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Surplus Leghorn Cockerels as Broilers

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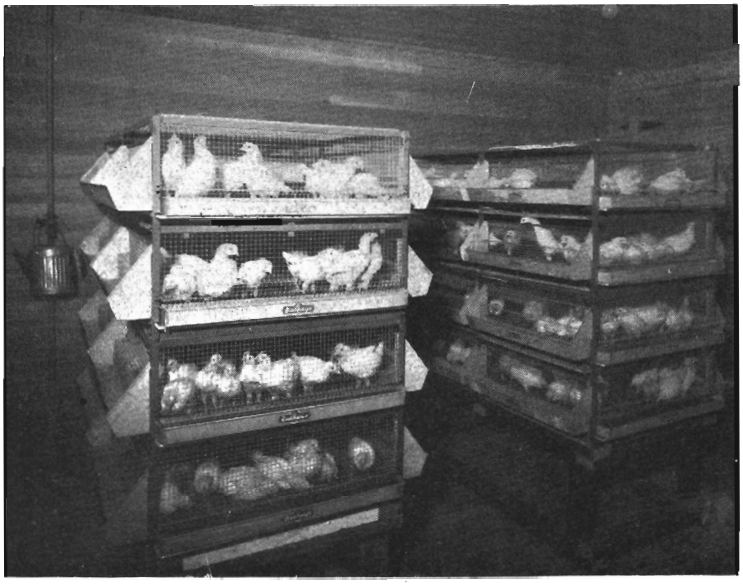

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SUMMARY

1. Economical gains in broiler growth were obtained on a free choice of dry mash and grain ration.
2. The ratio of mash to grain in total feed consumed during the 8-week period was 2:1 for both battery- and floor-reared broilers.
3. The total protein intake for the 8-week rearing period did not exceed 15.9 per cent with Leghorn broilers.
4. Rhode Island Red chicks consistently made greater gains than Leghorns for the 8-week period on approximately the same amount of feed and protein intake.
5. The amount of feed required to produce a pound of marketable chicken was consistently less than 3 pounds for those reared in batteries and slightly less than 4 pounds for the floor-reared birds for the 8-week period.
6. Battery-reared Leghorn broilers were approximately 1 week ahead of floor-reared birds in body weight at 8 weeks.
7. Battery-reared Rhode Island Reds of both sexes made more efficient gains than Leghorn males for the same period.
8. Mortality in battery equipment was not substantially lower than that normally obtained under sound brooder management with floor-reared broilers.
9. The incidence of breast blisters increased each successive week after the eighth regardless of the breed reared in batteries.
10. Reasonably good results were obtained in rearing broilers to 8 weeks on O.S.C. Chick Starter Mash and grain, but more economical results were obtained from the O.S.C. Broiler Mash and grain, all factors considered.
11. Under normal economic conditions operators who have ample brooding equipment and favorable market outlets may convert surplus Leghorn cockerels into a marketable product at a small profit per bird.
12. Reported and unreported broiler-rearing trials conducted at Oregon Experiment Station thus far indicate that the best broiler ration is the most efficient growing ration. The practice of using a fattening ration for various periods of time prior to marketing broilers has given adverse results in direct ratio to the length of time the fast-growing birds were deprived of the necessary growth nutrients not supplied in a fattening ration.
13. The O.S.C. Broiler Mash No. 1 was developed as a relatively fast growing ration containing an efficient balance of quality proteins that would permit the feeding of liberal amounts of lower-priced grains.
14. Rearing broilers of any breed in commercial numbers with battery equipment is a hazardous undertaking unless housed in a well-ceiled room in which the operator has definite control over room temperature, ventilation, and humidity.

Surplus Leghorn Cockerels as Broilers

By

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and

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INTRODUCTION

A broiler, according to the U. S. Standards, is a young chicken, of either sex, of marketable size, not exceeding 2½ pounds in weight and sufficiently soft meated to be cooked tender by broiling.

The production of broilers has attracted a widespread interest among poultrymen, specialized operators, and those affected by unemployment. This interest has been further stimulated by the surplus low-price, day-old Leghorn cockerels resulting from the industry's general acceptance of the policy of purchasing sexed day-old pullets to be reared for commercial egg production.

Approximately 50 per cent of all chicks hatched are cockerels and may be considered a by-product in relation to the business of rearing pullets. Hundreds of thousands of Leghorn cockerels are destroyed as soon as their sex is determined.

To obtain basic information regarding the production of broilers generally and particularly the feasibility of profitably converting surplus Leghorn cockerels into food, a series of experiments was conducted by the Poultry Department of Oregon State College.

The price received per pound of broiler sold and the cost of the feed consumed are not given. The number of pounds of broilers produced and the number of pounds of feed consumed to produce them are given. The price of poultry meat and the feed costs show much annual and seasonal variability, over which the broiler producer exercises no appreciable control. He may use available market information for any year in conjunction with the production information presented here in reaching a decision regarding the advisability of raising broilers that year.

DEVELOPMENT OF O. S. C. BROILER RATION

Oregon produces a surplus of grain as well as a surplus of Leghorn day-old cockerels. The generally accepted type of ration for broilers was a ration of relatively high protein content involving the feeding of little or no grain other than the amount contained in the ground constituents of the mash. Oregon poultrymen can purchase bulk grains to feed separately at lesser cost than in purchasing them at all-mash prices.

To develop an economic ration for broilers that involved the liberal use of grain and a subsequent lower protein intake, was a deviation from the accepted practices in feeding broilers. Various trials of different nutritional ingredients

Acknowledgments: The authors wish to acknowledge the valuable assistance rendered by H. E. Cosby and the late F. L. Knowlton, of the Poultry Department, and C. I. Branton, Assistant Agricultural Engineer, now on leave for military service, in planning and conducting the work presented in this publication.

were made until a most satisfactory and economical broiler ration was developed. The mash portion of this ration will be referred to in this publication as O. S. C. Broiler Mash No. 1.

TRIAL I. EFFICIENCY OF BROILER RATION WITH FALL-HATCHED LEGHORN COCKERELS

On October 4, 1938, 300 day-old sexed Leghorn cockerels were obtained for the first test. (The Leghorn cockerels in this and all succeeding Leghorn trials were of the same breeding and from the same source.) The chicks were divided according to body weight into similar lots of 150 chicks each. The net weight for each lot was 13.37 pounds or an average of 0.089 pound per chick. One lot was placed in a 16′ x 16′ brooder room equipped with a wire sun porch and brooded under an electric brooder of 500-chick capacity. The second lot was started and raised in battery equipment which was housed in a semidark, tightly ceiled battery room. Ample brooding space was available at all times for both lots.

The two lots of chicks were started and finished on O. S. C. Broiler Mash No. 1. By the end of the first week, the chicks were allowed free access to chick scratch and an acid-insoluble grit.

Table 1. O. S. C. BROILER MASH No. 1

300 pounds	Bran
400 pounds	Ground wheat
500 pounds	Ground yellow corn
250 pounds	Finely ground oats
100 pounds	Meat meal
175 pounds	Fish meal
100 pounds	Dried skim milk
80 pounds	Dried whey
100 pounds	Alfalfa leaf meal
40 pounds	Oyster shell flour
20 pounds	Fine salt
5 pounds	Vitamin A-D supplement (U.S.P. 400 D, 3000 A)
4 ounces	Manganese sulphate

The chick scratch used for the first 4 weeks was that given in Table 2. At 5 weeks of age, this was replaced by a broiler-developing scratch which is presented in Table 3.

Table 2. O. S. C. CHICK SCRATCH

1,200 pounds	Cracked wheat
800 pounds	Fine cracked corn

Table 3. O. S. C. BROILER SCRATCH

1,000 pounds	Wheat
600 pounds	Cracked corn
400 pounds	Heavy oats

The birds were fed in the conventional manner, and no attempt was made to force feed.

Random samples of birds from each of the lots were weighed weekly. The growth curves for these two lots are shown in Figure 1.

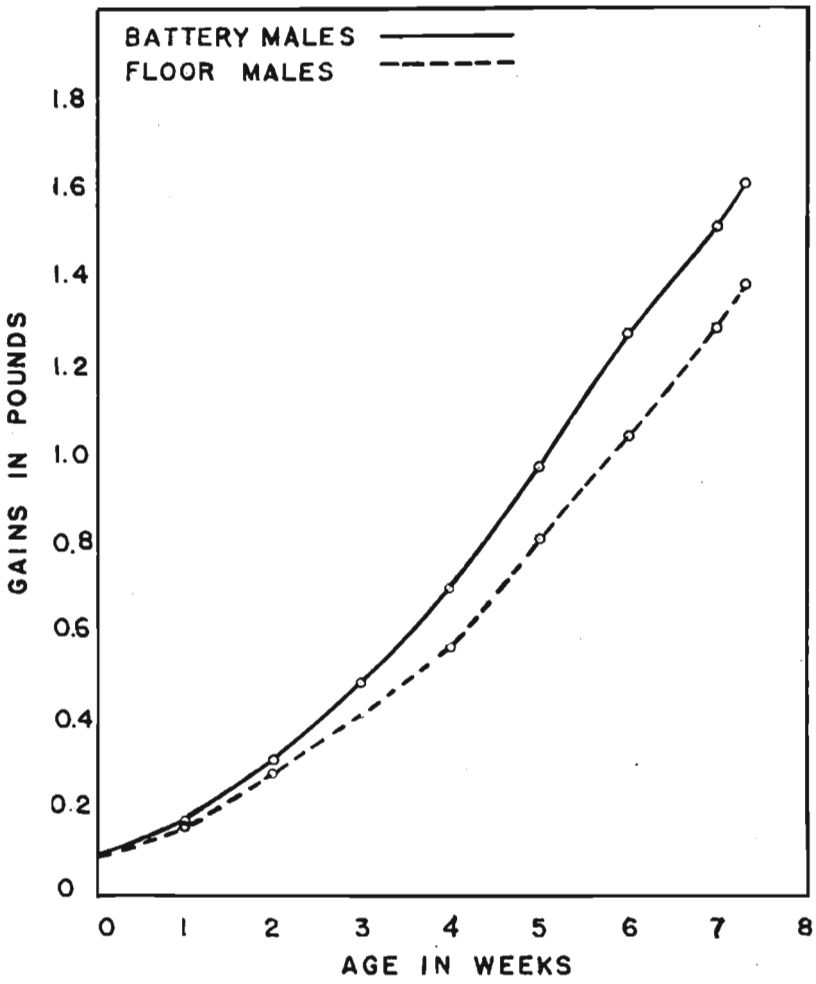

Figure 1. Curves showing rate of growth for floor and battery chicks (Fall, 1938).

The birds from this and all subsequent tests were marketed through the same commercial agency and grader.

At 52 days of age (7½ weeks), the first sale was made. Birds not weighing 1.4 pounds each or more were held for a later sale. At this age, the floor birds,

prior to any removals, averaged 1.38 pounds, and the battery birds averaged 1.61 pounds.

Forty-six birds were sold from the floor (30.7 per cent) averaging 1.48 pounds each. One hundred and twenty-eight birds (85.4 per cent) averaging 1.64 pounds each were sold from the battery lot.

One week later (8½ weeks) the remaining birds were large enough to be sold. Ninety-nine floor birds averaging 1.49 pounds each and 17 battery birds averaging 1.66 pounds each were marketed.

A summary of the marketing statistics for these two lots is presented in Table 4.

Table 4. SUMMARY OF MARKETING STATISTICS (FALL, 1938)

Lot	Number of birds	Per cent of total	Weight per bird	Grades in per cent			
				No. 1	No. 2	Rejects	Worthless
		Per cent	*Pounds*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Floor	145	96.7	1.48	86.2	13.8	....	....
Battery	145	96.7	1.64	94.5	4.8	0.7*	....

* The one reject was due to a breast blister.

The mortality for both lots was identical—3.3 per cent.

Table 5. POUNDS OF MARKETABLE MEAT PRODUCED DURING TEST

Lot	Birds started	Birds sold	Mortality		Initial weight	Final weight*	Gain
			Number	*Per cent*	*Pounds*	*Pounds*	*Pounds*
Floor	150	145	5	3.3	13.37	215.25	201.88
Battery	150	145	5	3.3	13.37	238.50	225.13

* Equivalent to pounds of chicken marketed.

The floor birds consumed 3.87 pounds of mash and grain for each pound of chicken marketed, while the battery birds consumed 2.88 pounds for each pound of chicken marketed. Table 6 shows total feed consumption for both lots.

Table 6. FEED CONSUMPTION FOR TEST PERIOD (FALL, 1938)

Lot	Feed consumed			Feed per pound of chicken sold
	Mash	Grain	Total	
	Pounds	*Pounds*	*Pounds*	*Pounds*
Floor	624	210	834	3.87
Battery	534	155	689	2.88

The rate of gain shown in Figure 1 and the quality of the birds marketed from both lots were very satisfactory. The battery birds made the faster and therefore the more economical gains of the two lots. The greater overhead investment and increased labor, however, in the care of the battery broilers would tend to offset this advantage in commercial practice.

Only one bird went down with a slipped tendon, and it was in the battery lot.

TRIAL II. BROILER MASH VS. STARTER MASH

During the spring of 1939 a second series of tests was conducted to obtain comparative information on the efficiency of the O. S. C. Broiler Mash No. 1 and the O. S. C. Chick Starter Mash. Four lots of Leghorn cockerels were used in this study.

Lot 1 consisted of 250 day-old Leghorn cockerels weighing 20.5 pounds or an average of 0.082 pound per chick. They were fed the O. S. C. Broiler Mash No. 1.

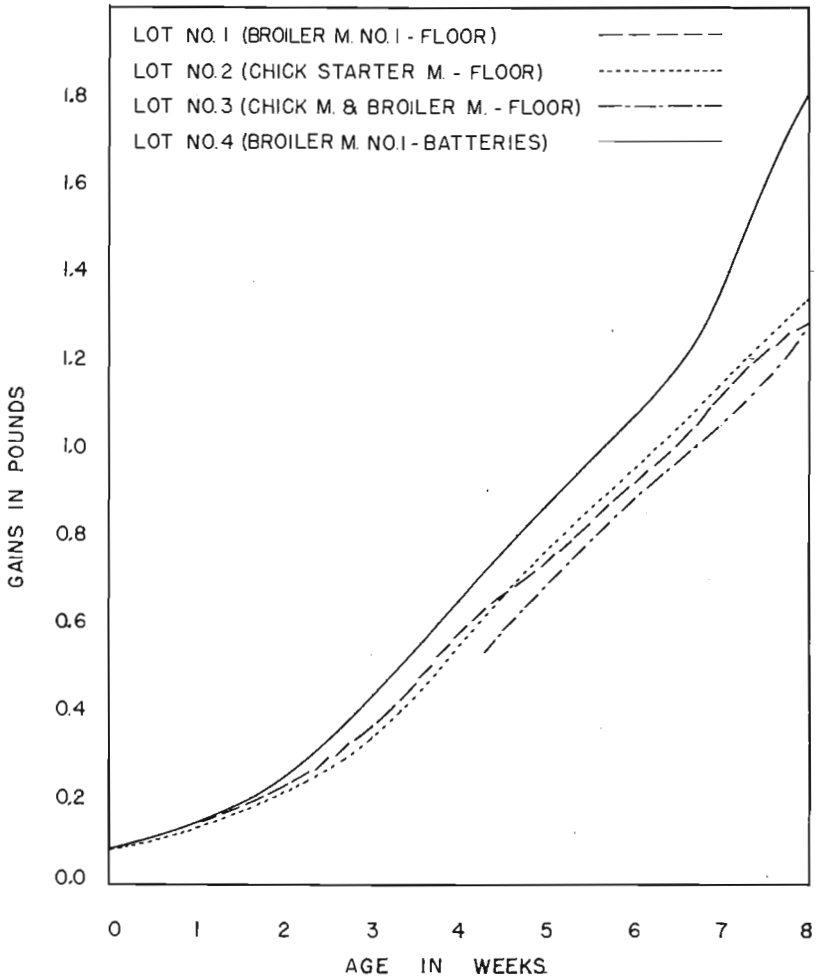

Figure 2. Curves showing rate of growth for floor and battery chicks (Spring, 1939).

Lot 2 consisted of 250 day-old Leghorn cockerels weighing 22.25 pounds or an average of 0.089 pound per chick. They were fed the O. S. C. Chick Starter Mash shown in Table 7.

Table 7. O. S. C. CHICK STARTER MASH

300 pounds	Bran
500 pounds	Ground wheat
500 pounds	Ground yellow corn
100 pounds	Ground oats
100 pounds	Meat meal
175 pounds	Fish meal
80 pounds	Dried skim milk
80 pounds	Dried whey
140 pounds	Alfalfa leaf meal
40 pounds	Oyster shell flour
20 pounds	Fine salt
5 pounds	Vitamin A-D supplement (U.S.P. 400 D. 3000 A)
4 ounces	Manganese sulphate

Both lots 1 and 2 were placed in 16′ x 16′ brooder rooms equipped with wire sun porches and brooded under electric brooders of 500-chick capacity.

Lot 3 consisted of Leghorn cockerels taken from a pen of 500 straight-run chicks that were being brooded under a 500-capacity electric brooder in a 16′ x 16′ brooder room equipped with a wire sun porch.

These straight-run chicks were fed the O. S. C. Chick Starter Mash. The 500 day-old chicks weighed 43.75 pounds or an average of 0.087 pound each. When the birds were 30 days old, 213 cockerels were removed and placed in an adjacent room of the same size and identical equipment. These cockerels were then fed the O. S. C. Broiler Mash No. 1.

Lot 4 consisted of 500 day-old Leghorn cockerels weighing 45.63 pounds or an average of 0.091 pound each. They were started and raised in battery equipment under as nearly the same management conditions as could be provided. The mash fed was the O. S. C. Broiler Mash No. 1.

All lots were allowed free access to grain, acid-insoluble grit, and clean fresh water. No attempt was made to force feed the birds in any of the lots.

Random samples of birds from each lot were weighed weekly. The growth curves for these four lots are shown in Figure 2.

The birds were marketed through the same agency as were the 1938 lots.

At 56 days of age (8 weeks), the first sale from all lots was made. As in previous tests, random samples of all lots were weighed before the birds were handled individually over a spring scale. Birds not weighing 1.25 pounds were held for a later sale.

The average weight per bird for the various lots prior to any removals is shown in Table 8.

Table 8. AVERAGE WEIGHT PER BIRD AT 8 WEEKS (SPRING, 1939)

Lot number	Ration	Location	Age	Average weight
			Weeks	*Pounds*
1	Broiler M.	Floor	8	1.28
2	Chick M.	Floor	8	1.33
3	Chick M.→ Broiler M.	Floor	8	1.27
4	Broiler M.	Battery	8	1.80

Table 9 shows the rate of development of the birds within the various lots, and also gives a broad picture of the marketing statistics.

Table 9. MARKETABLE BIRDS IN THE FOUR LOTS AT 8, 9, AND 10 WEEKS (SPRING, 1939)

Lot number	Number of birds	Per cent of total	Average weight of birds sold	Grades			
				No. 1	No. 2	Rejects	Worthless
		Per cent	*Pounds*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
8 weeks old							
1	142	56.8	1.38	97.2	.....	2.8	.....
2	162	64.8	1.40	100.0	.....	.....	.....
3	95	39.6	1.38	95.8	.....	4.2	.....
4	470	94.0	1.81	86.0	.....	13.8	0.2
9 weeks old							
1	54	21.6	1.38	94.5	.....	5.5	.....
2	60	24.0	1.40	95.0	.....	3.3	1.6
3	47	19.6	1.38	97.9	.....	2.1	.....
4	2	0.4	1.25	.....	.....	100.0	.....
10 weeks old							
1	25	10.0	1.44	68.0	.....	16.0	16.0
2	17	6.8	1.50	82.4	.....	11.7	5.9
3	44	18.3	1.24	66.0	.....	2.2	31.8
4	.....	.....	.....	.....	.....	.....	.....

Table 10 gives a composite summary of the marketing statistics for the four lots.

Table 10. SUMMARY OF MARKETING STATISTICS (SPRING, 1939)

Lot number	Number of birds	Per cent of total	Weight per bird	Grades			
				No. 1	No. 2	Rejects	Worthless
		Per cent	*Pounds*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	221	88.4	1.38	93.3	.....	4.9	1.8
2	239	95.6	1.40	97.5	.....	1.7	.8
3	186	77.5	1.35	89.3	.....	3.2	7.5
4	472	94.4	1.80	85.4	.....	14.4	.2

It will be noted that 14.4 per cent of the marketable battery birds were classed as "rejects." Eight per cent of these rejects were graded into this class because of blisters on the breasts. This is a defect that is rarely found on floor birds. Other defects causing birds to go into this class were poor fleshing, bruises, tears, broken wings, and bare backs.

The mortality for the various lots and the pounds of marketable meat produced during the test are presented in Table 11.

Table 11. MORTALITY AND POUNDS OF MARKETABLE MEAT PRODUCED (SPRING, 1939)

Lot number	Birds started	Birds sold	Mortality		Initial weight	Final weight‡	Gain
	Number	*Number*	*Number*	*Per cent*	*Pounds*	*Pounds*	*Pounds*
1	250	221	29	11.6	20.5	299.0	278.5
2	250	239	11	4.4	22.2	335.7	313.5
3	240*	186	54	22.5	21.2†	236.2	215.0
4	500	472	28	5.6	45.6	850.0	804.4

* The sex ratio was assumed to be 48 per cent male and 52 per cent female.
† Average weight of all day-old cockerels.
‡ Equivalent to pounds of chicken marketed.

Both lots 1 and 3 were handicapped materially in rate of gain by an outbreak of coccidiosis. The results may be noted in the "mortality" column of Table 11 and the "worthless" column of Table 10. The results of this disturbance were so serious as to render the data obtained on lot 3 of very little value from a comparative standpoint. Likewise, the value of the data obtained on lot 1 is minimized. The results obtained, however, do indicate what may be expected in the way of returns when similar losses occur.

Data on the pounds of grain and mash consumed as well as the pounds required to produce a pound of marketable chicken for the various lots are presented in Table 12.

Table 12. FEED CONSUMPTION AND EFFICIENCY (SPRING, 1939)

Lot number	Feed consumed			Feed per pound of chicken marketed
	Mash	Grain	Total	
	Pounds	*Pounds*	*Pounds*	*Pounds*
1	681.5	394.0	1,075.5	3.76
2	1,059.0	428.0	1,487.0	4.70
3	641.0	397.6	1,037.6	4.39
4	1,665.0	617.2	2,282.2	2.86

Lot 2, which was fed the O. S. C. Chick Starter Mash, made the best gains of the three floor lots, but did so at the expense of a greater feed intake per pound of meat marketed. It is also noted that this lot suffered the least mortality. The battery birds, as before, made the greatest gains over all lots, though the market grades into which they went were the poorest. This was due principally to breast blisters.

There were no cases of perosis.

The square inches of floor space allotted the 1939 spring battery broilers are given in Table 13.

Table 13. FLOOR SPACE ALLOTTED BATTERY BROILERS (SPRING, 1939)

1st week to end of 3rd week	1 chick per 27 sq. in.
4th week	1 chick per 30 sq. in.
5th week to end of 6th week	1 chick per 46 sq. in.
7th week to end of 8th week	1 chick per 65 sq. in.

TRIAL III. BROILER MASH VS. STARTER MASH

In the spring of 1940, 400 day-old Leghorn males were used in a final check on the efficiency of the O. S. C. Broiler Mash No. 1. The O. S. C. Chick Starter Mash was also fed.

The 400 chicks were divided equally according to body weight into 16 lots and carried in battery equipment. The initial weight of each lot was 2.125 pounds or an average of 0.085 pound per chick. One-half of the birds were fed the broiler mash (Table 1), and the other half were fed the chick starter mash (Table 7). At 4 days of age, chick scratch (Table 2) was sprinkled over the mash. When the birds were 1 week old, they received chick scratch and an acid-insoluble grit ad libitum. Broiler scratch (Table 3) was used to replace chick scratch when the birds were 5 weeks old. Feed for each lot was weighed

and fed twice daily. Whenever a chick died, the feed for that particular lot was weighed back. The dead chick was weighed, and the pounds of feed required to produce the chick were computed. This quantity of feed was then deducted from the total fed, thus making it possible to compute the pounds of feed required per pound of gain as well as the pounds of feed required to produce a pound of marketable chicken. The latter method of figuring feed consumption is more indicative of true feed costs since one has to pay for the feed consumed by birds that have died. It gives a distorted picture, however, when one desires to find the true efficiency of a ration. Both requirements will be shown.

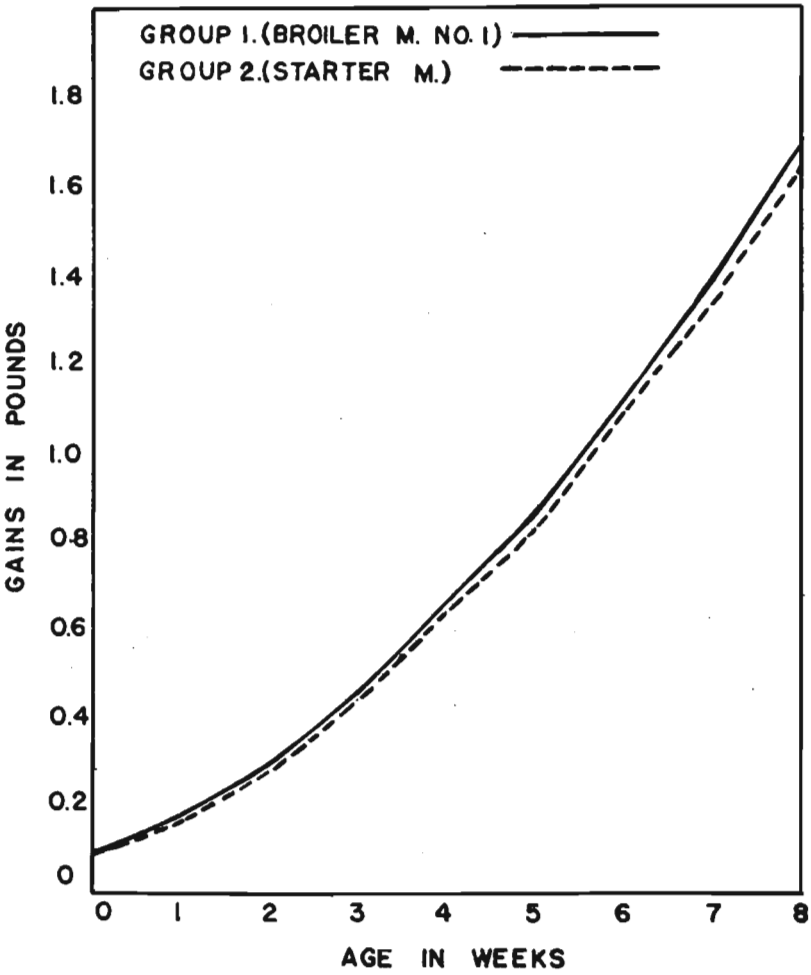

Figure 3. Curves showing rate of growth in batteries for broiler and starter mash fed chicks (Spring, 1940).

The 25 chicks in each lot had access to approximately 1,500 square inches of floor space, or 60 square inches per chick, which was more than ample room as demonstrated by earlier trials.

During this trial, the batteries were housed in a tightly ceiled room equipped with a turbine fan for ventilation, which is described elsewhere in this publication. A room thermostat controlled the air intake by shutting off the incoming air for short periods, thus making it possible to exercise considerable control over room temperature. The thermostat was set at 70° F. for the first 4 days of brooding, and then reduced to 65° F. until the chicks were 4 weeks old. At this time the thermostat was set for 60° F. and held for the duration of the test period. All windows were completely covered with black building paper for the purpose of excluding all outside light. Sixty-watt lamps were covered with used gallon fruit cans to give an indirect lighting effect and arranged over the ceiling in a manner that would permit the light to be reflected evenly on all feeders and drinking vessels.

Each lot of chicks was weighed at weekly intervals. The average growth curves for the two groups of eight lots each are shown in Figure 3. The weight fluctuation for individual lots from the mean at each weighing was very small.

At 56 days of age (8 weeks), all birds were sold regardless of individual weights. The average weight per bird for the two groups is shown in Table 14.

Table 14. AVERAGE WEIGHT PER BIRD AT 8 WEEKS

Group	Ration	Location	Age	Average weight
			Weeks	*Pounds*
1	Broiler mash	Batteries	8	1.69
2	Starter mash	Batteries	8	1.65

Table 15 gives a composite summary of the marketing statistics for the two groups.

Table 15. SUMMARY OF MARKETING STATISTICS (SPRING, 1940)

Ration	Number of birds	Per cent of total	Weight per bird	Grades			
				No. 1	No. 2	Rejects	Worthless
		Per cent	*Pounds*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Broiler mash	189	94.5	1.69	83.0	13.8	3.2	0.0
Starter mash	186	93.0	1.65	80.6	8.7	9.7	1.0

It will be noted in Table 15 that the birds fed broiler mash received a better average grade than those fed chick starter mash. This was true in every case when comparing the 16 individual lots that made up the two groups. The broiler mash consistently produced a little heavier and sturdier bird than the starter mash. Five of the six birds classed as rejects from lots fed broiler mash were graded as such because they were lighter than the pound and a quarter minimum demanded by buyers for this class of poultry. Fifteen of the 18 rejects from the lots fed starter mash were likewise light. Only two birds were graded down because of breast blisters, and they both came from lots on starter mash. Broken wings accounted for the remaining two rejects.

The per cent mortality for the two groups of eight lots each is given in Table 16.

Table 16. PER CENT MORTALITY (SPRING, 1940)

Group	Ration	Number of chicks started	Number of chicks finished	Mortality
				Per cent
1	Broiler	200	189	5.5
2	Starter	200	186	7.0

There was a similar differential in mortality between individual lots within the two groups. Four of the birds recorded in the mortality column were removed because of perosis. Three of these came from lots fed starter mash, and one from a lot fed broiler mash.

The pounds of grain and mash consumed, the pounds required to produce a pound of marketable chicken, and the pounds of feed required to produce a pound of gain are shown in Table 17. These figures represent total feed consumption (grain and mash) for the eight lots in the two respective groups.

Table 17. FEED INTAKE AND EFFICIENCY (SPRING, 1940)

Group	Ration	Feed consumed			Feed per pound of chicken sold	Feed per pound of gain
		Mash	Grain	Total		
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	Broiler	592.7	328.7	921.4	2.89	2.85
2	Starter	572.8	296.5	869.3	2.84	2.82

It will be noted in Table 17 that the starter mash was slightly more efficient in producing a pound of gain than was the broiler mash. This difference was small when individual lots were compared. The advantage gained in lower feed consumption per pound of gain for starter-mash-fed birds was more than offset by greater weight attained and better grade received for the broiler-mash-fed birds.

The computed average protein intake was 15.9 per cent for lots receiving broiler mash and 15.6 per cent for those fed chick-starter mash. All lots consumed approximately 1 pound of grain for every 2 pounds of mash during the 8-weeks period. The same protein intake and ratio of mash to grain has been true with battery birds fed these and similar rations in past trials. Such information is necessary when it is desired to estimate in advance feed cost for any given number of birds.

Leghorn battery broilers that are to be marketed when they weigh between 1¼ and 2 pounds each will require approximately 1 pound of grain and 2 pounds of mash to produce a pound of marketable chicken. This same ratio of grain to mash holds true for floor-reared broilers fed these rations, though they require nearly 4 pounds of feed per pound of marketable chicken, and are about 1 week slower in attaining the same average body weight.

For persons on diversified farms who purchase straight-run Leghorn chicks and choose to carry the males up to broiler size in floor pens, it would not be necessary to vary the feed or feeding practices that are most commonly followed in rearing pullet chicks. The work completed indicates that a good chick-starter ration will give very satisfactory results with floor-reared broilers. Those who operate large commercial egg farms and purchase straight-run chicks or incubate their own eggs, and carry the male chicks to broiler size, will find the broiler mash recommended in this bulletin very satisfactory. The broiler mash is particularly recommended for birds that are to be grown in battery equipment.

TRIAL IV. EFFICIENCY OF BROILER RATION WITH GENERAL-PURPOSE BREEDS

The problems involved in producing larger broilers and friers of the heavier breeds are also important in Oregon, though not as pressing economically as the ones just discussed. Only a comparatively few operators are interested in the production of broilers as a major enterprise. In these instances, the heavier breeds of chickens are raised in preference to Leghorns. Since a certain amount of interest exists in this specialized field, it was believed that any broiler ration recommended for Leghorn cockerels should also be satisfactory for other breeds.

One of the greatest problems confronted in producing broilers and friers of the general-purpose breeds is that of slipped tendons, more correctly named perosis. These breeds of chickens, for reasons not clearly understood, are more sensitive and susceptible to this nutritional disturbance than Mediterranean breeds. Wire floors, porches, and batteries exaggerate the condition. Oral feeding of manganese will help considerably to reduce the incidence of perosis, particularly when the calcium and phosphorus content of the ration is reasonably correct, but will not prevent its occurrence 100 per cent.

During the fall of 1939 the broiler mash shown in Table 1 was fed to two lots of S. C. Rhode Island Red chicks in batteries. One lot consisted of 70 males, and the other lot of an equal number of females. Room temperature, ventilation, and lighting were handled as described for the 1940 spring battery lots. The same procedure for feeding and weighing the birds was also followed.

The growth curves for the two lots of Rhode Island Red chicks are shown in Figure 4.

The birds were marketed at 8 weeks of age. The average weight per bird for the two lots is shown in Table 18.

Table 18. AVERAGE WEIGHT PER BIRD AT 8 WEEKS

Group	Ration	Location	Age	Average weight
			Weeks	*Pounds*
Males	Broiler mash	Batteries	8	1.85
Females	Broiler mash	Batteries	8	1.61
Average	.....	.....	8	1.73

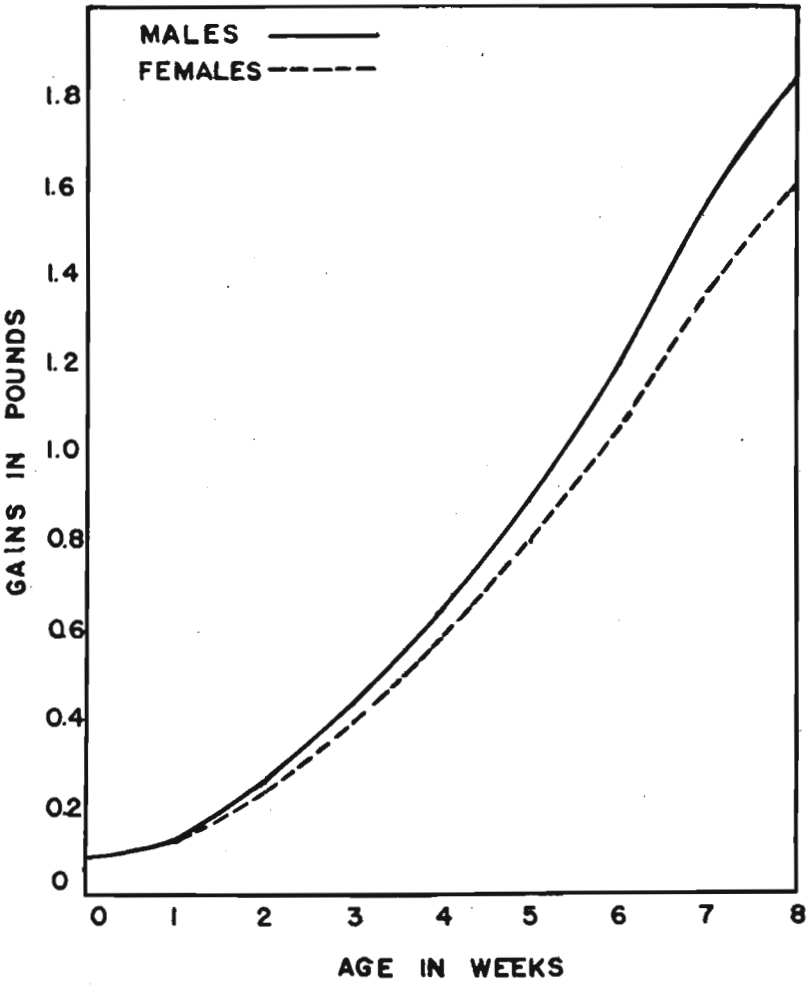

Figure 4. Curves showing rate of growth for S. C. Rhode Island Red chicks in batteries.

Table 19 gives a composite summary of the marketing statistics.

Table 19. SUMMARY OF MARKETING STATISTICS

Lot	Number of birds	Per cent of total	Weight per bird	Grades			
				No. 1	No. 2	Rejects	Worthless
		Per cent	*Pounds*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Males	60	85.7	1.85	76.6	16.7	6.7	0.0
Females ...	59	84.3	1.61	78.0	17.0	3.3	1.7
Average ...	....	85.0	1.73	77.3	16.8	5.0	.8

Three of the six birds graded as rejects were so placed because of breast blisters. The one worthless female was graded as such because she was crop-bound.

The percentage of mortality for the two lots is shown in Table 20.

Table 20. PERCENTAGE OF MORTALITY

Group	Ration	Number of chicks started	Number of chicks finished	Mortality
				Per cent
Males	Broiler mash	70	60	14.3
Females	Broiler mash	70	59	15.7
Average	.....	....	....	15.0

The mortality in both lots was excessively high for battery-reared chicks, but unavoidable. Forty-two and nine-tenths per cent (42.9%) of the mortality was due to neurolymphomatosis, commonly referred to as range paralysis; nine and five-tenths per cent (9.5%) was accidental, and the cause for the remaining mortality (47.6%) was undetermined.

Feed consumption and its efficiency are shown in Table 21.

Table 21. FEED INTAKE AND EFFICIENCY

Group	Ration	Feed consumed			Feed per pound of chicken sold	Feed per pound of gain
		Mash	Grain	Total		
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Males	Broiler	203.1	105.1	308.2	2.78	2.65
Females	Broiler	203.0	82.9	285.9	2.95	2.73

The average protein intake for the above chicks during the 8 weeks was 15.9 per cent for the males and 16.4 per cent for the females.

Rhode Island Red chicks have consistently made greater gains than Leghorns on approximately the same food intake and same level of protein.

As with Leghorn broilers in batteries, it is necessary to sell the heavier breeds at the end of 8 weeks or transfer them to floor pens in order to eliminate excessive grading loss due to the development of breast blisters.

TRIAL V. FATTENING PERIODS FOR BROILERS

An opinion prevails throughout the industry that broilers should undergo a period of fattening prior to marketing. A marked tendency exists to grow the chicks on a chick-starting mash to an average weight of approximately 1 pound or more and then change to a fattening finishing mash.

A tendency also prevails to underestimate the importance of having control of the factors of room temperature and ventilation with particular reference to battery equipment. To test these ideas a further experiment was conducted.

Eight hundred day-old, spring-hatched Leghorn cockerels were given ample room in batteries housed in a tightly ceiled room, ventilated by window regulation and room temperature subject to wide variation by weather conditions.

Two hundred and fifty day-old spring-hatched Leghorn cockerels from the same hatch were placed under a 500-capacity chick floor brooder in a room equipped with a wire porch to which the chicks had access after the first week.

Both lots of chicks were fed the O. S. C. Chick Starter Mash with free access to grain as in all reported trials. At 47 days, when the average weight was slightly in excess of 1 pound, both lots were gradually shifted to a fattening mash and all grain removed. This mash was given both dry and moistened to a porridge consistency.

At 56 days (8 weeks) all birds in each lot weighing 1.25 pounds or more were sold. Only 30.8 per cent and 48.7 per cent of the floor and battery birds respectively met the requirements.

At 63 days (9 weeks) a second sale was made in which only 22.6 per cent of the floor birds met requirements and none qualified from the batteries. Birds in batteries were more adversely affected by the deficient growing ration and hot weather temperatures than the floor birds.

There was no appreciable gain in body weights in either lot from the 47th to the 56th day on the fattening ration. After the top birds were marketed at 8 weeks, the remaining ones not only failed to gain but developed pronounced nutritional disturbances when continued on the fattening mash for a second week. Contrary to satisfactory results obtained in all other trials through the medium of rearing broilers on chick starters or broiler rations until marketed,

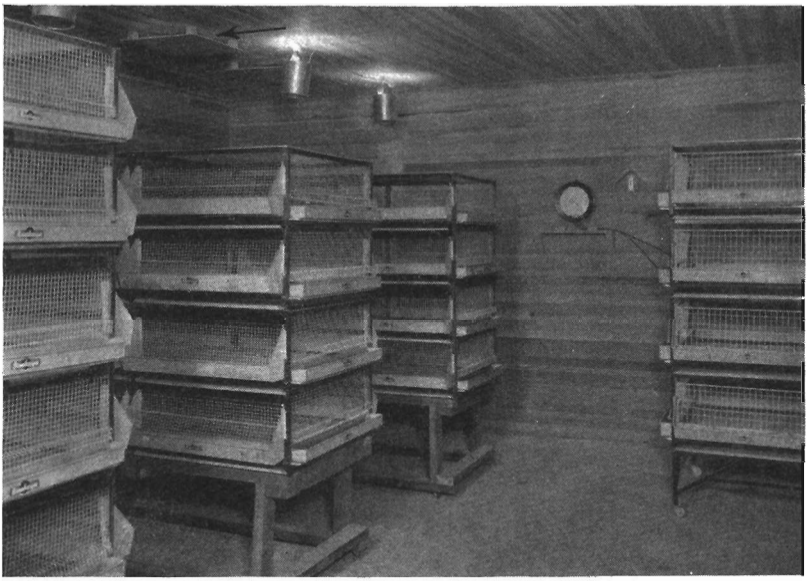

Figure 5. The arrow points to an air deflector mounted on the ceiling of the brooder room installed below the ventilation inlet to prevent a draft on the chicks below.

there remained unsold approximately 50 per cent of all broilers weighing less than 1.25 pounds at 9 weeks.

All unsold birds at 9 weeks were changed back to the original chick starter mash and grain in an effort to meet growth needs, restore lost appetites, and

regain vigor. The mortality increased, many were killed, and but relatively few eventually were marketed.

In the use of fattening rations with fast-growing broilers only 53.4 per cent of the floor birds and 48.7 per cent of the battery broilers met market weight

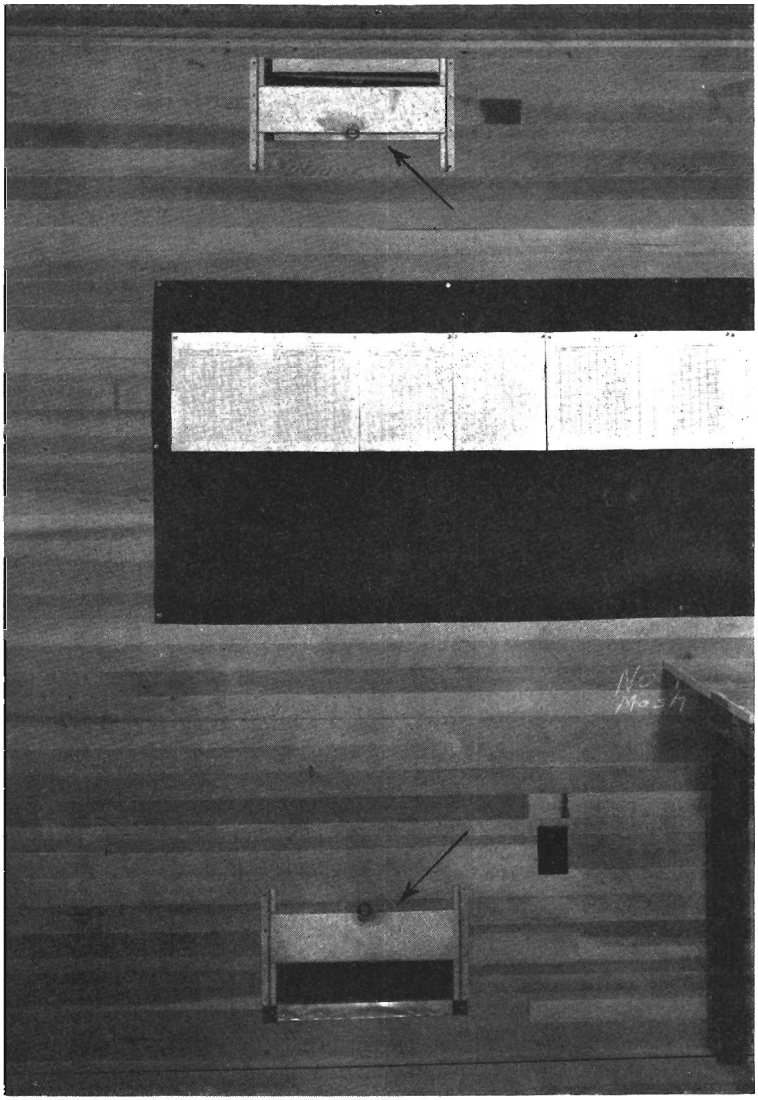

Figure 6. View of side wall of battery brooder room. Arrows point to ventilation outlets with sliding door to control size of opening near the floor and near ceiling. The upper outlet should be used in warm weather and the lower outlet in cold weather.

requirements by the end of 9 weeks. Broilers in batteries had less favorable conditions of ventilation and room temperatures than the broilers with the brooder house equipment, but the deficiency fattening ration produced a hazardous, money-losing condition with both lots.

VENTILATION OF BATTERY BROODER ROOMS

Forced ventilation of commercial battery brooder rooms is essential for satisfactory operation. The ventilation system must provide the following: (1) adequate fresh air for the chicks, (2) a method of holding the room temperature at 60° to 70° F. during cold weather as required according to the age of the birds, (3) adequate ventilation to prevent excessive room temperature during warm weather in the late spring or summer, (4) ventilation free from drafts and with uniform temperature throughout the room, and (5) ventilation that is not disturbed by winds from any direction.

A forced-ventilation system was installed in the battery brooder room used to conduct the experiments referred to in this bulletin. This consisted of a turbine fan that delivered the fresh air through plywood ducts to the several openings through the ceiling into the room. This equipment was located in the

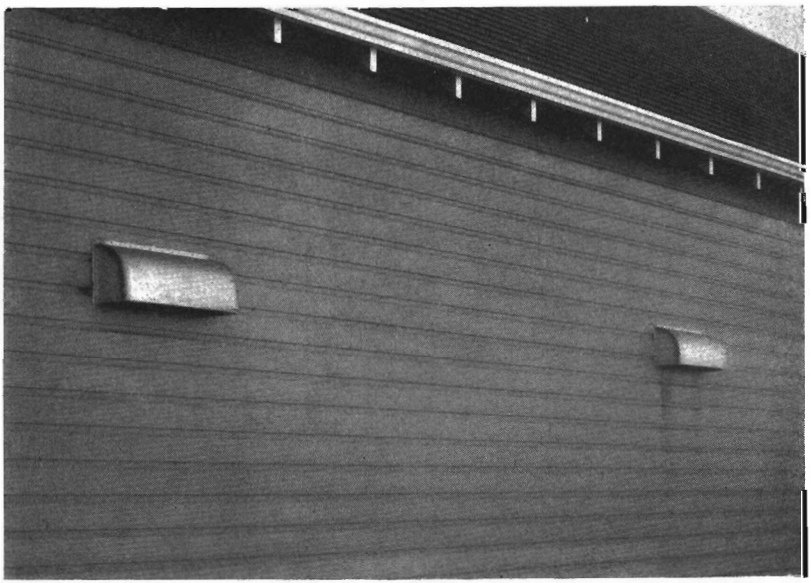

Figure 7. Outside of the wall of the battery brooding room showing hoods over ventilating outlets to prevent strong winds from blowing into the room.

attic. Ceiling deflectors to prevent drafts from the inlets were installed 2 inches below each ventilation inlet as shown in Figure 5, which caused the fresh air to flow along the ceiling until it settled down in the room. The air was exhausted from the room through outlets with slide doors that could be adjusted to various sizes as shown in Figure 6. These outlets should be in-

stalled in pairs with one near the floor and one near the ceiling. Hoods as shown in Figure 7 should be installed over the outlets in the outside wall in order to prevent air from blowing in when strong winds occur.

This ventilating system delivered 8/10 of a cubic foot of air per minute per chick to the battery brooder room. This amount produced excellent conditions in the room and was found very satisfactory. It was equivalent to 6.5 air changes in the room per hour. Several battery brooding ventilation systems have been designed by the Agricultural Engineering Department of the College on poultry farms for brooding 3,000 to 5,000 chicks, and 7 to 8 changes of air per hour have been used and found satisfactory. In all instances the air is forced into the room with a fan, thus producing a slight pressure in the room instead of exhausting the air from the room with a suction fan. The pressure method is necessary to prevent drafts.

This amount of fresh air was adequate to keep down excessive brooder room temperature during the warm days of April and May.

Some type of automatic temperature control should be installed to hold the room at a desired temperature range of between 60° and 70° F. to prevent excessive cooling due to ventilation during cold weather. This was done in these experiments by automatically shutting off the ventilation when the room drops below the desired temperature, by the use of an electric thermostat. As soon as the electric heaters in the battery brooders and the heat given off by the birds bring the room to the desired temperature the thermostat again starts the ventilation. When the room has its own separate ventilation system the thermostat would be connected so as to control the motor operating the electric fan. The arrangement at the college was different in that the battery brooder room was ventilated with the same fan as the laying-hen battery room and therefore should not be stopped. The ventilation for the brooder room was stopped to control minimum temperatures by installing a damper in the ventilating duct. A regular furnace damper-control motor, which was controlled by the thermostat, was used to operate the ventilation-duct damper. This was very effective in maintaining a uniform room temperature. This system has the advantage over the method of stopping the fan, because the damper in the air duct can be set to reduce the air flow instead of stopping it entirely.

An automatic heating system may be used to produce uniform room temperature, but it would be much more expensive. It was not found necessary, however, in these trials when brooding was done during the fall and spring months. The brooder room must be ceiled on the inside with tight tongue-and-groove lumber or plywood with building paper over the studding for insulation. Dry sawdust, shavings, or some other type of inexpensive insulation should be used over the ceiling. This is important for both winter and summer use. The heat from the brooders and the heat from the birds is an important factor in maintaining adequate room temperature if properly conserved and utilized.

Cost of operating ventilating fans. Records have been kept on several battery brooder rooms and the electricity used ranged from 15 to 30 kilowatt hours per 100 chicks per brood. At a 2¢ rate per kilowatt hour this would amount to 30 to 60 cents per 100 chicks per brood. If the system is properly installed and checked, the lower figure of cost is adequate to do the job.

Size of ducts and outlets. In planning a ventilating system the first step is to determine the amount of air required in cubic feet per minute by multiplying 0.8 times the number of chicks to be brooded in the room. If it should be 2,000 chicks, the air required would be (2,000 × .8), 1,600 cubic feet per

minute. The duct should be of sufficient size so that the air velocity in the duct is between 750 and 1,000 feet per minute. If we use a velocity of 800 feet per minute, it would require a duct 1 by 2 feet, or two square feet, in cross-section. The duct should be made of plywood and glued together with small strips in the corners.

The inlets from the overhead ventilating ducts into the room should be large enough to give an air velocity of about 600 feet per minute. In the above system the total cross-section of all room inlets would be $\left(\frac{1,600}{600} \right)$ 2.6 square feet. If the room inlets were 8 by 8 inches, six inlets would be required. The 12 × 12 inch deflectors below the inlets, as shown in Figure 5, would be necessary to prevent a draft. The outlet ducts should be somewhat larger in total cross-section.

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