction except for one item as noted below, holding twenty-five birds each, with double walls and ceilings, wooden floors, two windows and door at one end, give snug winter quarters. They are arranged in three groups, one row of five facing east, a second row of five facing west, and a third row of nine facing south. The twentieth is one of a fourth row of three houses facing south. The row of houses facing west differ in construction from the others in having a window on the south side. These houses make possible five groups of one hundred each, half of each group being quartered in the largest row, a fourth in each of the other two rows. Thus the housing conditions are alike in each of the five groups.

The birds used in these experiments were derived from some 700 Single Comb White Leghorn pullets hatched at weekly intervals from March 28 to May 30, 1923, which were left over after filling the main laying houses. Physically, they were the equal of the main flock, but for various reasons, chiefly some characteristic in their dams' record, were less suitable than their mates for the purposes of the breeding experiments.

The 500 pullets actually housed were selected in this way. The 700 were first culled severely for vigor. Then the entire hatch of April 4, and most of that of May 30, was discarded, leaving some 540 pullets, which were divided into four groups according to age. Then their band numbers were transcribed, each to a slip of paper, each age by itself, shuffled thoroughly, and each age group subdivided into five groups of 26 or 27 by drawing the slips of paper at random. The pullets were then distributed on the basis of this random sorting, 26 or 27 to each pen, the two oldest age groups being assigned the houses facing south, the next oldest the houses facing west and the youngest, the houses facing east. Finally the number in each house was reduced to twenty-five each by removing the excess birds, choosing always those least developed.

All pullets were trapnested beginning at the time the first egg was laid on the range in August, though the experiments were
not set up and changes in feed and management begun till October 21. As far as possible, details of management and feeding other than those under study have been kept alike, but the very nature of the experiments has resulted in some deviations from this rule, principally with the lighted pens, where the feeding, watering and trapping schedules had to be modified to agree with the change in length of day.

The standard rations used were a scratch grain composed of 300 pounds cracked corn, 100 pounds wheat, 80 pounds oats and a dry mash consisting of equal parts by weight of wheat bran, white middlings, ground oats, meat scrap, and corn meal. The shell, grit, charcoal, water and dry mash were always available. Green feed, consisting of Georgia collards or sprouted oats, was fed once daily in the morning ad libitum. The scratch grain was fed in small quantities five times daily, and at night all the birds would consume was fed in troughs, and afterwards a little grain was scattered in the litter to be available the first thing in the morning.

The changes in methods of feeding and managing were as follows. In the first two groups the lights were turned on in the morning at such an hour that the total length of day as measured by good visibility was twelve and one half hours, morning lights being used because best adapted to our labor system. Of course water, scratch grain in the litter and mash were available as soon as the lights came on. In these pens the first trapping had to be made between six and seven a.m.

In the second group, the cod-liver oil was fed by stirring the oil into the evening scratch feed which it will be recalled is fed in troughs. The dosage at first was small, but by gradually increasing the amount, no difficulty was experienced in getting the birds to eat an eighth of an ounce each, per day. The oil was not begun till November 25, because it was necessary first to learn if its use tainted the eggs. The oil used was unrefined oil from the Gorton Pews Fisheries Co.

In the third group the semi-solid buttermilk as taken from the barrel was available to the birds in troughs at all times.

The comb and wattles were removed from the pullets with shears October 20, when the older pullets were in good lay, but to our surprise, the operation was reflected in no way by egg
POULTRY SCIENCE

production, which continued in the days immediately following, as though the birds had not been touched.

REMARKS ON THE VALUE OF THE MEAN AND ITS PROBABLE ERROR

Before considering the results it is desirable to disgress to comment on the probable error of the mean as an index of reliability, because it has an inherent defect that is usually ignored, due to its being based on purely internal evidence. On the average in alternate series of data \( M \) will be greater (or less) than its calculated value by \( E \), and once out of 5.6 times its value will exceed \( M \pm 2E \), which in turn means that once out of 11.2 times the value will exceed either \( M + 2E \) or \( M - 2E \). Thus, if one takes eleven hundred birds, and divides them into 11 groups of 100 each, one group will have a production of \( M + 2E \) and another a production of \( M - 2E \). If \( M = 50 \) and \( E = .02 = 1 \), then \( M + 2E = 52 \) and \( M - 2E = 48 \). In an actual experiment we may have but one group of 100 birds each. Supposing through the operation of chance, the mean of the group we are working with comes out 52 and since there will be no material change in the percentage value of the probable error, \( M = 52 + 1.04 \). In this case \( M \pm 2E = 54 \) or 50. Now the circumstances are such that there is no way of knowing that 52 eggs is itself a deviation from the mean obtained when much larger numbers are used. Hence in comparing changes in management with that of a check group in experiments such as are reported here, it must also be borne in mind that the probable error may cover a real, though statistically non-significant difference.

RESULTS

In Table I, the mean egg production at three points in the progress of the experiments is given, these means being obtained from pen totals. The mean production to and including October 20, is that made prior to the beginning of the experiments. The several groups differ at most by .6 of an egg, about ten percent of the mean of the lowest group. December 1, the end of the sixth week of the experiment, is the point at which four of the five groups reached their highest weekly production. At this point the highest group total leads the lowest by three eggs, and the checks by one and one half eggs. Both lighted groups are ahead of all the unlighted groups. March 1, is the point com-
EFFECT OF MANAGEMENT ON WINTER PRODUCTION

Monly taken as the end of the winter production period. Again the two lighted groups lead, the difference between the leading pen and the checks being 6.6 eggs, an increase of a little less than 12 per cent.

**Table I.**—Mean egg production at various dates, calculated from pen records of production in each group

<table>
<thead>
<tr>
<th></th>
<th>Lights</th>
<th>Lights and Cod-liver Oil</th>
<th>Milk</th>
<th>Dubbed</th>
<th>Check Lot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>From Oct. 20th</td>
<td>Total</td>
<td>From Oct. 20th</td>
<td>Total</td>
</tr>
<tr>
<td>Oct. 20th</td>
<td>9.2</td>
<td>8.4</td>
<td>9.0</td>
<td>8.5</td>
<td>9.2</td>
</tr>
<tr>
<td>Dec. 1st</td>
<td>28.7</td>
<td>19.4</td>
<td>27.8</td>
<td>19.3</td>
<td>18.7</td>
</tr>
<tr>
<td>Mar. 1st</td>
<td>38.7</td>
<td>61.8</td>
<td>63.6</td>
<td>60.2</td>
<td>65.1</td>
</tr>
</tbody>
</table>

*Experiments begun October 21st.*
†Highest point in weekly production.
‡End of winter period.

In order to learn the statistical significance of this difference the statistical constants must be calculated. It is evident that if no statistically significant differences exist between the lowest and highest groups, it is unnecessary to calculate the constants for the other groups. It is more convenient to use the total individual records, from time of first egg to March 1, rather than the individual records from the beginning of the experiments. Reasons for using the latter records in preference to the former are academic rather than real under present circumstances. The constants so calculated are given in Table II. It is to be noted

**Table II.**—Statistical constants of highest and lowest groups, calculated from individual records

<table>
<thead>
<tr>
<th></th>
<th>Mean Production</th>
<th>Percentage of probable error in mean</th>
<th>Standard deviation</th>
<th>Coefficient of variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under Lights</td>
<td>66.0 ± 2.5</td>
<td>3.64</td>
<td>33.3 ± 1.7</td>
<td>50.5 ± 3.2</td>
</tr>
<tr>
<td>Check Lot</td>
<td>61.1 ± 2.3</td>
<td>3.79</td>
<td>32.1 ± 1.6</td>
<td>52.5 ± 3.3</td>
</tr>
<tr>
<td>Difference</td>
<td>4.9 ± 3.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

that the probable errors are more than three and one-half per cent of their respective means, and that the probable error of the difference between the means is more than one-half the value
of the difference itself. It is quite evident that the observed difference between the check group and the highest lighted group lacks statistical significance. From this it follows that, so far as the observations reported in this article are concerned, no one of the changes in methods studied, has any statistically significant influence on winter egg production. However, since both the lighted groups agree in having a slightly higher mean production than the three unlighted groups, and especially since this difference is in the same direction as that reported by many other students of the influence of lights upon production, it is quite possible that the observed difference could be shown by large scale experiments to be statistically significant.

It will not have escaped the notice of the reader, that such a difference in mean production between the check group and the lighted groups as exists is much less than that reported by others. The reason for this may be found in the relatively high production in the check lot, which is about double that normal for Leghorns, viz., 26.7 eggs, as reported by Card (Bulletin 91. Storrs, Conn., 1917). In more recent years lights have been used at the Storrs contest and winter production has almost exactly doubled. It is possible that the higher winter production is without lights, the less the increase in production brought about by lights. If this is true, then the use of lights is not justified on a plant devoted to breeding for increased production, for the use of lights tends to conceal the poorer layers. It also follows that it should be possible to breed a strain of birds that will lay as well without lights as with lights.

Students of the influence of increased length of day on winter egg production have commonly assumed that the beneficial effect came from increased opportunity to eat. It is claimed that the birds cannot consume enough food to last them through the long night. Several years ago, the writer had the opportunity of studying the trapnest records of several pens of pullets, some under lights, others without. In the latter group, production was relatively poor. A study of the trapnest records showed however, that production in the unlighted group, was being borne by a few individuals, which were laying just as well as the individuals in the lighted group. Obviously those individuals that were doing the laying in the unlighted pens found it possible to secure sufficient food for their needs without the aid of lights.
The outstanding difference between the two groups was that in the lighted pens, all or nearly all the birds were laying, while in the unlighted pen only a few were laying, the rest were not producing a single egg. If the usual differences in production between lighted and unlighted groups depend upon an inability to consume sufficient food, one would expect that many birds in the unlighted pens would be laying, but at a very slow rate. Since this is contrary to observation, it is possible that the increased production under lights is the result of a direct stimulus, resulting in accelerated maturity, a suggestion that can be put to experimental test.

Although dubbing the pullets resulted in no marked difference in production, the experience suggests that it is a solution of the problem of frozen and bleeding combs and wattles in cold climates, especially where it is impossible to protect the birds adequately. Possibly our own results in egg production would have been different had not the winter been exceptionally mild till toward the end of January. Again they might have been different had our houses been more subject to penetration by the cold.

**Summary**

Experiments were conducted to test the influence of (1) lights, (2) lights and cod-liver oil, (3) milk, (4) dubbing, on winter egg production as compared with a check lot. No differences of statistical significance were observed.