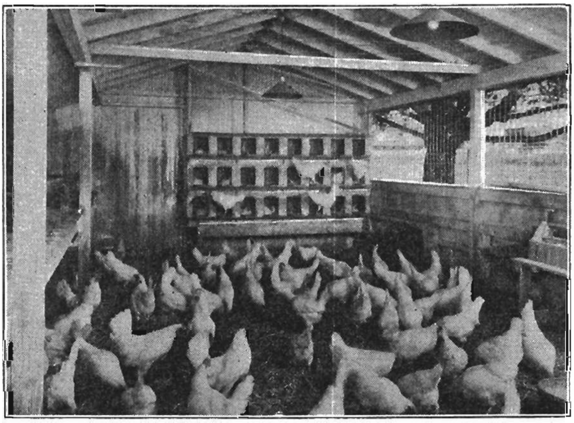
Station Bulletin 231 April, 1928

Electric Lights for Increasing Egg Production



Agricultural Experiment Station
Oregon State Agricultural College
CORVALLIS

CONCLUSIONS

ANNUAL returns from lighting laying fowls are sufficient to justify a considerable expenditure for providing the necessary illumination. This annual profit accrues although the lighted fowls which have produced heavily during the fall and winter months fall below the unlighted fowls in spring and summer production.

The use of artificial illumination should be recognized as a means for changing the seasonal production of a fowl to fit into the management plan which results in greatest profit. It is not primarily a means for increasing annual egg production.

The greatest profits from the use of lights come from lighting the highest producing fowls.

If artificial lighting is to be used most profitably, it must be accompanied by intelligent selection, segregation, handling, and feeding of the flocks.

The use of lights in the morning only is adequate for good results and is perhaps the most satisfactory system of lighting.

SUMMARY

THIS investigation was conducted to determine full-year returns from lighted and unlighted pens of pullets and hens. The study was carried on for two years with commercial flocks of 460 March-hatched White Leghorn pullets and 400 yearling White Leghorn hens.

NORMAL PRODUCTION AND PRICES.

Normal production of fowls is lowest during the fall and winter and highest in the spring.

Five-year average Portland egg prices ranged from a maximum of 43 cents per dozen in October and November to a minimum of 22 cents per dozen in March and April.

Five-year average Portland prices of light hens varied from a maximum of 20½ cents per pound in April to a minimum of 14 cents per pound in August.

EFFECT OF LIGHTING ON PRODUCTION.

When artificial lights were applied to a flock, the response in egg production was almost immediate, regardless of age or condition of the fowls.

All lighted flocks consistently maintained their production above that of the unlighted flocks from October until February.

Unlighted flocks all forged ahead of the lighted flocks in production in February and March. The time of this crossover in production varied somewhat for the two years, but in each year the change took place with all flocks at approximately the same time irrespective of age, feeding, or previous production.

Lighting fowls in the fall and winter leveled off the annual production curve both by increasing fall and winter production and decreasing spring and summer production.

Increased production from lighting was apparently not entirely a result of providing a lengthened feeding time.

The use of lights on pullets resulted in slightly increased annual production in all cases, the increase in percent production ranging from 0.6 to 6.6.

Yearling hens in continuous production and which had been lighted the previous year produced fewer eggs per year under lights than yearling hens without lights.

EFFECT OF LIGHTING ON FEED CONSUMPTION AND COSTS.

The fowls producing the largest number of eggs consumed the most feed regardless of whether they were lighted or not.

The amount of feed consumed was not governed by the number of hours of light in the day.

A large proportion of the feed consumed by the fowls was used for body growth and maintenance, and any egg production above the normal was obtained at a relatively low feed cost.

The cost of feed in some cases was greater for the lower producing fowls because of the larger proportion of mash consumed.

EFFECT OF LIGHTING ON MORTALITY.

The total mortality of lighted fowls was not excessive, ranging from 6.9 percent to 15.6 percent per year. The mortality in unlighted flocks varied from 3.4 percent to 15.5 percent. Mortality was greatest with the yearling hens and least with the quicker maturing pullets.

EFFECT OF LIGHTING ON FLOCK PROFITS.

Returns from lighted flocks were very considerably increased over those from unlighted flocks in all cases during the lighted period.

The highest producing fowls invariably yielded the greatest profit from lighting.

The cost of electricity was always small in comparison with the increased returns for winter eggs. Less than 2/5 of an egg per hen per month paid the electricity cost.

Where electricity can be profitably employed about the poultry plant for such uses as root shredding, green feed chopping, feed and bone grinding, incubation, brooding, spraying, egg candling, straw chopping, and for feed room and yard lights, the rate will usually be much lower and the cost for lighting considerably reduced.

Based upon results obtained, a flock of 400 average pullets would yield an excess profit (in 11 months) of $81.07 over the cost of lighting. This amount would pay 8 percent interest on a $1,000 investment in electric lines or a lighting plant.

PERTINENT SUGGESTIONS ON LIGHTING.

(1) Artificial light is an effective means of controlling the performance of any flock. It will not, however, make high producers from inferior stock or take the place of correct feeding and management.

(2) The physical condition of fowls is the most important factor to be considered in lighting. No attempt should be made to force sick, thin, or immature fowls into production under lights, and fowls which are being lighted should always be fed so as to maintain their body weight.

(3) Best results from the use of lights call for the grading and housing of fowls according to age, development, and condition.

(4) The use of lights in moderation accompanied by heavy grain feeding tends to build up body weight, while lighting accompanied by the feeding of high protein mashes tends to hasten maturity and to stimulate egg production.

(5) Regularity in lighting is essential to success.

(6) Twelve to thirteen hours of light per day are recommended for pullets and breeding stock and thirteen to fourteen hours for old hens or poor stock which is to be forced and then disposed of.

(7) Lights on early hatched pullets will tend to prevent a fall or winter molt during the first year.

(8) Increased production of early hatching eggs may be obtained by the use of lights on breeders in January and February. The stock should be in good physical condition and should have had a two months' rest. The hatchability of the eggs will not be impaired by the proper use of lights.

HOUSE ILLUMINATION AND WIRING.

In estimating the amount of illumination to provide in the laying house, allow ½ watt of lamp capacity for each square foot of floor space.

Hang lamps from the ceiling, 6 feet 3 inches above the floor and half way from the front of the house to the front edge of the dropping boards.

Space lamps 10 feet apart in houses 20 feet wide.

Use 100 watt inside-frosted Mazda lamps.

Reflectors may be either the R.L.M. dome type undersize (60 watt size), or specially constructed conical reflectors.

Morning lighting only is recommended as most satisfactory.

Use an alarm clock and a standard tumbler switch to turn on the lights.

Electric Lights for Increasing Egg Production[1]

By Geo. W. Kable, F. E. Fox, and A. G. Lunn[2]

The increasing of winter egg production through the use of artificial lighting is a matter of common knowledge among poultrymen. Much less is known of the effect of winter lighting upon *annual* production, feed consumption, and profits.

The investigation reported in this bulletin was undertaken to determine what expense is justifiable in providing electricity for use in the poultry house. It includes two years' tests with commercial flocks of lighted and unlighted pullets and yearling hens in which detailed comparisons were made of egg production, receipts for eggs, feed consumption and costs, and mortality. Special attention was given to a study of the returns from lighting for the different months of the year and for the full year, as well as for the winter lighting period.

Brief sections are devoted to various uses for lighting and recommendations concerning the amount of light, type and location of lamps, and the methods and costs of wiring houses. This information, which includes a concensus of experiences and opinions and is not all based on experimental data, is offered along with the foregoing experimental data for the benefit of poultrymen who may not be familiar with the different applications of lighting.

Normal egg production and price variations throughout the year. The accompanying curves (Fig. 1) show the relation between egg production, egg prices, and number of hours between sunrise and sunset in Oregon. The production curve is based upon available records of the production of average commercial and farm flocks in the state. The egg price curve is plotted from Portland price quotations on *current receipts* taken from the Northwest Daily Produce News for each Wednesday of the five-year period, 1923-1927.

The production of the average Oregon hen increases very rapidly from January until April, when it reaches the highest point of the year. The curve drops off gradually from April until August and reaches a minimum during the month of October. The increase in production

[1]The preparation of this bulletin and the experimental work upon which it is based have been in cooperation with the Oregon Committee on Electricity in Agriculture. This committee is made up of farmers, business men, and representatives of the State College, Grange, Farmer's Union, public utilities and equipment companies. Its purpose is "to determine and disseminate facts regarding the use of electricity for profit and convenience on Oregon farms."—James T. Jardine, Director, Agricultural Experiment Station; Chairman, Oregon Committee on Electricity in Agriculture.

[2]Geo. W. Kable, Experiment Station Agricultural Engineer and Project Director of the Committee on Electricity in Agriculture; F. E. Fox, Associate Professor of Poultry Husbandry; A. G. Lunn, Professor of Poultry Husbandry and Head of the Poultry Department.

from October throughout the winter is gradual except for a temporary standstill during the period of coldest weather.

The average price for eggs during this five-year period was 30 cents per dozen. The price was above this average from September to Jan-

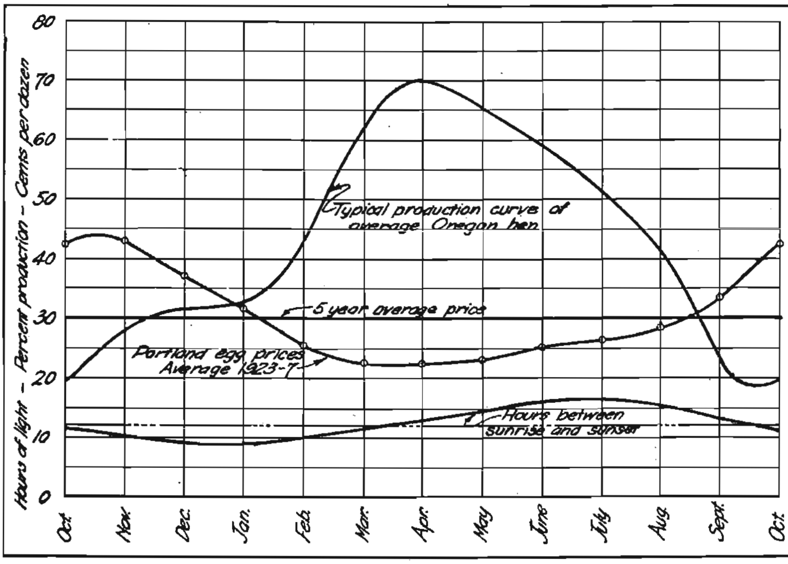


Fig. 1.

uary inclusive and below the average from February to August. The highest prices were paid in October and November followed by a rather rapid decline from December to February and with the lowest prices obtaining in March, April, and May.

It is noteworthy that the price curve trends upward rapidly in

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MANAGEMENT OF TEST FLOCKS

Housing.

Three commercial laying houses were used. Each house was divided by a sealed partition into two pens of equal size, one of which was lighted and the other not lighted. Each house provided approximately three square feet of floor space per fowl. Four hundred yearling hens were placed in one of the houses, being divided as nearly alike as possible between the two pens on the basis of egg production. In one of the remaining two identical houses were placed 230 pullets selected out of the pullet flock from appearance as being the earliest maturing fowls. The remaining 230 pullets were placed in the third house. The two pullet flocks were each divided equally between the lighted and unlighted pens.

Stock.

Single comb, White Leghorn fowls were used in all of the tests. They were hatched on March 28 in each of the three successive years. The fowls all came from the same breeding pens, were hatched and brooded together, and reared together on free range. The flocks were all handled on a commercial basis.

A few of the quicker-maturing pullets had commenced laying when they were brought in from the range in September. None of the slower-maturing pullets had started laying.

The yearling hens used in the test were selected from the pullet flocks of the preceding year. All had trap-nest records of 150 eggs or more in eleven months. The hens

August and September just before the pullets come into laying and reaches a maximum in October when production has dropped to the minimum. The period of lowest prices comes between March and May when egg production is at its peak. These facts are, of course, the chief economic reason for attempting to stimulate production through the use of artificial lighting during the fall and winter months.

Most investigators have surmised that the crop capacity of a hen was too limited to enable her to take enough food during the short winter days to maintain her body weight and her egg production. Whatever the reason for normal slacking off in production, it is a fact that the days from October to March are shorter than the average for the

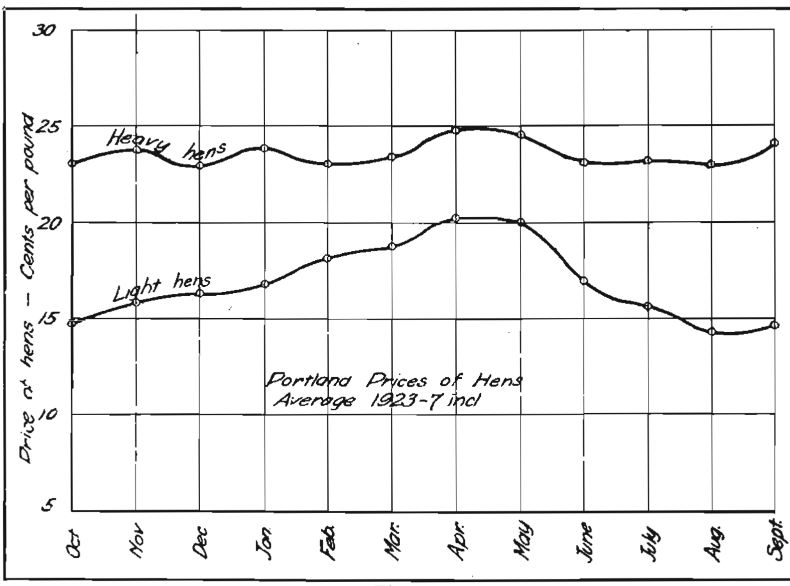

Fig. 2.

in the 1925-26 test had all been lighted as pullets, and more than half of the 1926-27 flock had been lighted. The hens were all moved from one house to another, and part of them from the South Experimental Farm to the Home Plant just before the test started. A number of them were molting at the beginning of each year and the flocks as a whole were not in good physical condition.

Lights.

Lights were hung 6 feet from the floor and half way from the front edge of the dropping boards to the front of the house and spaced 10 feet apart. Fifty-watt, mill-type, Mazda lamps were used with flat white glass reflectors 13½ inches in diameter. These units furnished light on the roosts as well as on the floor.

The lights were turned on simultaneously in all pens each day by a time switch and were turned off after daylight by the attendant. All lighting was done in the morning. At first the lights were turned on at 4 o'clock, the time switch being set later as the days lengthened in order to maintain a reasonably uniform light day of about 13 hours throughout the test.

The lighting period started October 1 and ended March 31. Lights were turned on abruptly at 4:00 a.m. on October 1. In March the normal lengthening of the light day and the later time of turning on the lights caused a gradual tapering off of the artificial lighting.

Feeding and Handling.

The regular college method of feeding (see Extension Circular 378) was followed, year, as indicated in Fig. 1. The shortening of the days is more pronounced in Western Oregon because of the dark days accompanying the rainy season.

Hen prices vary throughout the year. The market price of hens, as well as of eggs, varies with the season. This is especially true of light hens. The curves in Fig. 2 are plotted from average monthly prices of light and heavy hens as given on Wednesday of each week in the Northwest Daily Produce News for the five years of 1923-1927. Hens of the heavy breeds are in fairly constant demand, the price ranging from about 23 cents to 25 cents throughout the year. The prices of lighter hens cover a wider range, varying from a minimum of about 14 cents in August to a maximum of a little more than 20 cents in April. The price holds up well through May but drops off rather quickly in June.

Since the price of eggs reaches the low point in March, April, and May when the price of light weight hens is still up, a greater total profit may be made by selling these hens in the spring or early summer. This is especially worthy of consideration with the lighted hens which have been the heavier producers during the winter months.

Effect of lighting on egg production. Reference to Figs. 3 to 8 shows that when lights are applied to a flock the production of the flock is quickly built up regardless of the age or condition of the fowls. The flocks were not divided into lighted and unlighted pens until October 1, the division then being made as nearly even as possible on the basis of maturity or production. It is reasonable to assume that the fowls which made up the lighted pens and those which made up the unlighted pens after October 1 laid approximately the same number of eggs while they were all running together in September. Lights were turned on October 1. The October production of the lighted pens was greater than that of the unlighted pens in every case, the increase ranging from 11 percent to 83 percent. In several instances this was the maximum increase for any month of the year. The average increase in the actual number of eggs laid per hen by the lighted over the unlighted flocks in October was as follows: quicker maturing pullets, 3.7 eggs; slower maturing pullets, 2.2 eggs; yearling hens, 3.1 eggs. While there is not a large difference in these actual increases, it is of interest that the best fowls were responsible for the greatest increase.

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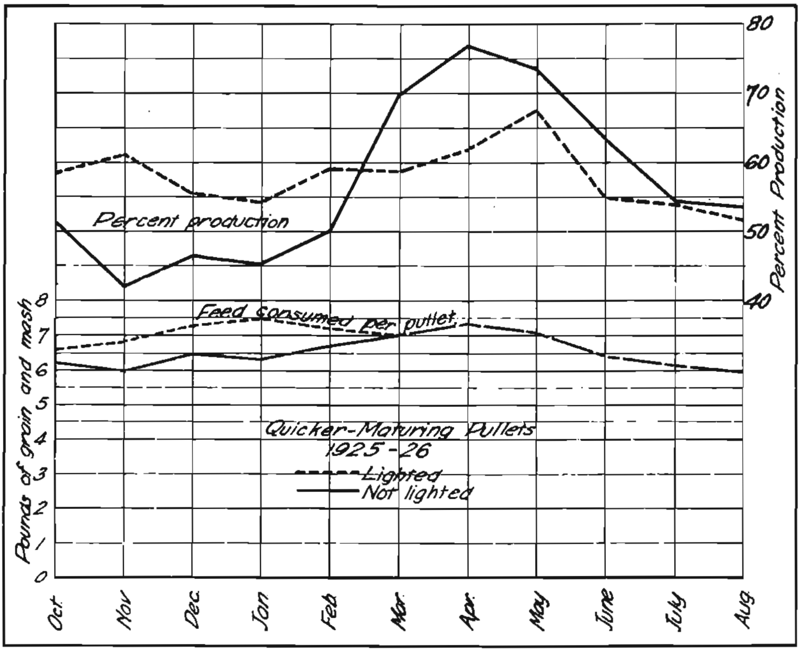
the No. 2 egg mash being used. The morning scratch feed was scattered in the litter at night. Dry mash, fresh buttermilk, water, and green feed were before the fowls at all times. The amount of scratch feed was varied by the attendant with the rate of laying, condition of the fowls, and their appetites.

Actual weights of feed consumed were kept for each pen until the lights were discontinued on April 1, when the lighted and unlighted pullets in each house were turned together and given access to the yards. Subsequent to April 1, the amount of feed charged to the lighted and unlighted pullets was prorated on a fowl basis for the entire flock. Feed records for the lighted and unlighted yearling hens were kept separate throughout the year. Wet mashes and green cut bone were fed to all pens in the fall when it was desired to stimulate production. The lower-producing pens received the larger amounts of these forcing rations.

All fowls were leg-banded and trap-nested so that the production of lighted and unlighted fowls was known throughout the test. No culling was done during the test.

In November, 1925, all of the fowls were vaccinated after having an attack of chicken-pox. In 1926 all of the pullets were vaccinated in September when they were brought in from the range.

Hens were disposed of September 1 and the pullets brought in from the range September 15. During the period of lighting all of the fowls except the yearling hens were confined in the houses.


Percent production
Feed consumed per pullet
Quicker-Maturing Pullets
1925-26
Lighted
Not lighted
Pounds of grain and mash
Percent Production
80
70
60
50
40
8
7
6
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3
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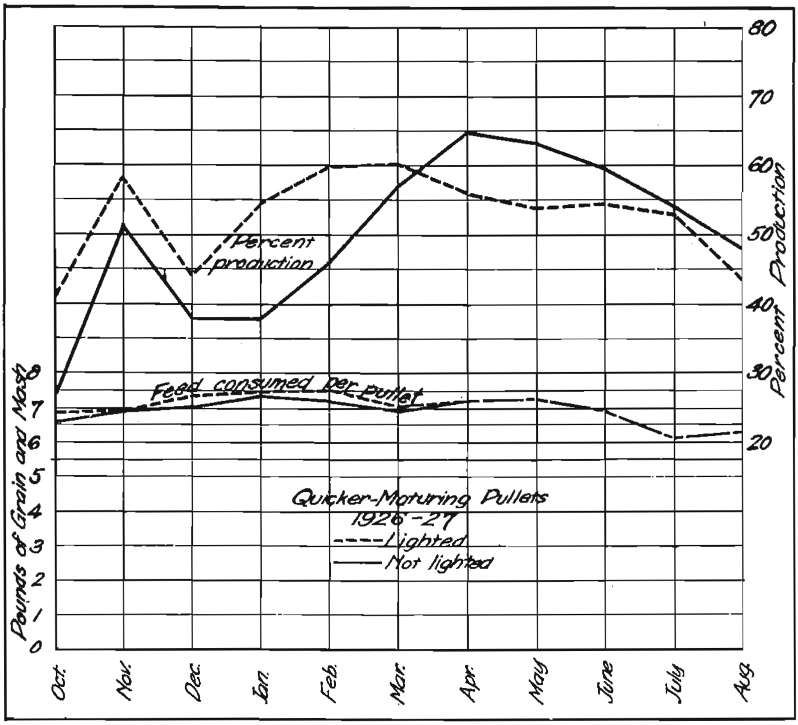
Percent production
Feed consumed per pullet
Quicker-Maturing Pullets
1926-27
Lighted
Not lighted
Pounds of Grain and Mash
Percent Production
80
70
60
50
40
30
20
8
7
6
5
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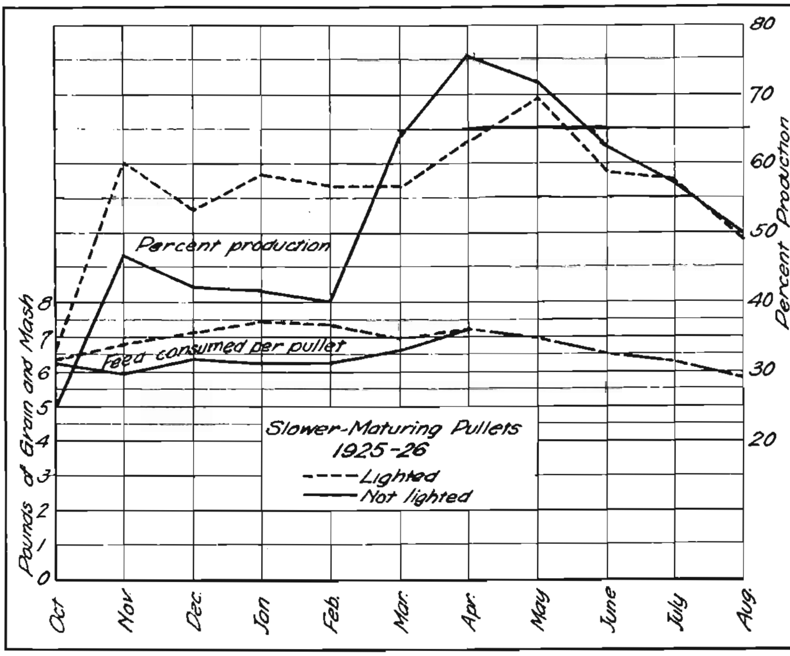
Figs. 3 and 4.


Percent production
Feed consumed per pullet
Slower-Maturing Pullets
1925-26
Lighted
Not lighted
Pounds of Grain and Mash
Percent Production
80
70
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30
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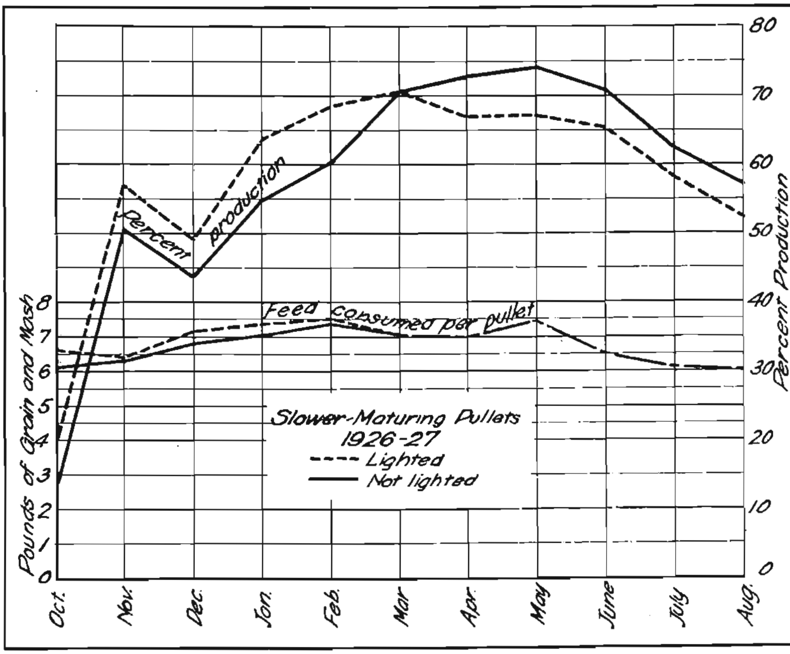
Percent production
Feed consumed per pullet
Slower-Maturing Pullets
1926-27
Lighted
Not lighted
Pounds of Grain and Mash
Percent Production
80
70
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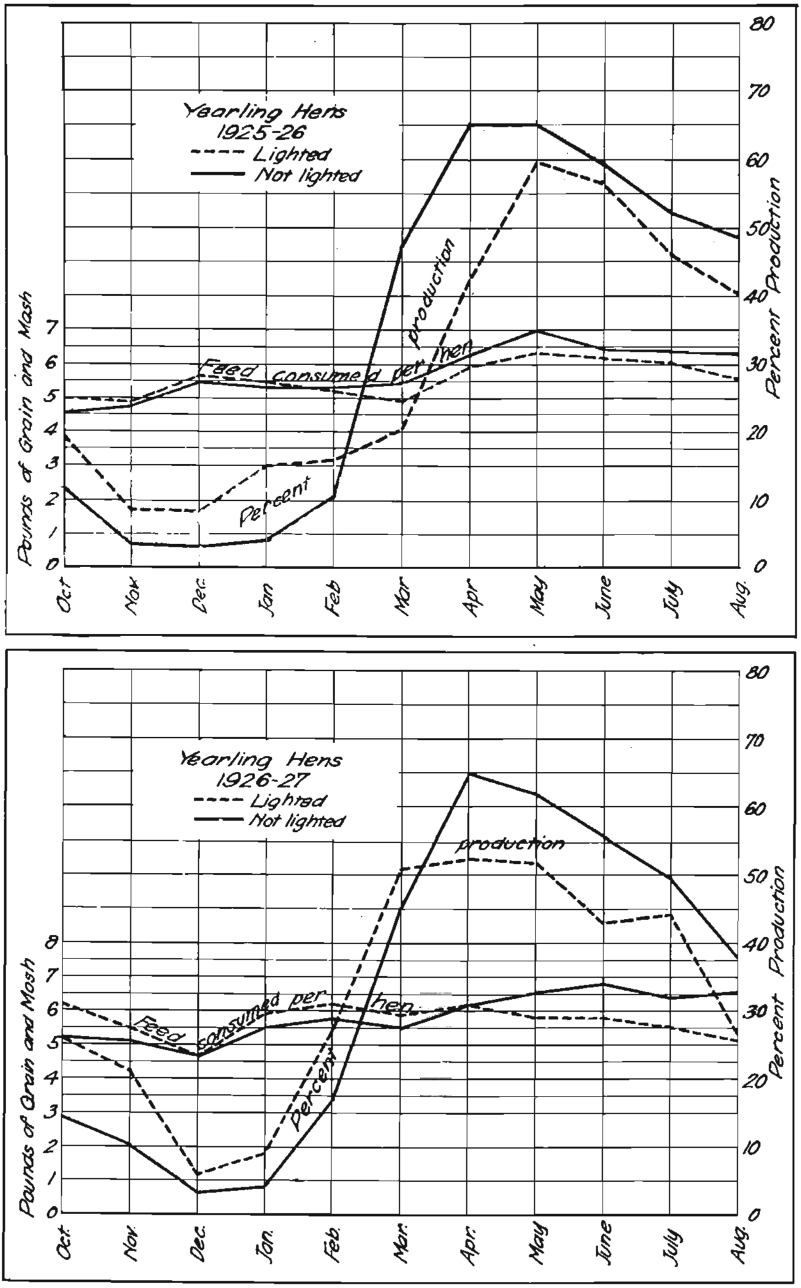
Figs. 5 and 6.


Yearling Hens
1925-26
Lighted
Not lighted
Feed consumed per hen
Percent production
Pounds of Grain and Mash
Percent Production
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
June
July
Aug.
Yearling Hens
1926-27
Lighted
Not lighted
Feed consumed per hen.
Percent production
Pounds of Grain and Mash
Percent Production
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.

Figs. 7 and 8.

TABLE I. SUMMARY FOR LIGHTED PERIODS (6 MOS.)
Monthly Averages for **1925-26** and **1926-27**

Stock	Year	Average flock	Percent production	Eggs laid per fowl No.	Eggs laid per fowl Value	Feed per fowl — Lbs. consumed Grain	Feed per fowl — Lbs. consumed Mash	Feed per fowl — Lbs. consumed Total	Feed per fowl — Total cost	Electricity used per fowl Kwh.	Electricity used per fowl Cost at 10c Kwh.	Profit per fowl over feed and light	Profit per fowl in favor of lighting
Quicker maturing pullets													
Lighted	1925-26	112.3	57.7	17.5	0.512	3.7	3.4	7.1	0.193	0.082	0.0082	0.312	0.058
Not lighted	1925-26	114.7	50.9	15.4	0.434	2.9	3.6	6.5	0.180	....	....	0.254	....
Lighted	1926-27	113.8	62.8	19.1	0.511	3.3	4.0	7.3	0.188	0.082	0.0082	0.315	0.080
Not lighted	1926-27	114.4	52.5	15.9	0.423	3.1	3.9	7.0	0.188	....	....	0.235	....
Slower maturing pullets													
Lighted	1925-26	113.7	53.1	16.1	0.463	3.7	3.4	7.1	0.189	0.075	0.0075	0.266	0.072
Not lighted	1925-26	114.8	43.4	13.2	0.371	2.8	3.6	6.4	0.177	....	....	0.194	....
Lighted	1926-27	110.9	54.8	16.5	0.427	3.2	3.9	7.1	0.183	0.094	0.0094	0.235	0.039
Not lighted	1926-27	113.7	48.6	14.7	0.376	3.0	3.8	6.8	0.181	....	....	0.196	....
Yearling hens													
Lighted	1925-26	196.9	14.5	4.4	0.129	2.3	2.9	5.2	0.153	0.091	0.0091	—0.033	0.019
Not lighted	1925-26	198.7	13.3	4.0	0.098	2.2	3.0	5.2	0.151	....	....	—0.052	....
Lighted	1926-27	196.2	23.3	7.1	0.176	2.5	3.3	5.8	0.159	0.073	0.0073	0.009	0.048
Not lighted	1926-27	196.0	15.6	4.7	0.111	2.1	3.3	5.4	0.150	....	....	0.039	....

EXPLANATIONS OF CURVES AND TABLES

Average flock.

The average flock is taken as the total hen days divided by total number of days.

Percent production.

The percent production in each case was computed by dividing the total number of eggs laid by the number of hen days.

Pounds of grain and mash consumed.

This includes the actual weights of grain, dry mash, and wet mash ingredients, when wet mash was fed. The relative proportions of scratch grain and mash varied from month to month depending upon production and condition of the fowls. Dry mash was before the fowls at all times.

Feed cost.

Feed costs include milk, bone, shell, grit, charcoal, straw litter, and lime for dropping boards in addition to grain and mash. The actual cost of feed was computed each month. Wheat and oats were purchased in the fall for the entire year. Other feeds were purchased from time to time in amounts to last one or more months and at current local prices. It should be noted that the curves representing feed costs

TABLE II. SUMMARY FOR YEAR (11 MONTHS)
Monthly Averages for 1925-26 and 1926-27

Stock	Year	Average flock	Per cent production	Eggs laid per fowl No.	Eggs laid per fowl Value	Feed per fowl: Lbs. consumed Grain	Mash	Total	Total cost	Electricity used per fowl Kwh.	Cost at 10c kwh.	Profit per fowl over feed and light	Profit per fowl in favor of lighting
Quicker maturing pullets													
Lighted	1925-26	110.9	57.8	17.6	$.0451	3.6	3.3	6.9	$0.181	Same as in Table I	Same as in Table I	$0.266	$0.014
Not lighted	1925-26	115.0	56.9	17.3	0.425	3.2	3.4	6.6	0.174			0.252	....
Lighted	1926-27	111.0	62.5	19.0	0.428	3.2	3.9	7.1	0.189			0.252	0.031
Not lighted	1926-27	111.1	59.3	18.1	0.393	3.1	3.9	7.0	0.189			0.204	....
Slower maturing pullets													
Lighted	1925-26	111.0	58.8	17.9	0.430	3.6	3.3	6.9	0.180			0.246	0.030
Not lighted	1925-26	113.1	52.4	15.9	0.388	3.1	3.4	6.5	0.172			0.216	....
Lighted	1926-27	107.1	57.6	17.5	0.381	3.1	3.8	6.9	0.184			0.192	0.010
Not lighted	1926-27	112.1	57.0	17.3	0.365	3.0	3.8	6.8	0.183			0.182	....
Yearling hens													
Lighted	1925-26	192.7	29.9	9.1	0.213	2.7	3.0	5.7	0.153			0.055	—0.012
Not lighted	1925-26	195.0	33.4	10.2	0.223	2.7	3.1	5.8	0.156			0.067	....
Lighted	1926-27	189.7	32.3	9.8	0.198	2.3	3.5	5.8	0.166			0.027	0.006
Not lighted	1926-27	188.8	32.5	9.9	0.184	2.4	3.5	5.9	0.163			0.021	....

may not have the same shape as the curves of pounds of feed consumed (Figs. 3-15). This is due to a variation in the percent of grain and mash consumed, whether or not wet mash was being fed, and the relative costs of other feed ingredients.

Electricity costs.

The electricity for lighting was assumed to cost 10 cents per kilowatt hour. This cost will vary in Oregon from about 2c to 10c, depending upon the amount of electricity used. In nearly all cases, the greater the use, the lower the rate.

Curves on 30-day month basis.

Since the days in the calendar months vary from 28 to 31, the total egg receipts, feed costs, etc., for the calendar months would not be comparable. In order to eliminate this variable, all of the records have been computed and plotted on the basis of a 30-day month. For example, the actual values for March, which contains 31 days, have been divided by 31 and multiplied by 30 to get the plotting values.

On most of the production curves, it will be noted that after this first spurt of the lighted fowls, the curves follow along roughly parallel to each other until February or March.

It is an interesting fact that the curves of production all cross in February in the year 1925-26 and in March in the year 1926-27, the lighted fowls being the higher producers prior to this time and the unlighted fowls taking the lead thereafter. These crossovers occur irrespective of age, feeding, or previous production. The crossing of the 1925-26 curves in February and the 1926-27 curves in March may have been due to seasonal differences or differences in physical condition of the flocks. In 1926-27 there was a sharp decline in production in December in all pens, lighted and unlighted. It is entirely possible that this retarding influence may have carried over into the spring production.

Inasmuch as the lights are still on the fowls at this time, it appears that the natural conditions which are normally responsible for high spring production have greater influence on the fowls than any artificial conditions which have been established through lighting and feeding. The fowls which have produced the least and are presumably in better physical condition come back with the higher production. This is illustrated by all twelve of the production curves but especially by the production of the yearling hens which have just ended a period of rest. (Figs. 7 and 8.)

During the period of low egg yield, the yearling hens had dry mash and green feed before them at all times, and in addition were fed green cut bone three times per week and wet mash once each day. In spite of the lights and the forcing rations, these hens continued with their molt and resting period. It appears, therefore, that it is not feasible to force hens into heavy production when they are not in good condition for laying, and that in lighting hens this factor should be taken into consideration.

Attention should be called to the effect of lights in flattening the annual production curve. It has been known for some years that the use of lights would tend to hold up production through the fall and winter months. The hold-over effect of lighting on production subsequent to the winter period has not been so well known. The results of our studies indicate that lighting fowls during the fall and winter, levels off the yearly production curve both by increasing fall and winter pro-

TABLE III. FEED COSTS PER 100 LBS.

	1925-26		1926-27	
	Grain	Mash	Grain	Mash
October	$2.15	$2.45	$2.02	$2.23
November	2.15	2.45	2.02	2.23
December	2.15	2.43	2.05	2.25
January	2.15	2.40	2.02	2.285
February	2.15	2.40	2.02	2.285
March	2.15	2.40	2.05	2.35
April	2.038	2.185	2.10	2.35
May	2.038	2.185	2.10	2.30
June	2.038	2.185	2.36	2.53
July	2.04	2.18	2.34	2.56
August	2.00	2.07	2.24	2.42
Average	$2.095	$2.30	$2.12	$2.344

Average price per 100 pounds for 2 years: milk $0.37, meat scrap $4.48, oyster shell $1.134, grit $0.893, lime $1.15, straw $0.35, charcoal $3.75, bone $2.80, fresh bone $3.00.

duction and by decreasing spring and early summer production. As an example of this leveling off in 1925-26 the unlighted pen of quicker maturing pullets ranged from 42 percent during the low production period in November to 77 percent during the high producing season in April, while the lighted flock held between 55 and 60 percent production during most of the year with its low point of 52 percent in August.

These results are also summarized under "Percent Production" and "Eggs Laid per Fowl" in Tables I and II. The average production for the six months lighted periods (Table I) favored the lighted fowls by a good margin in every case. The average production of the lighted pullet flocks for the eleven-month periods was greater in all cases than the production of the unlighted pullets, but the production of the hens favored the unlighted pens due to the severe slump of all of these hens during the winter months.

Effect of lighting on feed consumption and feed costs. Several facts relating to the consumption and cost of feed have stood out strikingly in the tests.

Anything which tends to cause a hen to lay more eggs will also cause her to eat more feed. The results indicate that this applies to the use of lights, but they also show that the mere lengthening of the light hours of the day does not cause a greater consumption of feed unless the lengthened feeding time is accompanied by heavier production.

The curves (Figs. 3 to 8) and summary Tables I and II all disclose that the heavier producing fowls consumed the larger amount of feed. During the period of lighting, the lighted fowls were the heavier producers and also the heavier consumers. Following the lighted period, when the unlighted fowls were producing the larger number of eggs, they were consuming the larger amount of feed. Fig. 7 shows that during February and March, while the lights were still in use, the unlighted yearling hens forged ahead of the lighted hens in production with accompanying greater feed consumption. One other observation may be made from the curves. The amount of feed consumed by all flocks in July and August when the days were long was near the minimum for

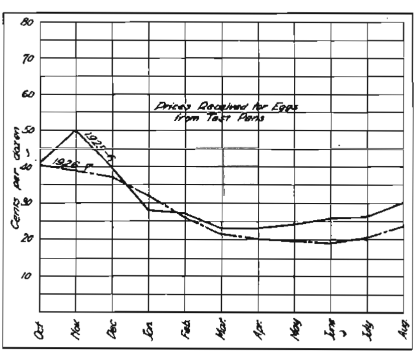


Fig. 9.

Weather.

The winter of 1925-26 was mild, there being very few freezing days. In 1926-27 there was about one week of freezing weather in February with a minimum temperature of 9° F.

Actual prices received for eggs from test pens.

Eggs from the test pens were all sold locally. Fig. 9 gives the actual prices received for the eggs and used in computing the receipts for eggs on the following pages. The maximum prices were paid in October and November and the lowest prices from March until June, conforming quite closely with the five-year average Portland price curve.

the year, while the feed consumption in April approached the maximum when the days were relatively shorter but when production was higher.

Summing up, it appears that while the lengthening of the feeding time by the use of lights during the winter does usually result in increased feed consumption and increased production, this increased feeding time is not the underlying cause of the increased feed consumption and production. The use of lights simply changes a winter condition into a condition which enables a hen, having a dormant capacity for increased production, to lay. A fowl without that latent ability to lay, at that particular time, can neither be made to lay more eggs nor to eat a considerably larger amount of feed by lengthening the feeding time.

Another fact concerning feed consumption under lights is that when the fowls have the capacity to lay the increase in the amount of feed consumed is in much smaller proportion than the increase in the number of eggs laid. For example, in December, 1925, an average winter month, the receipts from 100 lighted pullets were $9.20 more than from the unlighted pullets, while the increase in feed cost was only $0.50. In November, the increased receipts were $23.70 with a corresponding increase in feed cost of only $1.80. Figs. 7 and 8 also show that while the production of the yearling hens varied from less than one to more than 20 eggs per hen per month, the feed consumption range was only from 4½ to 7 pounds. In other words, a large proportion of the feed consumed by the fowls was used for body growth and maintenance and any production above the normal through the use of lights was obtained at a relatively low feed cost.

Attention is also called to the fact that although the amount of feed consumed was greater for the higher producing fowls, the cost of the feed did not vary in the same proportion, and in some cases was lower for the heavier producers. Reference to the amount of grain and mash fed (Table I) offers an explanation for this seeming discrepancy. It will be noted that during this lighted period when the lighted fowls were the heavier producers, the unlighted fowls were consuming a smaller total amount of feed but a larger proportion of more costly mash.

Effect of lighting on mortality. The mortality for the different pens by years is given in Table IV. There was only a small difference in mortality between the lighted and unlighted quicker-maturing pullets. The average mortality rate for these pullets for the two years was considerably lower than for the hens or the less mature pullets. This checks the logical assumption that fowls in good condition will stand lighting best and have the lowest total mortality.

TABLE IV. MORTALITY

Stock	1925-26		1926-27	
	No.	Percent	No.	Percent
Best pullets				
Lighted	8	6.9	13	11.2
Not lighted	4	3.4	12	10.4
Less mature pullets				
Lighted	12	10.4	18	15.6
Not lighted	5	4.3	7	6.0
Yearling hens				
Lighted	18	9.0	23	10.5
Not lighted	14	7.0	31	15.5

The less mature pullets suffered considerably from lighting. While the loss was not abnormally high, it was about 2½ times as great for the lighted as for the unlighted pens.

The death loss of hens was greater than of pullets. This is also to be expected. Lighting, however, seemed to have little effect upon the death rate, the loss in 1926-27 being 50 percent greater in the unlighted flock.

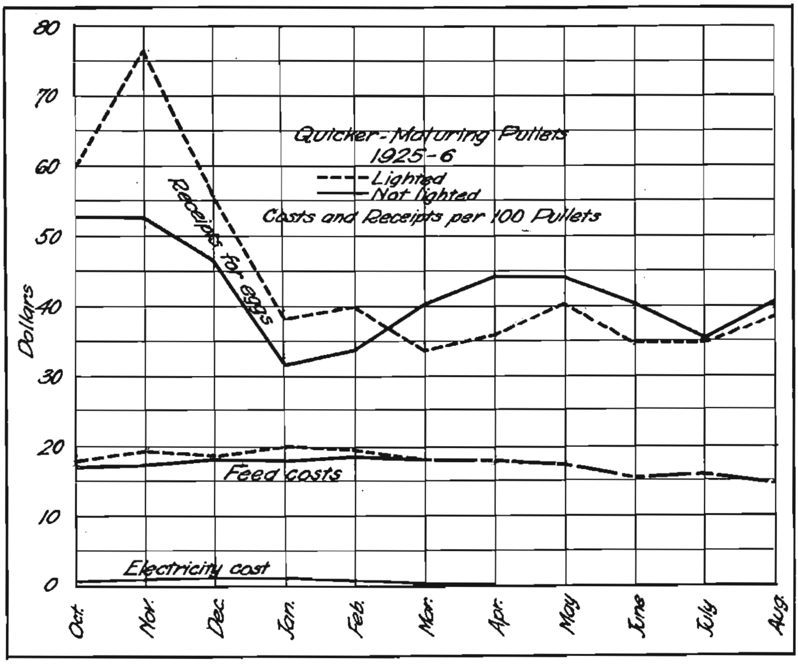
Effect of lighting on flock profits. *Value of eggs produced.* Small increases in production during the period of highest prices, as in November, 1925-26, are responsible for relatively large increases in total receipts (see Figs. 3, 10, 5, 12, 7 and 14). On the other hand, the large increases in spring production were insufficient to keep receipts from pullet pens at winter level because of the lower price of eggs. The general trend of the pullet production curve after December is upward while the general trend of the receipts curve is downward. These trends did not obtain in the hen flocks because of the rest period taken by the hens with accompanying extremely low winter production and very high spring production.

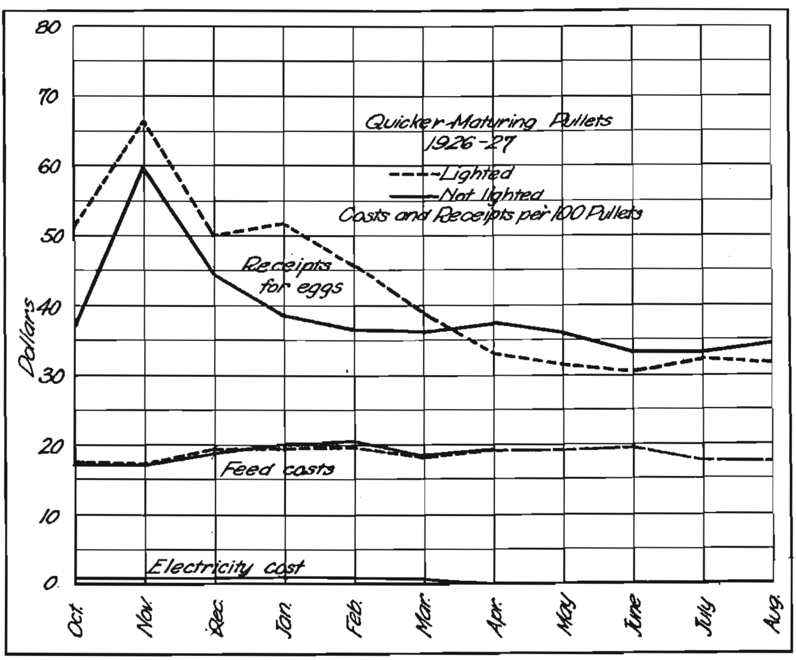
Cost of electricity. The cost of electricity for lighting was small in all cases compared with the increased returns for eggs (see Figs. 10 to 15). Table I gives the monthly consumption in kilowatt-hours per fowl and the monthly cost at 10 cents per kilowatt-hour. The maximum cost during any month was less than 1c per fowl, which at average prices of eggs during the lighted period would be less than the value of 2/5 egg per month per fowl.

It should be stated also that under practically all present rate schedules, the greater the use of electricity, the less the cost per kilowatt-hour. The assumed cost of 10c per kilowatt-hour is probably in excess of what most poultrymen would be required to pay.

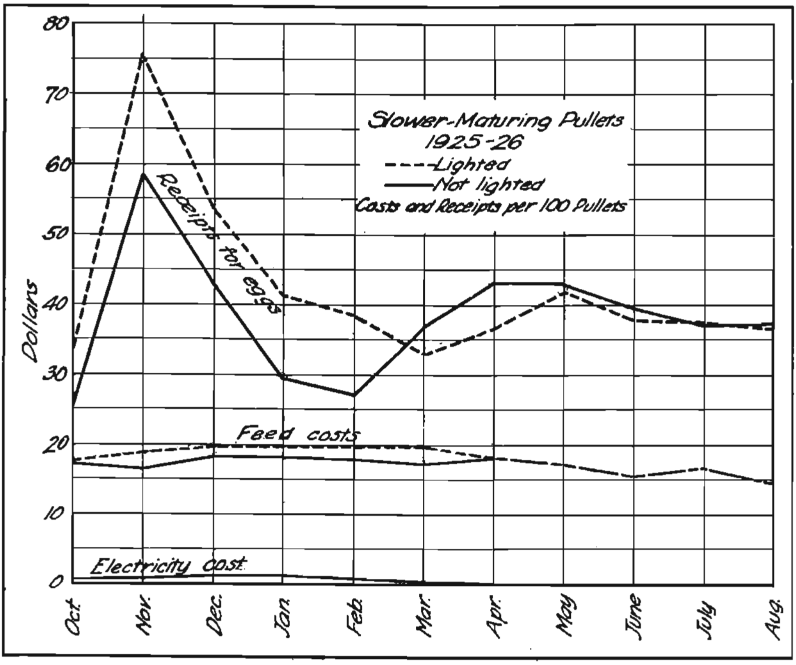
Returns from lighting. In all of the curves representing costs and receipts (Figs. 10 to 15) the vertical distance between the "Feed cost" curve and the curve of "Receipts for eggs" is a measure of returns above feed costs. A casual examination of the curves will show that these returns for all pullet pens, lighted and not lighted, were very much greater between October and March than in subsequent months. With the hens, the reverse was true. All of the curves for both pullets and hens and summary (Table I) show very considerably increased returns of lighted over unlighted fowls for the lighted period of October to March. The maximum average monthly profit per lighted fowl over unlighted fowls was 8c with a minimum of 1.9c. As spring came on and the artificial light was gradually lessened the profits as well as the production from the unlighted pens overtook that from the lighted pens and continued higher during the spring and summer, although the total receipts from both pens was much lower than during the winter months.

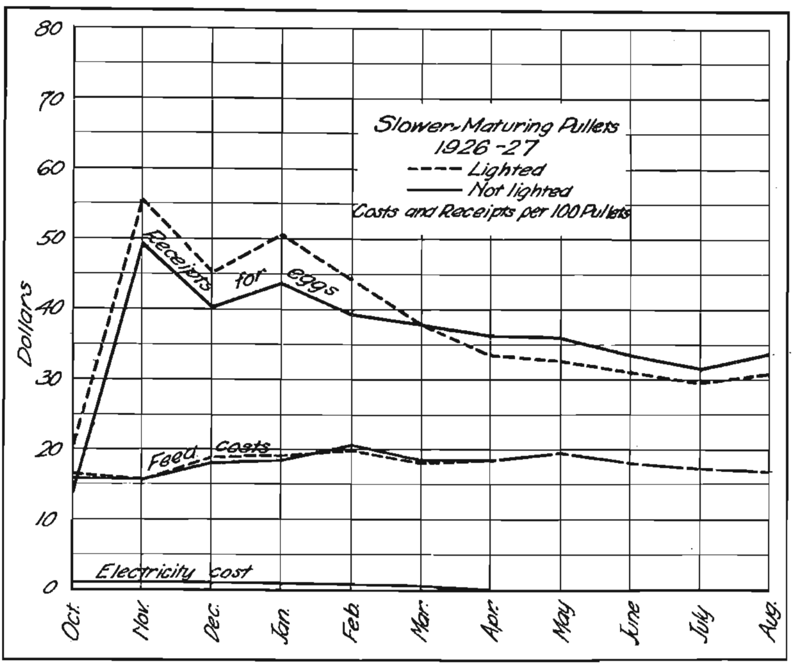
Both the curves and the tables bear out the fact also that the best fowls yielded the greatest profit from lighting. The records point to this fact in two ways. The profit per fowl in favor of lighting from Table II is 1.4c and 3.1c per fowl per month for the quicker maturing pullets for 1925-26 and 1926-27, respectively, or an average of 2.25c per



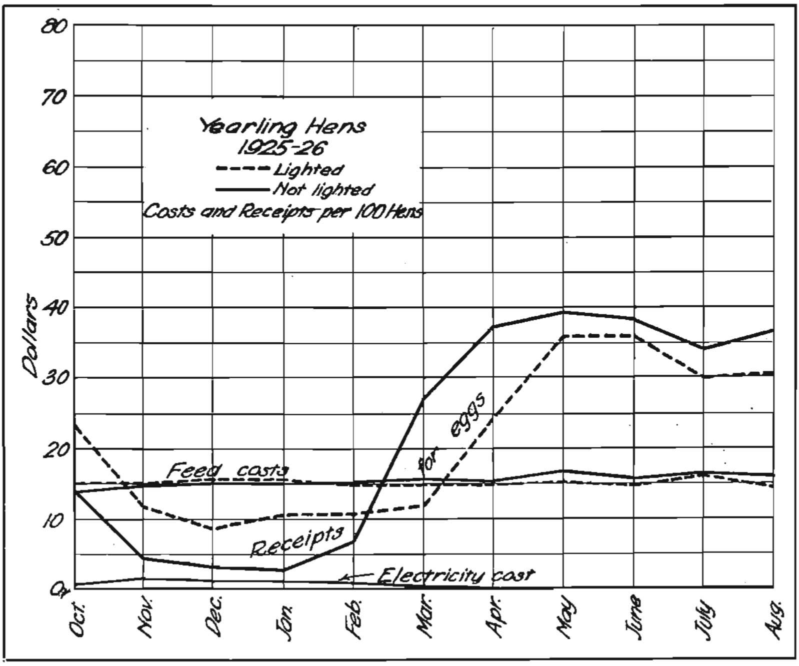


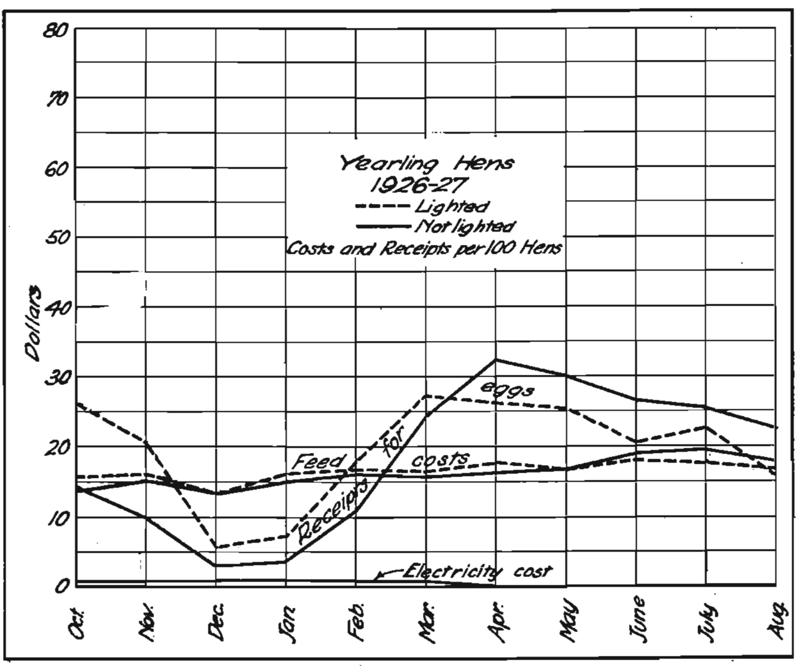
Figs. 10 and 11.





Figs. 12 and 13.





Figs. 14 and 15.

month. Similarly the average for the slower maturing pullets is 2.0c and for the hens a loss of 0.3c, the greatest average profit from lighting for the two years being made by the quicker maturing pullets. These were also the heaviest producers. Again, comparing one year's record with the other we find the 1926 quicker-maturing pullets, the 1925-26 slower-maturing pullets and the 1926-27 hens leading in profits per fowl in favor of lighting. Each of these leading flocks also has a higher production record than the corresponding lighted flock of the alternate year.

One factor in connection with profits should be mentioned. No attempt has been made to compute the net profit from the flocks by deducting the labor cost and overhead expense, which varies widely under different conditions. With the exception of interest and replacement on the electrical installation, which will be discussed later, these items of cost will be increased very little, if any, due to lighting. Assuming a constant figure for monthly labor and overhead and deducting this from the profits above feed and light would leave a much larger *percentage* of profit in favor of lighting.

After the flocks in this test were once selected no culling was done. An increase in net profit would probably have resulted had the flocks been culled in early summer when the margin of profit was small, the labor demand high, and the market price of light hens considerably above what it was in August and September (see Fig. 2). Under farm conditions, this culling would be done.

The five-year average price of light hens (Fig. 2) in May was 20c per pound and in August 14c per pound or a difference of 6c. If a hen weighs 4 pounds, the loss in market value of the hen from May to August is 24c. If she is a low producer, this is several times greater than the profit she would make over feed cost in the same period.

General comments on results. There seems to be good evidence that all fowls are quickly stimulated into higher production by the use of lights and that this increased production can be maintained throughout the season of the year when production is normally low; also, that this increase in production is not a direct result of providing a longer feeding time per day. Apparently there is a certain reserve built up in a fowl, a potential productiveness, which may be transformed into actual production through the use of lights but with an accompanying reduction in her residual potentiality. Stated in a different way, a hen may, by lighting and proper management, be made to give up more of her year's quota of eggs during the period of high egg prices, but she cannot be expected to replace all of these eggs with others during the normal heavy production period.

The use of artificial illumination, therefore, should be looked upon as a means for changing the seasonal production of a hen to fit into the management plan which results in greatest profit.

There is some liklihood that the use of lights merely enables the hen to keep in proper physical condition and body weight so that she can lay. Further investigation would be necessary to prove this point.

A checking of the daily production records of the slower maturing pullets for the month of October showed that about 50 percent of the lighted pullets came into production during that month, while only about

25 percent of the unlighted pullets came into production. It would appear, therefore, that the effect of lighting on the less mature birds was to hasten their development.

In all of the pens, the higher producing fowls returned the greatest profits from lighting. If the six tests on 1700 fowls extending through two years are sufficient to be conclusive, it will pay best to use lights on the best fowls.

Management methods to accompany lighting. Reference has been made to the need for proper management methods along with the use of lights. Hens are sensitive to management methods and fowls of different ages, different stages of maturity, and varying physical conditions require different treatment. It is desirable, therefore, to have the fowls separated into flocks according to age, maturity, and condition. Immature pullets should not be encouraged to lay. Immature production results in reduced vigor, underweight hens, and small eggs. Definite lengths of time are required to mature fowls of different breeds before laying should start. Pullets should not be forced to lay until they have attained their correct body weight, and they should not be held at such high production that they cannot maintain this weight. Hens cannot be held in production indefinitely by the use of lights or other methods. They must have a rest period, and if they are not given this rest period they will probably take it at a time which may be unprofitable to the poultryman.

It is a common practice to feed grain and especially corn for the building up of body weight and fat, and to feed high protein feeds for stimulation of egg production. Where special stimulation of production is desired the protein mashes are fed wet to encourage greater consumption.

Expenditure warranted for lighting. Results thus far have been stated in terms of one fowl for one month. Table V gives costs, receipts, and profits on the basis of a commercial flock of 400 fowls for six months and eleven months. This table was made up from the experimental results and represents what might be expected from flocks that are not culled during the year. It does not take into consideration the cost or value of the fowls themselves. Systematic culling would probably increase the profits to some extent.

While the excess profit in favor of lighting was greater for the six-months lighted period than for the whole year, the total profits were of course greater for the eleven-months period. The eleven-months period will, therefore, be used in estimating the expenditure warranted for lighting.

Estimated cost of wiring, lamps, shades, and switches for 400-hen house........$35.00	
Interest and depreciation at 18 percent	$6.30
Yearly lamp cost	2.00
Total	$8.30
The average excess profit per year from lighting all pullets (Table V)	$89.37
Less above cost	8.30
Net profit for 11 months	$81.07

This amount would pay 8 percent interest on an investment in lines or plant of $1013.

It must be understood that this figure is only an approximation and will vary with different flocks and different management.

According to our tests, lights on commercial flocks of the best pullets will pay most toward the installation of electric service; poorer pullets a little less; and yearling hens least.

TABLE V. ESTIMATED PROFITS FROM LIGHTING 400 HEN FLOCKS
(Based on 2-year average)

Stock	Per-cent pro-duc-tion	Re-ceipts for eggs	Feed cost	Elec-tricity cost	Profit over feed and light	Excess profit
Estimates for six-months lighted period—October 1 to April 1						
Quicker maturing pullets						
Lighted	60.3	$1225.20	$456.20	$19.68	$749.32	$162.32
Not lighted	51.7	1028.80	441.80	....	587.00	....
Slower maturing pullets						
Lighted	53.6	1068.20	447.40	20.18	600.62	133.22
Not lighted	46.0	897.60	430.20	....	467.40	....
Yearling hens						
Lighted	18.9	366.00	374.80	....	—28.54	79.46
Not lighted	14.4	252.20	360.20	....	—108.00	....
Estimates for eleven-months period—October 1 to September 1						
Quicker maturing pullets						
Lighted	60.2	1924.40	812.00	19.68	1092.72	93.72
Not lighted	58.0	1796.40	797.40	....	999.00	....
Slower maturing pullets						
Lighted	58.2	1778.20	799.80	20.18	958.22	85.02
Not lighted	54.6	1655.40	782.20	....	873.20	....
Yearling hens						
Lighted	31.1	909.60	703.20	19.74	186.66	....
Not lighted	33.0	908.20	704.40	....	203.80	17.14
Average of all flocks						
Lighted	47.0	1211.93	598.90	19.87	593.17	53.87
Not lighted	42.9	1089.77	586.03	....	503.73	....

Market value of flock of 400 hens in May $320.00; in August $224.00.

SUGGESTIONS REGARDING VARIOUS USES FOR LIGHTING

The following brief statements relative to the lighting of laying fowls has been prepared after careful consideration of results and experience in connection with the experiments reported and a review of the literature and opinions on the subject. The statements made are not to be regarded as conclusions supported in all cases by adequate experimental data. They should be useful, however, to the poultryman who may be considering the installation of lights without having had personal experience.

The physical condition of fowls is the most important factor in lighting. No attempt should be made to force sick or thin fowls into production with lights. Thin fowls are likely to molt.

Artificial light under 14 hours per day is apparently not detrimental to the health of good fowls.

Regularity in lighting is essential.

Fowls under lights need more grain to maintain their body weight.

Do not light pullets before October 1 or longer than about 13 hours per day. Excessive early production tends to decrease body weight and induce a winter molt.

Best results from the use of lights call for the grading and housing of fowls according to age, development, and condition.

Lights for pullets.

Early hatched pullets that are good layers and have full body weight should be given only sufficient light and animal protein feeds to maintain production at 55 to 60 percent. They should be fed plentifully on grain to keep up their body weight, and 12 to 13 hours of light appears to be ample.

Lights used on early-hatched pullets will tend to prevent a fall or winter molt during the first year.

Quicker-maturing pullets should have about 13 hours of light and be fed to maintain production at 55 to 60 percent. Sufficient grain should be fed to maintain body weight.

Slower-maturing pullets may be given a quicker start by providing 13 hours of light and feeding plenty of grain to build up body weight. High protein feeds should be limited at first.

Late-hatched pullets should acquire full body weight before being brought into production. Light for 12 hours and give all of the grain they will consume. Do not feed forcing rations until the pullets are up to correct weight.

Lights for hens.

Commercial layers. Good, late-laying hens may sometimes be held in production during August, September, and October, when egg prices are high and large eggs are in demand, by giving 13 to 14 hours of light and feeding heavily on mash and grain.

Lights for culls. Where it is impossible to replace culls with better stock, they may be forced into somewhat higher production by long hours of light, and heavy feeding. The profit from such a proceedure is doubtful.

Lighting breeders. Breeding hens should be given a complete rest of two months before being brought into production for hatching eggs. If pullet eggs are to be used for hatching, it would be best not to light the pullets in the fall and early winter.

After the two-months rest period, hens should be brought back into production gradually, starting with 12 hours of light in January and increasing to 13 hours if a large production of February hatching eggs is desired.

Some poultrymen start using 12 hours of light with heavy grain feeding after the hens have ceased production for about three weeks in order to hurry them through the molt. Such lighting is of doubtful value.

Where fall layers are used for breeding purposes the lights should be discontinued suddenly the first of November and the hens thrown into a molt. The lights are turned on again in January and the hens brought back into production gradually.

The hatchability of eggs is not impaired by lights when properly used. Fowls should be vigorous and increasing in production or at maximum production for best hatching eggs. They should not be forced into production too fast or permitted to lose body weight.

Molting regulated by lighting. Suddenly discontinuing lights tends to throw fowls into a molt.

Fall and winter molting of early-hatched pullets can often be prevented by lighting for 13 hours per day and giving a moderately heavy grain feed.

HOW TO LIGHT THE LAYING HOUSE—THE COST

Artificial light in a hen house is used to attract the fowls off the roosts, to stimulate them to activity, and to provide adequate illumination so they can find the feed in the litter. The first requirements, then, are that some light shall fall on the roosts and that there shall be ample light on the floor.

Most instructions for lighting poultry houses have aimed to provide a minimum of light for the sake of economy. The economy of this practice is very questionable. Lamps and reflectors get dirty, or the lamps lose efficiency as they get old and the illumination may be less than expected. No comparative records of production in well illuminated and poorly illuminated houses are available. Records are available, however, to prove that the production and morale of workmen in factories are greatly improved by good illumination, and it seems reasonable that good illumination might have a beneficial effect on the production of workers in a hen house. At any rate, the cost of electricity is small in comparison with the value of the increase in eggs, especially when power is used for other purposes, and it will scarcely be worth while to coax the hens down from the roosts and have them spend the morning hours searching for food by a dim light when they might be exercising vigorously and consuming grain to improve their vitality and body weight.

Illumination recommended. Use ½ watt of lamp capacity for each square foot of floor space.

To find the wattage of lamps required, divide the number of square feet of floor space in the house by 2. Example: The Oregon 400-hen house is 20 ft. by 60 ft. The wattage of lamps required is 20 x 60 divided by 2, which is 600.

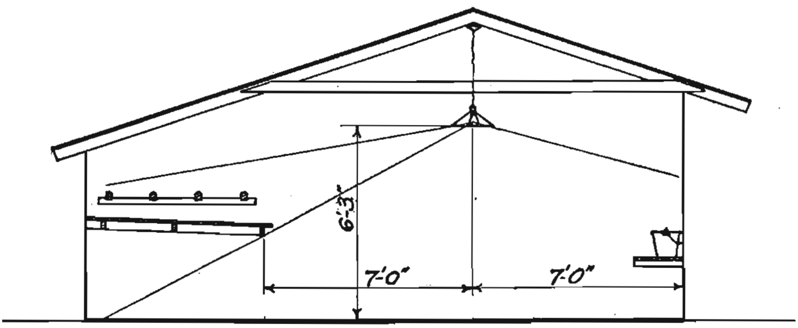
This is not brilliant illumination but is better than that usually recommended. At 10c per kilowatt-hour the cost would be approximately ½ egg per hen per month. (Eggs at 34c per doz.—average October to April price.)

Location of lamps. Hang the lighting units from the ceiling in a line half way from the front of the house to the front edge of the dropping boards in houses 24 feet wide or less. This location gives the most efficient illumination and the best distribution of light for the power consumed.

The lamps should be 6 feet 3 inches from the floor, which will put them out of the way of workers, give reasonably uniform distribution of light over the floor, light the roosts and still provide light under the dropping boards (see Fig. 16).

In houses of different sizes or shapes, other arrangements of lamps will be necessary. In wider houses two or more strings of lights may be desirable. In houses narrower than 20 feet the lamps should be placed closer to the front of the house in order to get light under the dropping boards.

Lamps placed over the windows in the front of wide houses give the poorest distribution of light on the floor. The intensity of illumination varies inversely with the square of the distance from the light. Therefore, a lamp on the front wall of the house will give only ¼ as much light under the front edge of the dropping boards as a lamp in the center of the house.



Location of Lamps

Direct light should reach the roosts, the floor under the dropping boards and the water pail

Fig. 16.

No one rule for placing lamps will apply to all houses. The location of feed hoppers, water pans, and other obstructions must be kept in mind and the lights placed to produce the smallest amount of shadow. Where hoppers are in the center of the house, the lamps should be directly over them.

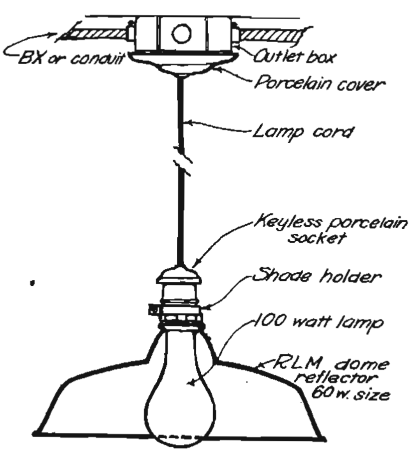


Fig. 17. Typical lighting unit.

The lighting unit. A lighting unit consists of a lamp with its socket and attachment, and a reflector (see Fig. 17).

Inside-frosted, 100-watt lamps are recommended. Lamps have recently been standardized in size, shape, and wattage. This is a new standard lamp.

Use keyless porcelain sockets with flexible lamp cord for the drop. The porcelain socket will eliminate possibility of shocks and will not corrode.

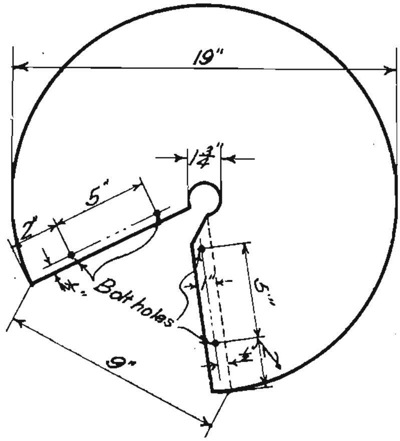


Fig. 18. Pattern for reflector. Make from No. 28 galvanized iron.

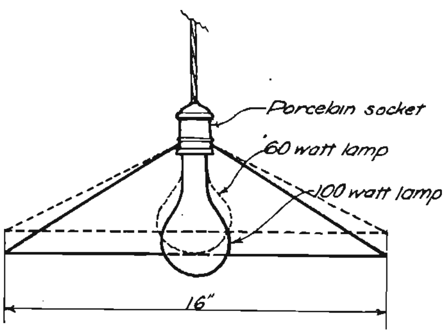


Fig. 19. Conical reflectors for 100-watt and 60-watt lamps.

The best reflector to use is an R. L. M. under-size dome reflector (60-watt reflector for 100-watt lamp), white enameled inside.* It is important that this reflector be of the size designated in order to have proper illumination of roosts and floor. More than half of the light from an electric lamp is directed to the sides and upward. In the poultry house the light is needed chiefly on the floor. The R. L. M. dome reflector is especially designed to distribute the light well over the floor and to avoid shadows. It does not provide quite as intense illumination on the roosts as does a cone-shaped reflector. The R. L. M. reflector is made by practically all lighting equipment manufacturers and costs about $2.00.

If a cheaper reflector is desired, a reasonably efficient one may be made by any tinsmith. Make it of No. 28 galvanized iron according to sketch in Fig. 18. Paint the under side with several coats of aluminum paint. No shade holder is needed since the neck of the reflector will fit closely about the porcelain socket. Be sure the reflector hangs straight.

*Comparison of reflectors. Lighting units were hung with the bottom of lamps 6 ft. 3 in. from the floor, 10 ft. apart and half way from front of dropping board to front of house. House 20 ft. wide. The same 100-watt lamps were used in both tests. The R. L. M. dome reflectors were of standard 60 watt size.

The cone-shaped reflectors were new and were 16 inches wide and 4½ inches deep, with two heavy coats of aluminum paint on the under side.

Location	Foot-candles illumination R. L. M. reflector	Foot-candles illumination Cone reflector
Directly under light	6.3	6.5
Under edge of dropping boards	2.5	2.1
18 in. from back wall	1.0	0.9
6 in. above rear roost	0.35	0.6

Ten inches of the floor at the rear of the house under the roosts was in shadow. The shadows with the cone reflector were sharp while with the R. L. M. reflector they were less distinct.

If lamps of any size other than 100 watts are to be used, have the tinsmith make the reflector so that the lamp, when screwed into the socket, will extend about 1 inch below the reflector (see Fig. 19).

This reflector will get dirty more quickly, will give less uniform illumination and sharper shadows, and more light on the roosts than will the R. L. M. reflector.

Control of lights. The use of lights only in the morning eliminates the need for dimming devices.* Figs. 20 and 21 illustrate very simple time switches for turning on the lights. These consist of standard tumbler switches mouned so that the alarm winding key of the clock will engage the tumbler. So place the switch that lifting the tumbler turns on the lights. Small depressions should be made in the clock shelf so that the clock may be accurately placed (see Fig. 21). A small staple driven over the leg of the clock opposite the alarm key will prevent its tipping yet not interfere with its removal.

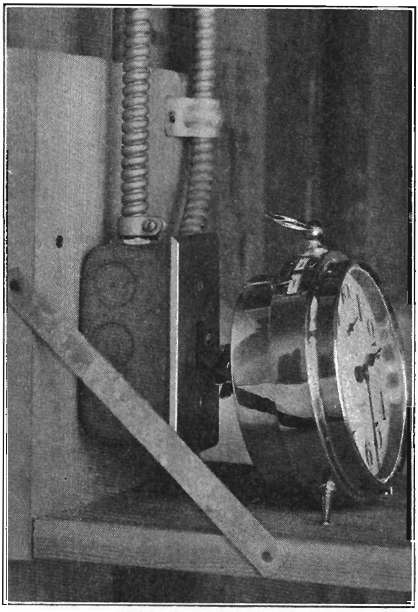


Fig. 20. Time switch. The center of the switch tumbler should be ¼ inch above the top of the alarm winding key when it is in a horizontal position. The switch and clock must be accurately placed to insure reliable operation.

A similar clock and switch may be used to turn off the lights or they may be turned off by the poultryman.

Some electric ranges are now provided with oven-control clocks which may be used to turn on the poultry-house lights from the kitchen.

Poultry-house wiring. In the installation of all electric wiring the state electrical code specifies what may or may not be done. The purpose is to prevent injury to persons or property through poor electric wiring. The State Code includes much of the "National Electrical Code" of the National Board of Fire Underwriters, which specifies regulations which must be complied with in order to obtain lower rates on fire insurance. While compliance with the regulations may make the job cost a little more, it will probably be more satisfactory in the end from the standpoint of safety, low depreciation, and reduced insurance costs.

Three systems of wiring are in use. Knob and tube wiring has been most common and as formerly installed was much cheaper than the other systems (see Fig. 22). Recent requirements have made this method more costly and many electrical contractors will install BX for the same price because less labor is required. Flexible conduit, or BX

*See Washington State College Bulletin 134 for "Methods of Dimming Lights for Poultry Houses."

(see Fig. 23), is coming into quite general use and is safer than open wiring. Rigid conduit is iron pipe through which the electric wires are pulled. This is considered the safest and most permanent kind of wiring but is also the most costly.

In the knob and tube system, the rubber-covered wires are supported in the open at intervals of not more than 4½ feet by porcelain knobs. In passing through partitions or timbers, the wire is carried in porcelain tubes.

BX consists of a flexible metal tubing containing the insulated electrical conductors. For damp places the conductors are covered with lead before being placed in the metal tubing. This tubing may be fastened directly to or carried through timbers or partitions. Wherever it is desired to have a lamp, switch or other connection, the BX is cut and fastened rigidly into a special metal outlet box. In this manner the wires are always protected from wear and abrasion.

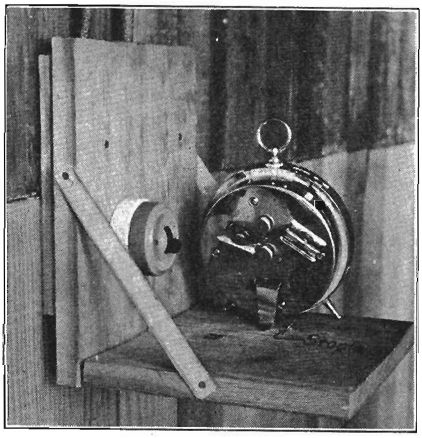


Fig. 21. Time switch for knob and tube wiring. Note depressions for clock feet to hold clock in position. Make them shallow at first until properly located by trial. The staple is to hold down the leg of the clock which has a tendency to lift. Slant it so that it will not interfere with removal of clock.

In conduit work, rigid pipe is substituted for the flexible metal tubing, the pipe being put in place first and the wires then drawn through. Outlet boxes of the same type are used.

In any system of wiring, provision must be made for inserting a switch and fuses in the circuit. These are placed where the wires enter the building so that the circuit in the building may be entirely cut off. The fuses give protection against fire, should there be short circuits or overloading of the system.

All wire splices should be soldered and taped.

Where several adjacent houses are to be lighted, all of the lights may be turned on simultaneously by one time switch.

COST OF WIRING AND EQUIPPING AN O. A. C. 400-HEN LAYING HOUSE

The following costs include all materials, switches, lamps, etc., including feed-room light, with the exception of an alarm clock. They do not include labor of installing. If several houses are to be wired, the cost per house would be slightly less.

Prices are March, 1928, Corvallis retail prices.

Knob and tube job.

1	— double pole, entrance switch for plug type fuses	$ .80
1	— 5 amp. 125 v. single pole surface tumbler switch. (For time switch)	.50
7	— 4-inch octagon outlet boxes at 25c	1.75
7	— porcelain covers for outlet boxes at 30c	2.10
16	— loom clamps at 4c	.64
7	— porcelain keyless sockets at 35c	2.45
6	— R. L. M. dome reflectors for 60-watt lamps with shade holders at $2.00	12.00
7	— 100-watt lamps at 40c	2.80
4	— 4-inch x 5/16-inch porcelain tubes	.12
50	— split porcelain knobs	1.25
18	— ft. loom at 3c	.54
28	— ft. lamp cord at 3c	.84
200	— ft. No. 14 rubber covered solid wire at 1½c	3.00
	Total	$28.79

Deduct $8.00 if galvanized iron reflectors are used.

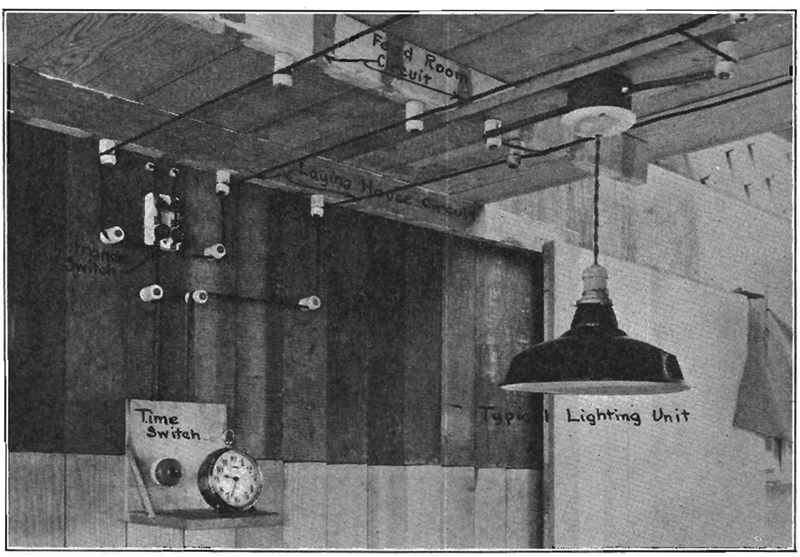


Fig. 22. Typical knob and tube wiring showing entrance to house, the laying house circuit controlled by the time switch, the feed room light circuit and a typical lighting unit.

BX job.

1 —	½-inch entrance cap	$ .60
1 —	pc. ½-inch conduit 20 in. long with right-angle bend	.20
1 —	ea. ½-inch bushing and lock nut	.03
1 —	10 amp. fused entrance switch in metal housing	2.00
1 —	5 amp. 125 v. flush single pole, tumbler switch and plate	.65
1 —	switch box	.25
7 —	4-inch octagon outlet boxes for ½ in. conduit at 25c	1.75
7 —	porcelain covers for 4 in. octagon outlet boxes at 30c	2.10
16 —	½-inch box connectors at 6c	.96
7 —	porcelain keyless sockets at 35c	2.45
6 —	R. L. M. dome reflectors for 60-watt lamps with shade holders at $2.00	12.00
7 —	100-watt inside frosted lamps at 40c	2.80
90 —	ft. BX No. 14 twin conductors at 11c	9.90
40 —	½-inch conduit straps at 1c	.40
28 —	ft. lamp cord at 3c	.84
	Total	$36.93

Deduct $8.00 if galvanized iron reflectors are used.

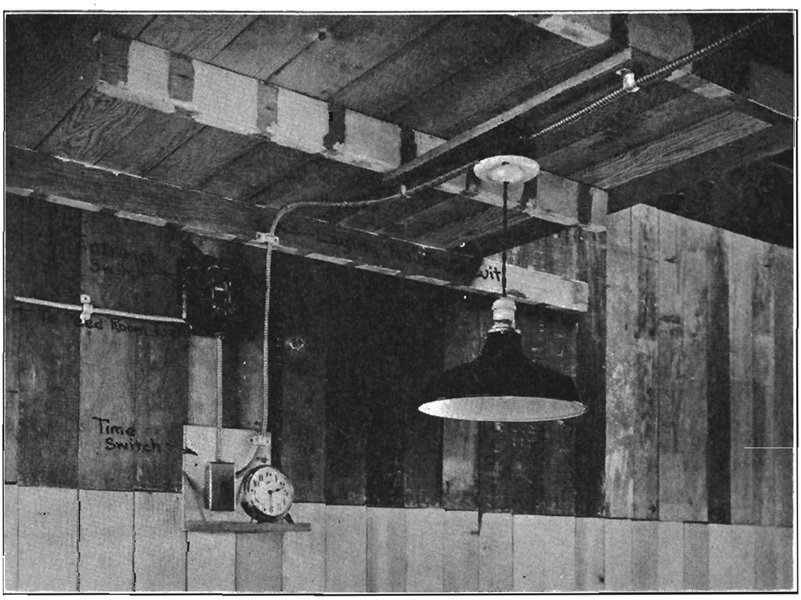


Fig. 23. Typical BX wiring showing entrance switch, time switch, feed-room circuit, and laying-house circuit.

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