

AN ABSTRACT OF THE THESIS OF

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Title ~~Artificial Incubation and Brooding of Ring-Necked~~ -----
~~Pheasants on State Game Farms at Eugene and Corvallis,~~ -----
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The objective in writing this thesis is to set forth the daily procedures and experiments in artificial incubation and brooding of ring-necked pheasants carried on at the Eugene and Corvallis State Game Farms, Oregon, during the 1936 and 1937 seasons, at which time the author was incubator-brooder operator.

Artificial incubation and brooding equipment for raising ring-necked pheasants was installed at the Eugene State Game Farm, Oregon, in 1934, and used there for three seasons. In 1937 the equipment was moved to the Corvallis State Game Farm which had been rebuilt and equipped for this special type of work. The Corvallis Game Farm is the present location of Oregon's artificial incubation and brooding unit for the propagation of ring-necked pheasants for liberation.

The variety of pheasant raised at the State Game Farms in Oregon on a commercial scale is commonly called the "China pheasant". Strictly speaking, it is not the pure Chinese ring-necked pheasant, but a mixture of the Chinese and Mongolian varieties.

Five electric still-air incubators and one forced-air circulation machine were in use during the 1936 and 1937 seasons. Two of these incubators were hot-water and four were hot-air machines. They each were of 540 hen-egg capacity. The still-air machines held 880 pheasant eggs and the forced-air circulation machine 825 eggs.

The birds were brooded for a period of six weeks; they were then taken to the holding pens on the Farm. The brooder houses at the Eugene Game Farm were of the stationary type, each nine feet by nine feet in size with a wire-covered cement run and an additional runway onto a clover plot. The brooder houses at the Corvallis Game Farm were portable, each 10 feet by 12 feet in size with a wire-covered yard 24 feet by 24 feet in size.

An electric radiant-heat type of brooder was used.

The basic portion of the feeding ration during the brooding period consisted of a wet feed, crumbly moist, which was fed three times daily on feed boards.

Experiments in artificial incubation and brooding of ring-necked pheasants were carried on to determine the most suitable incubation conditions and brooding practices to be followed. It was necessary to perform these experiments in conjunction with the general seasonal production of pheasants, and the results were necessarily included in the seasonal report. Incubation and brooding records of all hatches were kept. A brief outline of these experiments follows, which covered the two-year period and involved over 22,000 ring-necked pheasant eggs and 13,000 ring-necked pheasant chicks:

- I. Experiments in artificial incubation of ring-necked pheasant eggs.
 - a. Experiments in incubation temperatures.
 - b. Experiments in moisture during incubation.
 - c. Comparison of hatching results with turning eggs two times daily and three times daily.
 - d. Relative hatchability of eggs of various shapes, colors, and shell texture.
 - e. Comparison of incubator-hatched and hen-hatched birds as breeders.
 - f. Comparison of hatching results in still-air incubators and forced-air circulation machine.
- II. Experiments in artificial brooding of ring-necked pheasant chicks--comparison of exclusive dry feeding and wet feeding.

A sentence statement of the results of each experiment follows:

The still-air incubators gave best hatching results when operated at a temperature of 102° Fahrenheit throughout the incubation period with a moisture of 84° wet bulb temperature.

The forced-air circulation machine was run at 100° Fahrenheit for one hatch and 99° Fahrenheit for another for

experimental purposes, using a moisture of 84° wet bulb temperature in both cases. Indications were that 100° Fahrenheit was the more favorable incubation temperature. The forced-air circulation machine did not give as high an average hatch as did the still-air machines. The conclusions drawn as to the hatching results in the forced-air circulation machine apply only to this particular forced-air circulation machine and are not indicative of such machines in general as the machine used was of small capacity and the number of eggs set limited.

Increasing the number of times the eggs were turned produced a better hatch.

Culling the eggs was important in order to obtain a higher hatch, particularly was this true of the egg group, metallic shells.

No difference was noted between the relative merits of incubator-hatched and hen-hatched birds as breeders.

Ring-necked pheasants can be raised on exclusive dry feed with more rapid gain in weight and lower mortality than on the wet feed ration. In addition, the exclusive dry feed has other distinct advantages.

ARTIFICIAL INCUBATION AND BROODING
OF RING-NECKED PHEASANTS ON STATE GAME FARMS
AT EUGENE AND CORVALLIS, OREGON

by

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ARTIFICIAL INCUBATION AND BROODING
OF RING-NECKED PHEASANTS ON STATE GAME FARMS
AT EUGENE AND CORVALLIS, OREGON

INTRODUCTION

The objective in writing this thesis is to set forth the daily procedures and experiments in artificial incubation and brooding of ring-necked pheasants carried on at the Eugene and Corvallis State Game Farms, Oregon, during the 1936-1937 seasons, at which time the author was incubator-brooder operator.

Artificial incubation and brooding equipment for raising ring-necked pheasants was installed at the Eugene State Game Farm, Oregon, in 1934, and used there for three seasons. In 1937 the equipment was moved to the Corvallis State Game Farm, which had been built and equipped for this special type of work. The Corvallis Game Farm is the present location of Oregon's artificial incubation and brooding unit for the propagation of ring-necked pheasants for liberation.

The variety of pheasant raised at the State Game Farms in Oregon on a commercial scale is commonly called the "China" pheasant. Strictly speaking, it is not the pure Chinese ring-necked pheasant, but a mixture of the Chinese and Mongolian varieties.

DAILY ROUTINE GAME FARM WORK

The breeding birds at the Eugene Game Farm during the 1936 season were kept in wire-covered pens with one cock to five or seven hens.

At the Corvallis Game Farm the following year the breeding birds were brailed and kept in two large open pens, about 300 hens per pen with a ratio of cocks to hens of 1:6. These brails are leather straps which are fastened to one wing of the bird to keep it closed. The strap, split at one end in the form of a "Y", goes around the joint and fastens with a rivet on the outside of the wing. Two flight feathers of the bird are left outside the brail. If the bird has three flight feathers free, it can fly, but with only two it can fly only three or four feet into the air and then goes into a tailspin.

During the laying season, which began shortly after the first of April and extended to about the middle of July, the breeding birds were fed "egg maker paks", wheat, charcoal, and grit. They were given a "pheasant meal" or raw liver and mash on alternating days. During the winter prior to laying season the birds were fed wheat, charcoal, and grit and received no mash until the first of February.

Eggs were gathered twice daily and placed in market baskets, about 200 eggs per basket. The bottom of the basket was lined with excelsior with a layer of burlap on

top of this. The baskets were placed on a sand or cement floor to prevent the eggs from drying out during the time they were being held before being set.

Ring-necked pheasant eggs vary greatly in color from a dark olive to a light bluish shade.

Artificial Incubation

Types of Incubators. The incubation equipment used at the Eugene Game Farm consisted of five electric still-air incubators, each with four egg trays. An additional incubator, an electric forced-air circulation machine, was used during the 1937 season at the Corvallis Game Farm. Two of these incubators were hot-water and four were hot-air machines. They each were of 540 hen-egg capacity. The still-air machines held 880 pheasant eggs and the forced-air circulation machine 825 eggs.

The egg trays were covered with one-eighth inch mesh hardware cloth. If the mesh is too large, the pheasant chicks may get the joints of their legs caught down through the wire and become crippled. One-quarter inch mesh wire may cause crippling.

Incubator Room. The incubator room at the Eugene Game Farm was a cellar approximately one foot six inches underground with cement floor and cement to a height of two feet on the side walls. The remainder of the walls was made of heavy wall board. The room had five metal

ventilators, one at each corner near the ceiling and one in the center of the ceiling. Four of these ventilators operated automatically.

At the Corvallis Game Farm the incubator room had a cement floor and double walls four inches thick with sawdust between for insulation. The ventilators were placed in the same positions as formerly described.

A room temperature of 70° Fahrenheit was considered as optimum.

Operation of Incubators. The incubation period for pheasants is 23 days. The chicks begin pipping on the twenty-first day of incubation and the hatch is completed on the twenty-third day. The length of the incubation period may be varied by increasing or decreasing the incubation temperature a degree or two, thus increasing or decreasing the time required for the hatch to be completed. However, it was found that the highest quality chicks were obtained when the incubation period was twenty-three days.

The still-air machines were found to give best results when run at 102° Fahrenheit during the incubation period with the middle of the thermometer bulb at the level of the top of the egg. A moisture of 84° wet bulb temperature or 50 per cent relative humidity was maintained as measured by "Airguide Incubator Hygrometers" hung from the ceiling of the incubator and as close to the eggs as

possible without hindering removal of the trays. Sand trays on the floor of the incubators were used to supply moisture. When additional moisture was needed, warm water was sprinkled on the sand trays.

The forced-air circulation machine was run at 100° Fahrenheit for one hatch and 99° Fahrenheit for another for experimental purposes, as will be explained later in this report.

It is desirable to set the eggs as soon as possible in order to reduce the time for holding to a minimum. Keeping the eggs only two or three days is very desirable, as each additional day elapsing before setting decreases hatchability. If possible, the eggs should not be held for a longer period than a week.

The eggs were culled and sorted for the following physical defects: cracks, metallic shells, small size, irregular or odd-shapes, thin shells, and very light shell color.

The operation of the still-air incubators follows. The eggs were trayed, being placed in rows on the trays at a slight angle with the small end of the egg down. The ventilators of the incubators were left closed until the eighth day of incubation. On the eighth day they were opened and left open until the incubator was closed for hatching on the twentieth day of incubation. Best hatching

results were obtained when the eggs were turned three times daily. They were turned twice daily beginning the fourth day of incubation and three times daily on the ninth day of incubation and thereafter. The eggs were turned by hand. No cooling of eggs was practiced. On the eighth and nineteenth days they were tested for fertility and dead germs. The egg tester had an electric light globe enclosed in a metal case with the light projecting through a small hole. A reflector inside the case directed the light through this opening. The light was placed on the large end of the egg and then the germ could be seen. Removal of infertile eggs and dead germs gave ample room on the trays so that the eggs could be rolled about when being turned, instead of being left in rows as they were when first placed in the machine.

The incubator was prepared for hatching on the twentieth day of incubation. The eggs were turned for the last time on this day as the chicks began pipping on the twenty-first morning. If the eggs are turned too near the time when the chicks begin pipping the shell, the chicks will not have a chance to assume the correct position in the shell beforehand and may pip on the side or bottom of the egg instead of on top as is normal. The eggs were arranged in rows on the trays at a slight angle with the small end of the egg down, as they were when first trayed for

incubation. This arrangement tends to keep the temperature more uniform around the eggs and assures handling of every egg to be certain that the small end of the egg is down, so that the chick will pip at the large end. The sand trays were removed from the machine. Burlap was placed on top of newspaper in the nursery of the incubator. When the chicks have hatched they come to the front of the machine and drop to the nursery through an opening in the egg tray. Rough material on the floor of the nursery as burlap is better to use than smooth material, as pheasant chicks may develop "spraddle-legs" if allowed to stay on smooth material when they are small. The ventilators of the incubator were closed and left closed until the hatch was completed. Boiling water was placed in the moisture pans in the hot-water machines. No additional moisture was put in the machine during the time the chicks were hatching. The temperature of the machine was regulated to 102° Fehrenheit for the last time on the twentieth day. The chicks began pipping on the twenty-first day and the hatch was completed on the twenty-third day. The chicks were taken out of the incubator in the morning as soon as they had dried off, and were held in chick boxes until afternoon, when they were taken to the brooder houses.

The incubator and egg trays were then thoroughly washed with a disinfectant and the machine was ready to be

set again. The disinfectant used was "B-K" or "Bacili-Kil", the active agent being sodium hypochlorite in solution.

Artificial Brooding

Types of Brooder Houses. The brooder houses, 30 in number, at the Eugene Game Farm were stationary, each nine feet by nine feet in size with a wire-covered cement run in front. Sand was placed on these runs. A second runway attached to the end of the cement run was on a clover plot and provided green feed for the birds. These runs were approximately two and one-half feet in height. The chicks were let out into the first run at six or seven days of age and into the second runway at fourteen or fifteen days of age.

The front of the brooder house was covered with wire and had a removable muslin curtain which could be taken off to let the sunshine directly into the house.

Because of their wild nature, pheasant chicks require more floor space per bird than do domestic chicks. Eighty to eighty-five chicks per house, allowing one square foot of floor space per bird, proved to be the optimum number.

At the Corvallis Game Farm the brooder houses, 30 in number, were portable and had wooden floors. They were ten feet by twelve feet in size with wire-covered yards, twenty-four feet by twenty-four feet in size and approximately six

feet in height. The houses were arranged in six rows of five each with an electric power line for each row. The electric system was so arranged that each house could be moved to clean ground four times a season. The system provided that the same ground need be used only once every two years. The house was constructed on runners and to be moved to a new location was merely pulled along. Each house had 100 feet of cable attached to the power line, so that when the house was moved, the cable was let out and the brooder was ready for operation. "Chromax wire" was used, which did not require a ground wire for each house as did the "BX" wire formerly used. The pen was set on skids when it was moved. The yard had an inside movable panel, which was placed near the house to furnish a small enclosure for the birds when they were first let out. It could be moved back to divide the pen into half, and then when the birds were old enough, it was taken out and they were given the run of the whole yard. The chicks were let out into the small enclosure when they were six or seven days old, into the second enclosure when they were thirteen or fourteen days old, and into the whole yard when nineteen or twenty days old. Clover and rape furnished green feed in the yards.

The brooder houses had a wire-covered front with two muslin curtains on frames, which could be removed to let the sunshine directly into the house. These curtains were

left off all the time at the first of the season when the chicks were about sixteen days old, and when twelve days old or less later in the season when the weather was warm.

One hundred twenty to one hundred thirty chicks per house, allowing one square foot of floor space per bird, proved to be the optimum number. The chicks were kept near the hover the first three days by a circle of small mesh hardware cloth, encircling the brooder. This circle was made larger each day until on the fourth day it was removed, and the chicks were given the run of the whole room.

Portable brooder houses in themselves have certain obvious advantages over houses of the stationary type. Where available ground is not limited, the portable houses undoubtedly can be used to the best advantage. If they can be moved for each new hatch of birds to ground not previously used during that season, or moved during the brooding period of each hatch when the green feed in the yards has been eaten, this would be very desirable. It would reduce chances for disease to become introduced and would assure a plentiful supply of green feed to keep the birds busy and to reduce cannibalism to a minimum. On the other hand, where large numbers of birds are to be raised year after year and available ground is limited, cement runs with houses of the stationary type may have their place. The runs can be thoroughly cleaned in preparation for each new hatch of birds, after one lot has completed its brooding

period, thus permitting practice of strict methods of sanitation not possible when ground pens are used. However, unless sufficient green feed is available for the birds and overcrowding is avoided, cannibalism may become a serious factor.

Type of Brooder. An electric radiant-heat type of brooder, 250-chick size, was used. The hover was four feet in diameter and covered 1750 square inches of floor space. The temperature under the brooder was maintained at 98° to 100° Fahrenheit for the first two weeks of the brooding period. This varied to a certain extent with the weather. When it was cold and cloudy it sometimes needed to be increased to 103° or 104° Fahrenheit to keep the chicks comfortable. When the birds were fifteen or sixteen days old, the brooder temperature was lowered to 95° Fahrenheit, and then gradually reduced at the rate of three degrees every two days until it was 75° when the birds were five weeks old. This was the general practice, but was not a "hard-fast" rule to be followed, as the brooder temperature used varied according to weather conditions. On warm days the heat was turned off in the daytime on chicks three and one-half or more weeks old.

The birds were brooded in the houses for a period of six weeks. Four or five days before they were taken out of the houses, the heat was left off both day and night.

Types of Litter. Straw was used as litter during the 1936 season. It did not prove very satisfactory, as a number of the birds ate the burs and foreign materials in the straw. Also the houses had to be cleaned every ten to fourteen days during the brooding period except in very dry weather.

Peat moss was used as litter during the 1937 season and was found very satisfactory. Labor in cleaning the houses was greatly lessened. One-half bale of peat moss was used per house for each lot of chicks, and did not need to be replaced during the brooding period of six weeks. Finely ground peat moss proved most satisfactory.

Feeding Methods. When the chicks were first put into the brooder houses they were given a commercial "chick starter mash" and water. This dry mash was kept before the birds all the time. When they were twenty-four hours old they were given the first wet feed, which was fed three times daily thereafter at regular intervals: 7:00 a.m., 11:00 a.m., and 3:00 p.m. This was composed of a commercial "chick starter mash", 50 per cent; "pheasant meal", 10 per cent; chopped lettuce or onion tops, etc., 20 per cent; curd, 10 per cent; hard boiled egg, 5 per cent; and ground boiled liver, 5 per cent. Boiling water was mixed with the "pheasant meal" until it was soft and crumbly, and then this mixture was left overnight to absorb the water. The eggs were boiled for not less than fifteen minutes. The "chick starter mash" was moistened with boiling water until it was

crumbly moist. The mashes and greens were mixed together, and then the egg, which had been pressed through a screen, ground liver, and curd were added and mixed in thoroughly. This feed should be crumbly and moist, but not sloppy or the chicks will not eat it well. One of the most important considerations in feeding is cleanliness. The wet feed was placed on feed boards about three-fourths of an inch deep and ten inches square. These boards were scraped each time before the next feeding. The birds were fed lettuce in addition to the green feed in the wet mash.

When the chicks were ten days old, chick scratch, charcoal, and commercial grit were added to the ration. Gravel was kept before the birds in the yards.

At the beginning of the third week the amount of egg in the wet feed was gradually reduced until at the end of the third week it was eliminated.

Whole wheat was fed when the birds were five weeks old and a "developing mash" was gradually substituted for the "starter mash".

The water fountains were placed over screens of hardware cloth to keep the litter dry. The birds were watered twice daily.

After the birds had been brooded for six weeks, they were taken to the holding pens on the farm. These pens were forty-eight feet square and held about one hundred birds per pen. During the period they were kept here, they were

fed "developing paks", wheat, charcoal, and grit. The wet feed was discontinued.

At the end of the brooding period the brooder houses were cleaned and then scrubbed with lye water. All feed boards and dishes were washed and disinfected with "B-K" in preparation for the next hatch.

EXPERIMENTS IN ARTIFICIAL INCUBATION AND BROODING

Experiments in artificial incubation and brooding of ring-necked pheasants were carried on to determine the most suitable incubation conditions and brooding practices to be followed. It was necessary to perform these experiments in conjunction with the general seasonal production of pheasants, and the results necessarily were included in the seasonal report. A brief outline of the experiments follows which covered the two-year period and involved over 22,000 ring-necked pheasant eggs and 13,000 ring-necked pheasant chicks:

- I. Experiments in artificial incubation of ring-necked pheasant eggs.
 - A. Experiments in incubation temperatures.
 - B. Experiments in moisture during incubation.
 - C. Comparison of hatching results with turning eggs two times daily and three times daily.
 - D. Relative hatchability of eggs of various shapes,

colors, and shell texture.

E. Comparison of incubator-hatched and hen-hatched birds as breeders.

F. Comparison of hatching results in still-air incubators and forced-air circulation machine.

II. Experiments in artificial brooding of ring-necked pheasant chicks. Comparison of exclusive dry feeding and wet feeding.

Details of the experiments follow.

Artificial Incubation

Experiments in Incubation Temperatures. Experiments were carried on during the 1936 season using different incubation temperatures to determine the optimum temperature to use for hatching ring-necked pheasant eggs in the still-air machines.

The first two hatches of the season were incubated at 102° Fahrenheit during the first eight days of the incubation period, 101° Fahrenheit during the next eight days, and 100° Fahrenheit the last eight days. The bulb of the thermometer was located one and three-fourths inches above the egg tray or at a height corresponding to the upper side of a domestic hen's egg. One lot of eggs was set in an incubator of the hot-water type and the other in a hot-air incubator. Eggs were turned twice daily beginning the third day of incubation. They were cooled twice a day after the first week of incubation. The incubators were

closed for hatching on the twentieth day. Results are given in the following table:

Classification (1936 season)		May 10		May 13	
Date of hatch		Hot-water		Hot-air	
Type of incubator		880		770	
Number eggs set					
		<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out		233	26.2	233	29.9
Infertiles		119	13.4	130	16.7
Broken		2	.2	4	.5
Dead germs		112	12.6	99	12.7
Dead in shell		218	24.7	186	24.1
Cripples		16	1.8	13	1.4
Net hatch (% is of total eggs set)		413	46.9	338	43.8
Net hatch of fertile eggs			54.2		52.8
Net hatch of eggs left in incubator when closed			63.8		62.9
Incubation period (days)		25		24	

By the time the results of these hatches were known, the next three hatches had already been started under the same temperature conditions during the incubation period as previously described. In the first two hatches, these temperatures were found to produce insufficient heat, as the incubation period had been prolonged to twenty-four and twenty-five days. Consequently, when these next incubators were closed for hatching, the temperature was raised to 103° Fahrenheit in the hot-air machines and 102½° Fahrenheit in the hot-water machine (the temperatures recommended by the manufacturers for use in incubating domestic hen eggs) with the middle of the thermometer bulb at the level of the top of the egg, the position at which the thermometer is

ordinarily placed in incubating domestic hen eggs. The eggs had been turned twice daily beginning the third day of incubation. They had been cooled twice a day after the first week of incubation. The incubators had been closed for hatching on the twentieth day. Results are given in the following table:

Classification (1936 season)

Date of hatch	May 16		May 18		May 21	
Type of incubator	Hot-air		Hot-air		Hot-water	
Number eggs set	880		824		880	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	253	28.4	274	31.6	262	29.4
Infertiles	150	17.0	111	13.3	113	12.7
Broken	5	.5	4	.4	6	.6
Dead germs	98	10.9	159	17.9	143	16.1
Dead in shell	153	17.3	209	25.3	260	29.5
Cripples	15*	1.7*	13	1.5	11	1.2
Net hatch (% is of total eggs set)	459	52.1	328	39.8	347	39.4
Net hatch of fertile eggs		62.7		46.0		45.2
Net hatch of eggs left in incubator when closed		73.2		59.6		56.1
Incubation period (days)	24		24		25	

The next two incubators were operated at the temperatures recommended by the manufacturers for use in incubating domestic hen eggs as follows: in the hot-water incubator $102\frac{1}{2}^{\circ}$ Fahrenheit during the entire incubation period and in the hot-air incubator 102° Fahrenheit during the first week

*NOTE: Fourteen (1.5%) chicks had the joints of their legs caught down through the wire of the egg tray. Smaller mesh wire was used thereafter on the egg trays to prevent crippling of the chicks.

of the incubation period and 103° Fahrenheit thereafter. Eggs were turned twice daily beginning the third day of incubation. They were cooled twice a day after the first week of incubation. The incubators were closed for hatching on the twentieth day. Results are given in the following table:

Classification (1936 season)				
Date of hatch	June 3		June 6	
Type of incubator	Hot-water		Hot-air	
Number eggs set	880		800	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	333	37.4	235	29.1
Infertiles	102	11.4	87	10.8
Broken	5	.5	5	.5
Dead germs	226	25.5	143	17.8
Dead in shell	174	19.7	303	37.8
Cripples	10	1.1	25	3.1
Net hatch (% is of total eggs set)	363	41.2	237	29.6
Net hatch of fertile eggs		46.6		33.2
Net hatch of eggs left in incubator when closed		66.3		41.9
Incubation period (days)	23½		23	

In the two preceding hatches the incubation temperature was undoubtedly too high and the moisture too low, as the embryos were dried down in the shell too much and the resultant hatch produced small chicks. Consequently, the next five incubators were run at 102° Fahrenheit during the entire incubation period with a moisture of 84° wet bulb temperature. In all preceding hatches no hygrometers were available with which to measure the moisture. Hygrometers were purchased at this time and used thereafter to measure the moisture. Results are given in the following table:

Classification (1936 season)

Date of hatch	June 26		June 29		July 2		July 5		July 8	
Type of incubator	Hot-air		Hot-air		Hot-water		Hot-water		Hot-air	
Number eggs set	880		770		880		880		770	
	<u>No.</u>	<u>%</u>								
Total tested out	114	12.9	93	11.9	111	12.3	159	17.9	131	16.8
Infertiles	82	9.2	69	8.9	85	9.5	111	12.5	110	14.2
Broken	2	.4	2	.2	5	.5	2	.2	2	.2
Dead germs	30	3.3	22	2.8	21	2.3	46	5.2	19	2.4
Dead in shell	218	25.0	181	23.5	225	25.5	147	16.7	195	25.3
Cripples	9	1.0	4	.5	8	.9	11	1.2	14	1.8
Net hatch (% is of total eggs set)	539	61.2	492	63.8	536	60.9	563	63.9	430	55.8
Net hatch of fertile eggs		67.5		70.1		67.4		73.2		65.1
Net hatch of eggs left in incubator when closed		70.3		72.6		69.7		78.0		67.2
Incubation period (days)	23		23		23 1/3		23		23	

NOTE: The varying numbers of dead germs in the different experiments may have been caused by the varying ages of the eggs at the time of setting.

Conclusions were drawn from these experiments that an incubation temperature of 102° Fahrenheit throughout the incubation period with a moisture of 84° wet bulb temperature was the optimum for incubating ring-necked pheasant eggs in the still-air machines of the hot-air and hot-water types used. This temperature was recorded with the middle of the bulb of the thermometer at the level of the top of the eggs. This temperature is one-half to one degree lower than that recommended by the manufacturers of these incubators for use in hatching domestic hen eggs.

The following is a summary of the hatching results for the 1936 season:

Classification	<u>No.</u>	<u>%</u>
Number of hatches	12	
Total eggs set	10,094	
Total tested out	2,431	24.0
Infertiles	1,269	12.5
Broken	44	.4
Dead germs	1,118	11.07
Per cent fertility		87.1
Dead in shell	2,469	24.4
Cripples	149	1.4
Net hatch (% is of total eggs set)	5,045	49.9
Net hatch of fertile eggs		57.1
Net hatch of eggs left in incubator when closed		65.8

Experiments in Moisture During Incubation. Experiments were carried on during the 1937 season using a different degree of moisture to determine the optimum moisture conditions to use for hatching eggs in the still-air machines. An incubation temperature of 102° Fahrenheit was used during

the season for all hatches in the still-air machines. In the experiment with moisture three lots of eggs were set in incubators of the hot-water type. A moisture of 82° wet bulb temperature was used. The eggs were turned twice daily beginning the fourth day of incubation and three times daily on the ninth day of incubation and thereafter. No cooling of eggs was practiced. The incubators were closed for hatching on the twentieth day of incubation. Results are given in the following table:

Classification (1937 season)

Date of hatch	May 14		May 22		June 9	
Type of incubator	Hot-water		Hot-water		Hot-water	
Number eggs set	880		880		880	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	154	17.3	114	12.7	65	7.2
Infertiles	118	13.3	92	10.3	43	4.8
Broken	2	.2	0	0	0	0
Dead germs	34	3.8	22	2.4	22	2.4
Dead in shell	136	15.4	128	14.5	106	12.0
Cripples	9	1.0	7	.7	6	.6
Net hatch (% is of total eggs set)	581	66.0	631	71.7	703	79.8
Net hatch of fertile eggs		76.2		80.0		83.9
Net hatch of eggs left in incubator when closed		80.0		82.3		86.2
Incubation period (days)	23 $\frac{1}{4}$		23 $\frac{3}{4}$		23 $\frac{1}{5}$	

A moisture of 84° wet bulb temperature was used in the still-air machines during the remaining nine hatches of the season, as it proved to give best hatching results. A temperature of 102° Fahrenheit was used throughout the incubation period. The eggs were turned twice daily beginning the fourth day of incubation and three times daily on the

ninth day of incubation and thereafter. No cooling of eggs was practiced. The incubators were closed for hatching on the twentieth day of incubation. Results are given in the following table:

Classification (1937 season)

Date of hatch Type of incubator Number eggs set	May 25		May 30		June 2		*July 2		July 10	
	Hot-air 880		Hot-air 880		Hot-air 880		Hot-air 880		Hot-air 880	
	<u>No.</u>	<u>%</u>								
Total tested out	80	9.0	64	7.0	73	8.1	84	9.4	104	11.7
Infertiles	59	6.7	56	6.2	62	6.9	53	5.9	69	7.8
Broken	1	.1	0	0	1	.1	0	0	0	0
Dead germs	20	2.2	8	.8	10	1.1	31	3.5	35	3.9
Dead in shell	69	7.8	86	9.7	90	10.2	222	25.2	122	13.8
Cripples	2	.2	6	.6	7	.7	12	1.3	6	.6
Net hatch (% is of total eggs set)	729	82.8	724	82.2	710	80.6	562	63.8	648	73.6
Net hatch of fertile eggs		88.7		87.8		86.7		67.9		79.9
Net hatch of eggs left in incubator when closed		91.1		88.7		87.9		70.6		83.5
Incubation period (days)	23		23		23		23		23	

*NOTE: July 2 hatch - Power went off during a thunderstorm while this incubator was hatching.

Classification (1937 season)

Date of hatch	July 12		July 16		July 21		*August 1	
Type of incubator	Hot-air		Hot-water		Hot-water		Hot-air	
Number eggs set	880		880		880		868	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	84	9.3	131	14.7	124	13.8	180	20.6
Infertiles	56	6.3	88	9.9	72	8.0	81	9.3
Broken	0	0	1	.1	3	.3	6	.6
Dead germs	28	3.0	42	4.7	49	5.5	93	10.7
Dead in shell	149	16.9	224	25.4	154	17.5	132	15.2
Cripples	13	1.4	16.	1.8	11	1.2	9	1.0
Net hatch (% is of total eggs set)	634	72.0	509	57.8	591	67.1	547	63.0
Net hatch of fertile eggs		76.9		64.2		73.1		69.5
Net hatch of eggs left in incubator when closed		79.6		67.9		78.1		79.5
Incubation period (days)	23		23		23 1/5		23	

*NOTE: August 1 hatch includes 297 eggs set in an experiment as explained later in the text, see page 25.

Comparison of Hatching Results with Turning Eggs Two Times Daily and Three Times Daily. During the 1936 hatching season the eggs were turned twice daily beginning the third day of incubation. During the 1937 season the eggs were turned twice daily beginning the fourth day of incubation and three times daily on the ninth day of incubation and thereafter. It is believed that increasing the number of times the eggs are turned per day is more important after the first week of incubation when the germ has become well developed than during the early stages of the incubation period. Also the eggs were tested on the eighth day, and since removal of infertile eggs and dead germs gave additional space on the egg tray to facilitate turning of the eggs, the ninth day was chosen as the day to begin the additional turnings. Turning the eggs three times daily instead of twice daily undoubtedly produces better hatching results.

Relative Hatchability of Eggs of Various Shapes, Colors, and Shell Texture. During the last hatch of the 1937 season, August 1 hatch, 297 eggs of various shapes, colors, and shell texture were set to determine the relative hatchability of these different groups. The eggs were marked so that the tests and hatching results of each group could be determined. The chicks from the different groups of eggs were not kept separate at hatching time. The eggs were set in an incubator of the hot-air type, which was run on the

regular routine game farm basis; namely, a temperature of 102° Fahrenheit and a moisture of 84° wet bulb temperature. These eggs were classified into groups, based on the following characteristics:

1. Shape
 - a. Long, narrow, and pointed
 - b. Blunt end
 - c. Knobby end
2. Color
 - a. Light blue or green
 - b. Pink
 - c. White
 - d. Speckled
3. Shell texture - metallic shell

Hatching results of these experimental eggs are given in the following table with the hatching results of the other eggs in the incubator for comparison.

Classification	Color								Shell Texture	
	Light Blue or Green		Pink		White		Speck- led		Metal- lic Shell	
Number eggs set	62		15		33		16		37	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	9	14.4	4	26.6	11	33.2	2	12.4	17	45.9
Infertiles	4	6.4	3	20.0	8	24.2	0	0	11	29.7
Broken	0	0	0	0	0	0	1	6.2	0	0
Dead germs	5	8.0	1	6.6	3	9.0	1	6.2	6	16.2
Dead in shell	11	17.7	4	26.6	4	12.1	4	25.0	7	18.9
*Total hatch (% is of total eggs set)	42	67.7	7	46.6	18	54.5	10	62.5	13	35.1
*Total hatch of fertile eggs		75.8		58.3		72.0		62.5		50.0
*Total hatch of eggs left in incubator when closed		79.2		63.6		81.8		71.4		65.0

*NOTE: Total hatch includes cripples as distinguished from net hatch.

Classification	Shape						Total Experi- mental Eggs	Other Eggs in Incubator		
	Long, Narrow, Pointed	Blunt End		Knobby End						
Number eggs set	10		44		80		297	571		
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	1	10.0	10	22.7	16	19.9	70	23.4	110	19.1
Infertiles	0	0	0	0	9	11.2	35	11.7	46	8.0
Broken	0	0	0	0	0	0	1	.3	5	.8
Dead germs	1	10.0	10	22.7	7	8.7	34	11.4	59	10.3
Dead in shell	4	40.0	6	13.6	14	17.5	54	18.1	78	13.6
*Total hatch (% is of total eggs set)	5	50.0	28	63.1	50	62.5	173	58.2	383	67.0
*Total hatch of fertile eggs		50.0		63.1		70.4		66.0		72.9
*Total hatch of eggs left in incubator when closed		55.5		82.3		78.1		76.2		83.0

*NOTE: Total hatch includes cripples as distinguished from net hatch.

Even though the numbers of eggs used in this experiment were small, yet the results indicated the importance of culling the eggs to obtain better hatching results; particularly was this true of the egg group, metallic shells. The experimental eggs produced a total hatch of 58.2%, while the other eggs in the incubator gave a total hatch of 67.0% or an increase of 8.8% over the experimental eggs.

Comparison of Incubator-Hatched and Hen-Hatched Birds as Breeders. Much controversy has arisen over the relative merits of incubator-hatched and hen-hatched birds as breeders. During the 1937 laying season at the Corvallis Game Farm the breeding birds were brailed and kept in two large open pens, about 300 hens per pen with a ratio of cocks to hens of 1:6. One pen of these birds consisted of birds which had been hatched in incubators and reared in brooder houses the previous year at the Eugene Game Farm. The other pen consisted of birds which had been hatched and reared by domestic hens at the Eugene Farm. Eggs from these two pens were kept separate during the 1937 season and hatching results were tabulated for the two groups. In some cases the chicks from each group were kept separate at hatching time. Approximately the same number of eggs from both pens was set in each incubator, so the experiments which were carried on during the 1937 season did not influence final hatching results. The following tables give the results of fertility and hatchability of each

hatch for both groups of birds (additional headings are explained as follows: heading marked "Feather Brooder Birds" referred to ten hens and two cocks which had been brooded for the six weeks brooding period in a feather brooder at the Eugene Farm. These birds were kept in enclosed wire-covered pens, five hens and one cock per pen during the 1937 season. However, the number of hens was too small to draw any conclusions. The heading "Eugene Farm Birds" referred to the hens at that farm; eggs were brought to the Corvallis Game Farm for incubation.)

The eggs were incubated in the still-air machines with the exception of two hatches; namely, May 28 and July 28 hatches which were incubated in the forced-air circulation machine.

<u>Table I.</u>	<u>Incubator-</u>		<u>Hen-</u>		<u>Feather</u>		<u>Eugene</u>	
<u>Classification</u>	<u>Hatched</u>		<u>Hatched</u>		<u>Brooder</u>		<u>Farm</u>	
<u>May 14 hatch</u>	<u>Breeders</u>		<u>Breeders</u>		<u>Birds</u>		<u>Birds</u>	
Number eggs set	80		120		14		666	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	16	19.8	27	22.4	13	92.7	98	14.6
Infertiles	12	14.9	23	19.1	12	85.6	71	10.6
Broken	1	1.2	0	0	1	7.1	0	0
Dead germs	3	3.7	4	3.3	0	0	27	4.0
Dead in shell	14	17.5	18	15.0	0	0	104	15.6
Cripples	0	0	1	.8	0	0	8	1.2
Net hatch (% is of total eggs set)	50	62.5	74	61.6	1	7.1	456	68.4
Net hatch of fer- tile eggs		73.5		76.2		50.0		76.6
Net hatch of eggs left in incubator when closed		78.1		79.5		100.0		80.2
Per cent net hatch of entire incubator of total eggs set	66%							
Per cent cripples in incubator	1.0%							

Table II. Classification May 22 hatch	Incubator- Hatched Breeders		Hen- Hatched Breeders		*Feather Brooder Birds	
	No.	%	No.	%	No.	%
Number eggs set	389		448		43	
Total tested out	37	9.3	48	10.5	29	67.3
Infertiles	30	7.6	34	7.5	28	65.0
Broken	0	0	0	0	0	0
Dead germs	7	1.7	14	3.0	1	2.3
Dead in shell	61	15.7	65	14.5	2	4.6
Cripples	1	.2	5	1.1	1	2.3
Net hatch (% is of total eggs set)	290	74.5	330	73.6	11	25.5
Net hatch of fertile eggs		80.7		79.7		73.3
Net hatch of eggs left in incubator when closed		82.3		82.5		78.5

Per cent net hatch of entire incubator of total eggs set -
71.7%. Per cent cripples in incubator - .7%

NOTE: A dormant male pheasant was taken out of one of the
Feather Brooder Pens and another male substituted. This
no doubt accounted for the low fertility in the first
hatches.

Table III.	Eugene Farm Birds	
Classification May 25 hatch	No.	%
Number eggs set	880	
Total tested out	80	9.0
Infertiles	59	6.7
Broken	1	1.1
Dead germs	20	2.2
Dead in shell	69	7.8
Cripples	2	.2
Net hatch (% is of total eggs set)	729	82.8
Net hatch of fertile eggs		88.7
Net hatch of eggs left in incubator when closed		91.1

Table IV. (Forced-Air Circulation Incubator)

Classification	Incubator- Hatched Breeder		Hen- Hatched Breeder		Feather- Brooder Birds		Eugene Farm Birds	
	No.	%	No.	%	No.	%	No.	%
May 28 hatch	384		360		14		67	
Number eggs set	384		360		14		67	
Total tested out	45	11.6	33	9.1	5	35.6	7	10.4
Infertiles	34	8.8	27	7.5	4	28.5	7	10.4
Broken	0	0	0	0	0	0	0	0
Dead germs	11	2.8	6	1.6	1	7.1	0	0
Dead in shell	114	29.6	120	33.3	3	21.4	14	20.3
Cripples	28	7.2	22	6.1	2	14.2	4	5.9
Net hatch (% is of total eggs set)	197	51.3	185	51.3	4	28.5	42	62.6
Net hatch of fertile eggs		56.2		55.5		40.0		70.0
Net hatch of eggs left in incubator when closed		58.1		56.5		44.4		70.0
Per cent net hatch of entire incubator of total eggs set - 51.8%. Per cent cripples in incubator - 6.7%.								

Table V

Classification	Incubator- Hatched Birds		Hen- Hatched Birds		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
May 30 hatch	371		489		20	
Number eggs set	371		489		20	
Total tested out	26	6.9	32	6.4	6	30.0
Infertiles	22	5.9	28	5.6	6	30.0
Broken	0	0	0	0	0	0
Dead germs	4	1.0	4	.8	0	0
Dead in shell	33	8.8	50	10.2	3	15.0
Cripples	2	.5	3	.6	1	5.0
Net hatch (% is of total eggs set)	310	83.5	404	82.6	10	50.0
Net hatch of fertile eggs		88.8		87.6		71.4
Net hatch of eggs left in incubator when closed		89.8		88.4		71.4

Per cent net hatch of entire incubator of total eggs set - 82.2%. Per cent cripples in incubator - .6%.

Table VI.

Classification June 2 hatch	Incubator- Hatched Breeder		Hen- Hatched Birds		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
Number eggs set	422		432		26	
Total tested out	41	9.5	28	6.3	4	15.3
Infertiles	34	7.9	24	5.4	4	15.3
Broken	1	.2	0	0	0	0
Dead germs	6	1.4	4	.9	0	0
Dead in shell	43	10.1	47	10.8	0	0
*Total hatch (% is of total eggs set)	338	80.0	357	82.6	22	84.6
*Total hatch of eggs left in incubator when closed		88.7		88.3		100.0

Per cent net hatch of entire incubator of total eggs set - 80.6%. Per cent cripples in incubator - .7%.

*NOTE: Total hatch includes cripples as distinguished from net hatch.

Table VII.

Classification June 9 hatch	Incubator- Hatched Breeder		Hen- Hatched Birds		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
Number eggs set	420		440		20	
Total tested out	33	7.7	32	7.1	0	0
Infertiles	21	4.9	22	4.9	0	0
Broken	0	0	0	0	0	0
Dead germs	12	2.8	10	2.2	0	0
Dead in shell	50	11.9	56	12.7	0	0
Total hatch (% is of total eggs set)	337	80.2	352	80.0	20	100.0
Total hatch of eggs left in incubator when closed		87.0		86.2		100.0

Per cent net hatch of entire incubator of total eggs set - 79.8%. Per cent cripples in incubator - .6%

Table VIII.

Classification	Incubator- Hatched Breeder		Hen- Hatched Birds		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
*July 2 hatch						
Number eggs set	415		440		25	
Total tested out	37	8.8	44	9.8	3	12.0
Infertiles	25	6.0	27	6.0	1	4.0
Broken	0	0	0	0	0	0
Dead germs	12	2.8	17	3.8	2	8.0
Dead in shell	106	25.5	112	25.4	4	16.0
Total hatch (% is of total eggs set)	272	65.5	284	64.5	18	72.0
Total hatch of eggs left in incubator when closed		72.0		71.7		81.8

Per cent net hatch of entire incubator of total eggs set - 63.8%. Per cent cripples in incubator - 1.3%.

*NOTE: Power went off during a thunderstorm while this incubator was hatching.

Table IX.

Classification	Incubator- Hatched Breeder		Hen- Hatched Birds		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
July 10 hatch						
Number of eggs set	395		440		45	
Total tested out	51	12.7	49	10.9	4	8.8
Infertiles	28	7.0	38	8.5	3	6.6
Broken	0	0	0	0	0	0
Dead germs	23	5.7	11	2.4	1	2.2
Dead in shell	50	12.6	69	15.6	3	6.6
Total hatch (% is of total eggs set)	294	74.4	322	73.1	38	84.4
Total hatch of eggs left in incubator when closed		85.4		82.3		92.6

Per cent net hatch of entire incubator of total eggs set - 73.6%. Per cent cripples in incubator - .6%.

<u>Table X.</u>	<u>Incubator- Hatched Breeder</u>		<u>Hen- Hatched Breeder</u>		<u>Feather- Brooder Birds</u>	
Classification						
July 12 hatch						
Number eggs set	351		512		17	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	37	10.4	44	8.3	3	17.5
Infertiles	22	6.2	32	6.1	2	11.7
Broken	0	0	0	0	0	0
Dead germs	15	4.2	12	2.2	1	5.8
Dead in shell	68	19.0	80	15.6	1	5.8
Total hatch (% is of total eggs set)	246	70.0	388	75.7	13	76.4
Total hatch of eggs left in incubator when closed		78.3		82.9		92.8

Per cent net hatch of entire incubator of total eggs set - 72.0%. Per cent cripples in incubator - 1.4%.

<u>Table XI.</u>	<u>Incubator- Hatched Breeder</u>		<u>Hen- Hatched Breeder</u>		<u>Feather- Brooder Birds</u>	
Classification						
July 16 hatch						
Number eggs set	407		440		33	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	71	17.2	54	12.1	6	18.1
Infertiles	48	11.6	36	8.1	4	12.1
Broken	1	.2	0	0	0	0
Dead germs	22	5.4	18	4.0	2	6.0
Dead in shell	99	24.3	120	27.2	5	15.1
Total hatch (% is of total eggs set)	237	58.4	266	60.4	22	66.6
Total hatch of eggs left in incubator when closed		70.5		68.9		81.4

Per cent net hatch of entire incubator of total eggs set - 57.8%. Per cent cripples in incubator - 1.8%.

Table XII.

Classification July 21 hatch	Incubator- Hatched Breeder		Hen- Hatched Breeder		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
Number eggs set	365		484		31	
Total tested out	49	13.3	69	14.0	6	19.2
Infertiles	35	9.5	34	6.9	3	9.6
Broken	0	0	3	.6	0	0
Dead germs	14	3.8	32	6.5	3	9.6
Dead in shell	65	17.8	80	16.5	9	29.0
Total hatch (% is of total eggs set)	251	68.7	335	69.2	16	51.6
Total hatch of eggs left in incubator when closed		79.4		80.7		64.0

Per cent net hatch of entire incubator of total eggs set - 67.1%. Per cent cripples in incubator - 1.2%.

Table XIII. (Forced-Air Circulation Incubator)

Classification July 28 hatch	Incubator- Hatched Breeder		Hen- Hatched Breeder		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
Number eggs set	297		495		33	
Total tested out	55	18.4	74	14.9	9	27.2
Infertiles	37	12.4	50	10.1	7	21.2
Broken	0	0	4	.8	0	0
Dead germs	18	6.0	20	4.0	2	6.0

Per cent net hatch of entire incubator of total eggs set - 45.6%. Per cent cripples in incubator - 9.5%.

Table XIV.

Classification	Incubator- Hatched Breeder		Hen- Hatched Breeder		Feather- Brooder Birds	
	No.	%	No.	%	No.	%
August 1 hatch Number eggs set	238		287		46	
Total tested out	49	20.5	49	16.9	12	26.0
Infertiles	30	12.6	16	5.5	0	0
Broken	1	.4	3	1.0	1	2.1
Dead germs	18	7.5	30	10.4	11	23.9
Dead in shell	39	16.3	30	10.4	9	19.5
Total hatch (% is of total eggs set)	150	63.0	208	72.4	25	54.3
Total hatch of eggs left in incubator when closed for hatching		79.3		87.3		73.5

Per cent net hatch of entire incubator of total eggs set - 63.0%. Per cent cripples in incubator - 1.0%.

NOTE: The 297 eggs set as an experiment in this incubator are not included in the above figures, as a number of them would ordinarily have been sorted out as culls.

The following is a summary of the fertility and hatchability of the different groups of eggs hatched during the 1937 season in the still-air incubators (Tables I-XIV exclusive of Tables IV and XIII, which are hatches in the forced-air circulation incubator):

Classification	Incubator- Hatched Breeder	Hen- Hatched Breeder	*Feather- Brooder Birds	Eugene Farm Birds
Total eggs set	3,853	4,532	320	1,546
	<u>No.</u> <u>%</u>	<u>No.</u> <u>%</u>	<u>No.</u> <u>%</u>	<u>No.</u> <u>%</u>
Total tested out	447 11.6	476 10.5	86 26.8	178 11.5
Infertiles	307 7.9	314 6.9	63 19.6	130 8.4
Broken	4 .1	6 .1	2 .6	1 .06
Dead germs	136 3.5	156 3.4	21 6.5	47 3.0
Per cent fertility	92.0	93.0	79.8	91.54
Dead in shell	628 16.2	727 16.0	36 11.2	173 11.1
Net hatch (% is of total eggs set)				
3 hatches	650 77.3	808 76.4		
4 hatches			60 49.1	
2 hatches				1185 76.6
Cripples				
3 hatches	3 .3	9 .8		
4 hatches			2 1.6	
2 hatches				10 .6
Total hatch				
8 hatches	2125 70.5	2512 72.2		
7 hatches			136 68.6	

NOTE: The 297 eggs set as an experiment in the still-air incubator hatching August 1 are not included in the above figures, as a number of them would ordinarily have been sorted out as culls.

* A dormant male pheasant was taken out of one of the Feather Brooder pens and another male substituted. This no doubt accounted for the low fertility.

The following is a summary of the fertility and hatchability of the different groups of eggs hatched during the 1937 season in the forced-air circulation incubator (Tables IV and XIII; the hatches in the forced-air circulation incubator will be explained in further detail later in the report):

Classification	Incubator- Hatched Breeder		Hen- Hatched Breeder		Feather- Brooder Birds		Eugene Farm Birds	
	No.	%	No.	%	No.	%	No.	%
Total eggs set	681		855		47		67	
Total tested out	100	14.6	107	12.5	14	29.7	7	10.4
Infertiles	71	10.4	77	9.0	11	23.4	7	10.4
Broken	0	0	4	.4	0	0	0	0
Dead germs	29	4.2	26	3.0	3	6.3	0	0
Per cent fertility		89.6		90.6		76.6		89.6
Dead in shell	114	16.7	120	14.0	3	6.3	14	20.8
Net hatch (% is of total eggs set)								
1 hatch	197	51.3	185	51.3	4	28.5	42	62.6
Cripples								
1 hatch	28	7.2	22	6.1	2	14.2	4	5.9

The following is a summary of the fertility and hatchability of the different groups of eggs hatched during the 1937 season both in the still-air incubators and forced-air circulation machine (Tables I-XIV inclusive):

Classification	Incubator- Hatched Breeder		Hen- Hatched Breeder		Feather- Brooder Birds		Eugene Farm Birds	
Total eggs set	4,534		5,387		367		1,613	
	No.	%	No.	%	No.	%	No.	%
Total tested out	547	12.0	583	10.8	100	27.2	185	11.4
Infertiles	378	8.3	391	7.2	74	20.1	137	8.4
Broken	4	.08	10	.1	2	.5	1	.06
Dead germs	165	3.6	182	3.3	24	6.5	47	2.9
Per cent fertility	91.62		92.7		79.4		91.54	
Dead in shell	742	16.3	847	15.7	39	10.6	187	11.5
Net hatch (% is of total eggs set)								
4 hatches	847	69.1	993	70.0				
5 hatches					64	47.0		
3 hatches							1227	76.0
Cripples								
4 hatches	31	2.5	31	2.1				
5 hatches					4	2.9		
3 hatches							14	.8
Total hatch								
8 hatches	2125	70.5	2512	72.2				
7 hatches					136	68.6		

NOTE: The 297 eggs set as an experiment in the still-air incubator hatching August 1 are not included in the above figures, as a number of them would ordinarily have been sorted out as culls.

No difference was noted between the relative merits of the two groups of birds as breeders; namely, the incubator-hatched and hen-hatched birds. The eggs from both groups produced very similar hatching results as pertained to fertility, dead germ tests, dead in shell, cripples, and per cent net or total hatch.

It will be noted that the fertility of the eggs at the first and last of the season was approximately the same with a high point reached during the middle of the season. The average fertility in the brail pens for the 1937 season

was 92.1 per cent with a high peak of 95.1 per cent reached in the early part of June.

Likewise the hatchability at the first and last of the season was approximately the same with the highest peak reached during the middle of the season. At this time the eggs hatched from 85 to 90 per cent of fertile eggs.

Comparison of Hatching Results in Still-Air Incubators and Forced-Air Circulation Machine. Experiments were carried on during the 1937 season using different incubation temperatures in the forced-air circulation machine to determine the optimum. This machine had a capacity of 540 hen eggs or 825 pheasant eggs. It had five metal turning egg trays; the eggs were turned automatically. The eggs were placed in the channels of the trays with the small end straight down; they were not placed on their sides. Then when the channels were turned to one side or the other, the eggs were tipped at a slight angle on their sides.

The machine was run at 100° Fahrenheit (the manufacturer's directions for incubating domestic hen eggs) for one hatch and 99° Fahrenheit for another for experimental purposes. A moisture of 84° wet bulb temperature was used for both hatches. A sand tray on the floor of the machine was used to supply the moisture. The eggs were turned twice daily beginning the fourth day of incubation and three times daily beginning the ninth day of incubation and thereafter. In the first hatch, which was run at 100°

Fahrenheit, the eggs were turned four times daily, beginning the sixteenth day of incubation and thereafter. The door of the incubator was left open and the current turned off for five to ten minutes twice a day beginning the fourth day of incubation to permit air change in the cabinet. The large ventilator in the center of the top of the machine was left open all the time; the two slide ventilators were kept closed until the chicks began to hatch, then they were opened. The eggs were turned for the last time and transferred to the hatching baskets on the nineteenth day of incubation. Results are given in the following table:

Classification (1937 season)	100° F.		99° F.	
Incubation temperature	100° F.		99° F.	
Date of hatch	May 28		July 28	
Number eggs set	825		825	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Total tested out	90	10.8	138	16.5
Infertiles	72	8.7	94	11.3
Broken	0	0	4	.4
Dead germs	18	2.1	40	4.8
Dead in shell	251	30.4	231	28.0
Cripples	56	6.7	79	9.5
Net hatch (% is of total eggs set)	428	51.8	377	45.6
Net hatch of fertile eggs		56.8		51.5
Net hatch of eggs left in incubator when closed		58.2		54.8
Incubation period (days)	24		26	

Indications from these experiments were that 100° Fahrenheit was the more favorable incubation temperature, as it produced the greater per cent net hatch of total eggs set, of eggs left in the incubator when closed for hatching,

and a slight decrease in the percentage of cripples. In both cases a number of chicks had to be helped out of the shell; this undoubtedly caused the high percentage of cripples. Also a number of chicks in both hatches pipped and died in the shell. The number of chicks helped out and the number which pipped and died in the shell were, however, less in the hatch which was run at 100° Fahrenheit during the incubation period. The moisture supply at hatching time seemed to be inadequate, as both hatches were "dry" hatches. In the case of the hatch which was run at 100° Fahrenheit, the incubation period was lengthened to one day above the optimum period, and in the hatch which was run at 99° Fahrenheit, the completion of the incubation period was prolonged three days above the optimum.

The forced-air circulation machine did not give as high an average hatch as did the still-air machines. It is planned to carry on another experiment with the forced-air circulation machine during the 1938 season. This will consist of incubating the eggs in the forced-air circulation machine and transferring them to a still-air incubator for the hatching period, a procedure which has proven popular to poultrymen and turkey raisers. This would eliminate the hand turning of eggs involved in incubating the eggs in the still-air machine, a distinct advantage of the forced-air circulation incubator over the still-air incubator. The conclusions drawn as to the hatching results in the

forced-air circulation machine apply only to this particular forced-air circulation machine and are not indicative of such machines in general as the machine used was of small capacity and the number of eggs set limited.

The following table is a summary of the hatching results for the 1937 season, giving results obtained in the still-air incubators, the forced-air circulation machine, and the average of the two:

Classification	*Still-Air Incubators		Forced-Air Circulation Incubator		All Incubators	
Number of hatches	12		2		14	
Total eggs set	10,548		1,650		12,198	
	No.	%	No.	%	No.	%
Total tested out	1257	11.9	228	13.8	1485	12.1
Infertiles	849	8.0	166	10.0	1015	8.3
Broken	14	.1	4	.2	18	.1
Dead germs	394	3.7	58	3.5	452	3.7
Per cent fertility		91.9		89.8		91.6
Dead in shell	1618	15.3	482	29.2	2100	17.2
Cripples	104	.9	135	8.1	239	1.9
Net hatch (% is of total eggs set)	7569	71.7	805	48.7	8374	68.7
Net hatch of fertile eggs		78.0		54.2		74.8
Net hatch of eggs left in incubator when closed		81.4		56.6		78.1

*NOTE: All eggs set in the still-air incubators, including the 297 experimental eggs set in the incubator which hatched August 1, are included in this summary.

The net hatch for the 1937 season of total eggs set in the still-air incubators was 71.7 per cent. The net hatch for the season of total eggs set in the still-air

incubators excluding the 297 experimental eggs in the August 1 hatch, a number of which would ordinarily have been sorted out as culls, was 72.1 per cent.

The net hatch for the season of total eggs set in the forced-air circulation machine was 48.7 per cent.

The net hatch for the season of total eggs set in all incubators was 68.7 per cent.

Artificial Brooding

Comparison of Exclusive Dry Feeding and Wet Feeding.

Experiments were carried on during the 1937 season to determine the relative values of exclusive dry feed and the regular Oregon Game Farm wet feed ration for the pheasant chicks during the six weeks brooding period.

Three different kinds of exclusive dry feeds were used. In each experiment, check pens were fed the wet feed ration. Birds from the same hatches were used for comparison. They were brooded with the same type of electric brooder. Approximately the same number of birds was put in each house. Birds were weighed at various ages and mortality records were kept throughout. Peat moss was used as litter in all houses.

An explanation of the different feeds and feeding methods follows in detail. Analyses and lists of ingredients of the feeds as determined by the respective feed companies are given.

WET FEED - The wet feed ration was explained earlier in the text, but will be repeated for clarity. Under this system the chicks were given a commercial "chick starter mash" ("pellets" and loose mash) and water when they were first put into the brooder houses. This dry mash was kept before the birds all the time. The analysis and list of ingredients of this mash were as follows:

Analysis:

Protein (minimum)	17%
Fat (minimum)	4%
Fiber (maximum)	5%
Ash (maximum)	8%
Moisture (average)	11%

Ingredients:

Ground corn, ground wheat, wheat mixed feed, oat meal, dried skim milk, dried whey, fish meal, meat meal, alfalfa leaf meal, linseed oil meal, minerals 3%, cod liver oil, irradiated yeast, salt.

When the chicks were twenty-four hours old they were given the first wet feed, which was fed three times daily thereafter at regular intervals: 7:00 a.m., 11:00 a.m., and 3:00 p.m. This was composed of the commercial "chick starter mash", 50 per cent; "pheasant meal", 10 per cent; chopped lettuce or onion tops, etc., 20 per cent; curd,

10 per cent; hard boiled egg, 5 per cent; and ground boiled liver, 5 per cent. Boiling water was mixed with the "pheasant meal" until it was soft and crumbly, and then this mixture was left overnight to absorb the water. The eggs were boiled for not less than fifteen minutes. The "chick starter mash" was moistened with boiling water until it was crumbly moist. The mashes and greens were mixed together and then the egg, which had been pressed through a screen, ground liver, and curd were added and mixed in thoroughly. This feed should be crumbly and moist, but not sloppy or the chicks will not eat it well. The analysis and list of ingredients of the "pheasant meal" were as follows:

Analysis:

Protein	20.0%
Fat	2.0%
Fiber	1.5%
Carbohydrates	60.0%

Ingredients:

Wheat flour, meat and bone cooked.

The birds were fed lettuce in addition to the green feed in the wet mash.

When the chicks were ten days old, chick scratch, charcoal, and commercial grit were added to the ration. Gravel was kept before the birds in the yards.

At the beginning of the third week the amount of egg in the wet feed was gradually reduced until at the end of the third week it was eliminated.

Whole wheat was fed when the birds were five weeks old and a "developing mash" was gradually substituted for the "starter mash". The analysis and list of ingredients of this "developing mash" (pellets) were as follows:

Analysis:

Protein (minimum)	17.0%
Fat (minimum)	4.5%
Fiber (maximum)	6.0%
Ash (maximum)	10.0%
Moisture (average)	11.0%

Ingredients:

Ground corn, wheat mixed feed, ground wheat, ground oats, fish meal, dried skim milk, alfalfa leaf meal, meat meal, dried whey, linseed oil meal, minerals 3%, cod liver oil, salt.

DRY FEED NUMBER 1 - An exclusive dry feed in "pellets" which were cracked to make an ideal size for pheasant chicks was tried in the experiments. This feed was kept before the chicks all the time, fed at first on feed boards and then later in troughs when the chicks were old enough to eat out of them. The troughs were filled once daily. The

chicks were supplied with water and fed green feed (lettuce) as in the case of the chicks on the wet feed ration.

Gravel was kept before the birds in the yards. When the birds were about five weeks old, the "developing pellets" were gradually substituted for the "starter pellets" and commercial grit was added. Whole wheat was also fed at this time. The analysis and list of ingredients of the "starter" and "developing pellets" were as follows:

Analysis:

Protein	30.0%
Fat	5.0%
Fiber	5.5%
Carbohydrates	44.5%

Ingredients:

Corn meal, wheat bran, wheat flour middlings, feeding oat meal, alfalfa leaf meal, dried buttermilk, salt, not over 3% iodized calcium carbonate, fish meal, meat scraps, beef meal, soy bean oil meal, cod liver oil, linseed meal.

DRY FEED NUMBER 2 - This was another exclusive dry feed in pellet form which was tried. The chicks were given water as with the chicks on the other exclusive dry feed. The dry feed was fed on feed boards at first and later in troughs. The troughs were filled once daily. The chicks

were given green feed (lettuce). Commercial grit was added to the "pellets" when the chicks were ten days old and chick scratch when they were three weeks old. Gravel was kept before the birds in the yards. When the chicks were five weeks old, the "developing pellets" were gradually substituted for the "starter pellets" and whole wheat was added. The analysis and list of ingredients of the "starter" and "developing pellets" were as follows:

Analysis:

	<u>Starter Pellets</u>	<u>Developing Pellets</u>
Protein	26%	21%
Fat	6%	5%
Ash	9%	9%
Fiber	5%	5%

Ingredients:

(Same ingredients for both the "starter" and "developing pellets".) Wheat germ meal, millrun without screenings, wheat shorts, wheat middlings, ground corn, ground oats, dehydrated alfalfa meal, fish meal, meat meal, soy bean meal, dried skim milk, dried whey, salt, a complete mineral mixture, molasses, high potency cod liver oil, rice bran, dried malt, dried liver meal, brewers' yeast.

DRY FEED NUMBER 3 - An exclusive dry feed in "pellets" with loose mash to be mixed in for the chicks when they were small, was tried. The chicks were given water. The dry feed was fed on feed boards at first and later in troughs. The troughs were filled once daily. Green feed (lettuce) was supplied. Commercial grit was added to the ration when the chicks were ten days old and chick scratch when they were three weeks old. Gravel was kept before the birds in the yards. When the birds were five weeks old, whole wheat was added to the ration. The analysis and list of ingredients of the "starter pellets" and mash were as follows:

Analysis:

Protein (minimum)	24%
Fat (minimum)	5%
Fiber (maximum)	6%
Ash (maximum)	9%
Moisture (average)	11%

Ingredients:

Ground corn, ground wheat, wheat mixed feed, oat meal, ground oats, dried skim milk, dried whey, meat meal, fish meal, alfalfa leaf meal, linseed oil meal, sesame oil meal, minerals 3%, cod liver oil, salt, irradiated yeast.

The analysis and list of ingredients of the "developing pellets" were as follows:

Analysis:

Protein (minimum)	21%
Fat (minimum)	5%
Fiber (maximum)	7%
Ash (maximum)	11%
Moisture (average)	11%

Ingredients:

Ground corn, ground wheat, wheat mixed feed, ground oats, ground barley, dried skim milk, dried whey, meat meal, fish meal, alfalfa leaf meal, linseed oil meal, soy bean oil meal, minerals 4%, cod liver oil, salt.

The results of the experiments with the three different dry feeds and the wet feed ration, which served as a check, follow in detail. Each individual dry feed will be treated separately with its corresponding wet feed check pen. The dry feeds will be designated by the numbers assigned and the per cent protein of the "starter mash" or "pellets" by analysis.

DRY FEED NUMBER 1 (30% protein) - The data of the experiment follow:

	<u>Wet Feed</u>	<u>Dry Feed Number 1</u>
Date of hatch	May 14	May 14
Date birds put into brooder house	May 15	May 15
Number of houses	1	1
Number birds per house	125	127
Date birds taken out of houses	June 27	June 27
Days brooded	43	43

The birds were weighed at four weeks of age and at the end of the brooding period. The weight record for the four-weeks period follows:

	<u>Wet Feed</u>	<u>Dry Feed Number 1</u>
Date weighed	June 11	June 11
Age of birds	28 days	28 days
Number birds weighed	60 (in lots of 15 each)	60 (in lots of 15 each)
Weights of individual lots (pounds)		
(15 birds)	3.08	4.84
(15 birds)	3.82	4.74
(15 birds)	3.44	4.55
(15 birds)	3.58	4.75
Total weight (60 birds)	13.92	18.88
Average weight per lot	3.48	4.72
Average weight per bird	.232	.314

The weight record of the birds at the end of the brooding period follows:

	<u>Wet Feed</u>	<u>Dry Feed Number 1</u>
Date weighed	June 27	June 27
Age of birds	44 days	44 days
Number birds weighed	Whole house (lots of 10 each)	Whole house (lots of 10 each)
Weights of individual lots (pounds)		
(10 birds)	4.84	6.22
(10 birds)	3.86	6.36
(10 birds)	5.08	6.25
(10 birds)	4.53	6.07
(10 birds)	4.49	6.59
(10 birds)	4.52	6.26
(10 birds)	4.39	5.60
(10 birds)	5.28	5.92
(10 birds)	4.11	6.37
(10 birds)	5.21	6.50
(7 birds)	2.96	(10 birds) 6.00
		(13 birds) 7.70
Total weight (107 birds)	49.27	(123 birds) 75.84
Average weight per bird	.460	.616

The mortality record for the brooding period follows:

	<u>Wet Feed</u>		<u>Dry Feed Number 1</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Number birds put into houses	125		127	
Total mortality	16	12.80	5	3.91
Causes:				
Materials (as wild carrot, grass root) lodged in crop or gizzard	6	4.80	1	.78
Accident			1	.78
Crooked neck	1	.80	1	.78
Slipped tendon	1	.80		
Unknown	8	6.40	2	1.57

DRY FEED NUMBER 2 (26% protein) - Three lots of birds representing three different hatches were used in the experimental feeding of dry feed number 2. The data of the

first lot follow:

	<u>Wet Feed</u>	<u>Dry Feed Number 2</u>
Date of hatch	May 30	May 30
Date birds put into brooder house	May 30	May 30
Number of houses	1	1
Number birds per house	128	131
Date birds taken out of house	July 11	July 11
Days brooded	42	42

The birds were weighed at 30 days of age and at the end of the brooding period. The weight record for the 30-day period follows:

	<u>Wet Feed</u>	<u>Dry Feed Number 2</u>
Date weighed	June 29	June 29
Age of birds	30 days	30 days
Number birds weighed	60 (in lots of 15 each)	60 (in lots of 15 each)
Weights of individual lots (pounds)		
(15 birds)	4.49	5.36
(15 birds)	4.24	5.67
(15 birds)	4.46	5.58
(15 birds)	3.96	5.71
Total weight (60 birds)	17.15	22.32
Average weight per lot	4.28	5.58
Average weight per bird	.285	.372

The weight record of the birds at the end of the brooding period follows:

	<u>Wet Feed</u>	<u>Dry Feed Number 2</u>
Date weighed	July 11	July 11
Age of birds	42 days	42 days
Number birds weighed	Whole house (in lots of 10 each)	Whole house (in lots of 10 each)
Weights of individual lots (pounds)		
(10 birds)	4.51	5.80
(10 birds)	4.11	5.66
(10 birds)	4.24	6.05
(10 birds)	4.29	5.89
(10 birds)	3.87	5.79
(10 birds)	4.62	5.54
(10 birds)	5.00	5.94
(10 birds)	4.74	5.40
(10 birds)	4.63	6.12
(10 birds)	4.97	6.46
(9 birds)	3.24	(12 birds) 6.82
(5 birds)	2.27	(11 birds) 6.16
Total weight (114 birds)	50.49	(123 birds) 71.63
Average weight per bird	.442	.582

The mortality record for the brooding period follows:

	<u>Wet Feed</u>		<u>Dry Feed Number 2</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Number birds put into houses	128		131	
Total mortality	13	10.14	9	6.86
Causes:				
Materials (as wild carrot, grass root) lodged in crop or gizzard	2	1.56		
Cannibalism	3	2.34		
Accident			1	.76
Crooked neck	1	.78	1	.76
Digestive disorder	1	.78		
Unknown	6	4.68	7	5.34

The data of the second lot of birds fed dry feed number 2 follow:

	<u>Wet Feed</u>	<u>Dry Feed Number 2</u>
Date of hatch	July 10	July 10
Date birds put into brooder houses	July 11	July 11
Total number birds	224	336
Number of houses	2	3
Number birds per house	112	112
Date taken out of houses	August 21	August 21
Days brooded	41	41

Birds were weighed at the end of the brooding period.

The weight record follows:

	<u>Wet Feed</u>	<u>Dry Feed Number 2</u>
Date weighed	August 21	August 21
Age of birds	42 days	42 days
Number birds weighed	100 (one house in lots of 10 each)	100 (one house in lots of 10 each)
Weights of individual lots (pounds)		
(10 birds)	4.76	5.85
(10 birds)	4.51	6.21
(10 birds)	4.03	5.30
(10 birds)	4.22	6.16
(10 birds)	4.31	6.44
(10 birds)	4.17	5.99
(10 birds)	3.85	5.62
(10 birds)	4.50	5.94
(10 birds)	4.16	5.38
(10 birds)	4.82	6.58
Total weight (100 birds)	43.33	59.47
Average weight per lot	4.33	5.94
Average weight per bird	.433	.594

The mortality record for the brooding period follows:

	<u>Wet Feed</u>		<u>Dry Feed</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Number birds put into houses	224		336	
Total mortality	32	14.26	24	7.10
Causes:				
Materials (as wild carrot, grass root) lodged in crop or gizzard			1	.29
Accident	2	.89	1	.29
Crooked neck	4	1.78	5	1.48
Digestive disorder	4	1.78	1	.29
Cripples	3	1.33	2	.59
Smothered			1	.29
Broken neck			1	.29
Unknown	19	8.48	12	3.58

The data of the third lot of birds fed dry feed number 2 follow:

	<u>Wet Feed</u>	<u>Dry Feed</u>
		<u>Number 2</u>
Date of hatch	July 12	July 12
Date birds put into brooder houses	July 12	July 12
Total number birds	219	315
Number of houses	2	3
Number birds per house	1-106; 1-113	105
Date taken out of houses	August 24	August 24
Days brooded	43	43

Birds were weighed at the end of the brooding period.

The weight record follows:

	<u>Wet Feed</u>	<u>Dry Feed Number 2</u>
Date weighed	August 24	August 24
Age of birds	43 days	43 days
Number birds weighed	100 (one house plus birds from another to make 100) (weighed in lots of 10 each)	100 (one house plus birds from another to make 100) (weighed in lots of 10 each)
Weights of individual lots (pounds)		
(10 birds)	4.19	5.66
(10 birds)	4.46	6.12
(10 birds)	5.08	6.60
(10 birds)	4.89	6.37
(10 birds)	3.82	6.46
(10 birds)	4.28	5.82
(10 birds)	4.32	5.90
(10 birds)	4.86	6.11
(10 birds)	4.93	5.43
(10 birds)	4.63	6.01
Total weight (100 birds)	45.46	60.48
Average weight per lot	4.54	6.04
Average weight per bird	.454	.604

The mortality record for the brooding period follows:

	<u>Wet Feed</u>		<u>Dry Feed Number 2</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Number birds put into houses	219		315	
Total mortality	36	16.40	29	9.18
Causes:				
Accident	2	.91	2	.63
Crooked neck	5	2.27	4	1.26
Slipped tendon	2	.91		
Cripples	5	2.27		
Digestive disorder			1	.31
Unknown	22	10.04	22	6.98

DRY FEED NUMBER 3 (24% protein) - The data of the experiment follow:

	<u>Wet Feed</u>	<u>Dry Feed Number 3</u>
Date of hatch	July 21	July 21
Date birds put into brooder house	July 22	July 22
Number of houses	1	1
Number birds per house	123	122
Date birds taken out of house	September 2	September 2

As will be seen in the following mortality record for the brooding period, a number of the birds fed dry feed number 3 developed slipped tendons. By the time the birds were eighteen days old (August 9), six birds with slipped tendons had been killed, and a number of others were beginning to show leg weakness and enlargement of the joints. For this reason a gradual change was made to dry feed number 2, beginning August 9. By the end of the brooding period this condition apparently had been corrected, as no birds at that time showed pronounced signs of slipped tendons. In the previous feeding experiments, none of the birds in the seven houses fed dry feed number 2 or in the one house fed dry feed number 1 developed slipped tendons. The birds on dry feed number 3 at the time that the change of feed was made, eighteen days of age, did not have the uniformity of size and smoothness of feathering characteristic of the seven houses fed dry feed number 2 and the one house fed dry feed number 1.

The mortality record for the brooding period of the birds fed dry feed number 3 follows in detail, with dates and causes of mortality given:

<u>Date</u>	<u>Wet Feed</u>	<u>Dry Feed Number 3</u>
July 25		1 (cripple)
July 25		2
July 26	1	
July 27	1	
July 28	4 (colds)	1 (crooked neck)
July 29	7 (colds)	
July 30	6 (colds)	
July 31	1	
August 2	1	
August 4	1	
August 5		1 (cripple)
August 7		1 (crooked neck)
August 7		2 (slipped tendons)
August 8	1 (crooked neck)	
August 9		4 (slipped tendons)
August 9		Changed to dry feed number 2
August 10		1
August 11	2	
August 15	1	
August 22		1 (cripple)
September 2	4	1 (crooked neck)
Total	30	15

The following gives the mortality for the brooding period, grouped according to causes and per cent of each:

	<u>Wet Feed</u>		<u>Dry Feeds</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Number birds put into houses	123		122	
Total mortality	30	24.38	15	12.29
Causes:				
Slipped tendons			6	4.91
Colds	17	13.82		
Crooked neck	1	.81	3	2.46
Cripples			3	2.46
Unknown	12	9.75	3	2.46

Birds were weighed at the end of the brooding period.

The weight record follows:

	<u>Wet Feed</u>	<u>Dry Feeds</u>
		<u>Numbers 3 & 2</u>
Date weighed	September 2	September 2
Age of birds	43 days	43 days
Number birds weighed	100 (one house plus birds from another to make 100) (weighed in lots of 10 each)	100 (from one house) (weighed in lots of 10 each)
Weights of individual lots (pounds)		
(10 birds)	4.84	5.75
(10 birds)	5.64	5.87
(10 birds)	5.09	6.14
(10 birds)	5.06	6.32
(10 birds)	5.47	5.97
(10 birds)	4.75	5.60
(10 birds)	4.22	5.60
(10 birds)	5.04	5.65
(10 birds)	4.70	5.45
(10 birds)	4.98	4.96
Total weight (100 birds)	49.79	57.31
Average weight per lot	4.97	5.73
Average weight per bird	.497	.573

A summary of the feeding experiments follows:

	<u>Wet Feed</u> <u>(Check Pens)</u>	<u>Dry Feed</u> <u>Number 1</u>	<u>Dry Feed</u> <u>Number 2</u>	<u>*Dry Feeds</u> <u>Numbers 3 & 2</u>
Summary of hatching				
Data:				
Total number birds put into houses	819	127	782	122
Number of birds - date hatched	125-May 14 128-May 30 224-July 10 219-July 12 123-July 21	127-May 14	131-May 30 336-July 10 315-July 12	122-July 21
Number of houses	7	1	7	1
Summary of weight records (weights at end of brooding period):				
Total number birds weighed	521	123	323	100
Number birds - age when weighed	107-44 days 200-43 days 214-42 days	123-44 days	100-43 days 223-42 days	100-43 days
Total weight (pounds)	238.34	75.84	191.58	57.31
Average weight per bird (pounds)	.457	.616	.593	.573

	Wet Feed (Check Pens)		Dry Feed Number 1		Dry Feed Number 2		*Dry Feed Numbers 3 & 2	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Summary of mortality Records (mortality at end of brooding period):								
Number birds put into houses	819		127		782		122	
Total mortality	127	15.46	5	3.91	62	7.89	15	12.29
Causes:								
Materials (as wild carrot, grass root) lodged in crop or gizzard	8	.97	1	.78	1	.12		
Accident	4	.48	1	.78	4	.51		
Cannibalism	3	.36						
Crooked neck	12	1.46	1	.78	10	1.28	3	2.46
Slipped tendons	3	.36					6	4.91
Cripples	8	.97			2	.25	3	2.46
Digestive disorder	5	.61			2	.25		
Colds	17	2.07						
Smothered					1	.12		
Broken neck					1	.12		
Unknown	67	8.18	2	1.57	41	5.24	3	2.46

	Wet Feed (Check Pens)		Dry Feed Number 1		Dry Feed Number 2		*Dry Feed Numbers 3 & 2	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Summary - age at which mortality occurred during brooding period:								
Number birds put into houses	819		127		782		122	
Total mortality	127	15.46	5	3.91	62	7.89	15	12.29
Mortality during first week of brooding period	26	3.17	1	.78	38	4.87	4	3.30
Second week	49	5.89	2	1.57	7	.89		
Third week	15	1.83	1	.78	5	.63	9	7.37
Fourth week	14	1.70			3	.39		
Fifth week	11	1.34	1	.78	3	.39	1	.81
Sixth week	12	1.44			6	.72	1	.81

*NOTE: Birds on dry feed number 3 were gradually changed to dry feed number 2, beginning at 18 days of age because a number had developed slipped tendons.

These experiments indicated that pheasants can be raised on exclusive dry feed with more rapid gain in weight and lower mortality than on the wet feed ration.

Dry feed number 3 proved unsatisfactory as the birds which were fed this feed had a strong tendency toward the development of slipped tendons.

Dry feeds numbers 1 and 2 produced very good results. Dry feed number 1 produced satisfactory growth, uniformity of size, and a low mortality comparable to those of dry feed number 2, but because of cost and distant location of the feed source of the former, dry feed number 2 was considered as the best. It produced very satisfactory results as pertained to rate of growth, rapidity of feathering, low mortality, and activity and wariness of the birds.

In comparison with the birds on the wet feed ration, the birds fed dry feed number 2 were characterized by uniformity of size consistently throughout the flocks, more rapid growth (.593 pounds average weight per bird at the end of the brooding period as compared to .457 pounds), smoothness of feathering (feathering out at an earlier age), lower mortality (7.89 per cent at the end of the brooding period as compared to 15.46 per cent), and greater activity not as apparent in the birds fed the wet feed ration.

The birds on the wet feed ration were not as uniform in size as those fed the exclusive dry feed, probably

because the rule "first come, first served" applied here; the larger birds had first chance and the smaller ones were crowded out, even though sufficient feeding space were provided. The dry feed birds were more active and flighty; they ate when no one was around. The hoppers were filled only once a day. In the case of the wet feed, which was fed three times daily, the birds associated the coming of the feeder and his buckets with something to eat and would flock into the house whenever he appeared. This hand feeding would undoubtedly tend to make the birds tamer. The necessity for this was eliminated in the exclusive dry feed pens.

The use of dry feed eliminated the labor necessary in the preparation of the wet feed and scraping of feed boards before each feeding, reduced the number of feedings to one instead of three times daily, and lessened the danger from spoiled feed which is always more or less prevalent when a moist mash is used. Especially is this true during warm weather.

The exclusive dry feed number 2 (26 per cent protein) as used in these experiments proved superior to the wet feed ration for the following reasons:

1. It produced more rapid gain in weight and lower mortality.
2. It produced uniformity of size consistently throughout the flocks.

3. It produced greater smoothness of feathering, with the birds feathering out at an earlier age.

4. It produced greater activity and wariness.

5. It required no preparation and greatly lessened labor in feeding.

6. It lessened the danger from spoiled feed which is always more or less prevalent when a moist mash is used.

Additional Brooder Data. Complete mortality records during the six weeks brooding period were kept for all hatches during both seasons--1936 and 1937. The causes of mortality and the per cent due to each cause were listed.

The following tables give the mortality record for hatches during the 1936 season.

Classification (1936 season)

Date of hatch	May 10	May 13	May 16	May 18	May 21	June 3	June 6
Number birds put into brooder houses	413	338	459	328	347	363	237
Number days brooded	43	43	42	42	40	42	42
	<u>No.</u> <u>%</u>						
Total mortality	68 16.4	41 12.1	58 12.6	50 15.2	40 11.5	45 12.3	52 21.9
Causes:							
Accident	2 .48	3 .88	2 .43	2 .60		2 .55	
Cannibalism	4 .96	3 .88					1 .42
Crooked neck-	2 .48	5 1.47	10 2.17	18 5.48	9 2.59	13 3.58	10 4.21
Cripples	33 7.99	5 1.47	3 .65	5 1.52	3 .86	4 1.10	8 3.37
Digestive dis-							
order	3 .72	6 1.77	4 .87	4 1.21	10 2.88	6 1.65	4 1.66
Weak legs		3 .88					
Smothered		1 .29	2 .43				
Unknown	24 5.81	15 4.43	37 8.06	21 6.40	18 5.18	20 5.50	29 12.23

Classification (1936 season)

Date of hatch	June 26	June 29	July 2	*July 5	**July 7	July 8
Number birds put into brooder houses	539	492	536	533	512	430
Number days brooded	42	42	42	43	41	42
	<u>No.</u> <u>%</u>					
Total mortality	129 23.9	110 22.35	89 16.60	70 13.1	182 35.54	148 34.4
Causes:						
Accident			2 .37	1 .18	3 .58	
Cannibalism		2 .40		2 .37	16 3.12	1 .23
Crooked neck	21 3.89	12 2.43	13 2.42	7 1.31	2 .39	5 1.16
Cripples	3 .55	6 1.21	7 1.30	3 .56	2 .39	6 1.39
Digestive disorder	5 .92	3 .60	3 .55	4 .75	4 .78	3 .69
Weak legs					6 1.17	6 1.39
Smothered						
Unknown	100 18.55	87 17.68	64 11.94	53 9.94	149 29.10	127 29.53

NOTE: *July 5 hatch consisted of 563 birds of which 533 were put into the electric brooder houses and 30 into a feather brooder for experimental purposes.

** These birds were hatched from Game Farm eggs July 7 at a turkey ranch near Corvallis and brought to the Eugene Game Farm July 8 to be brooded.

The summary of the mortality at the end of the brooding period and its causes for the 1936 season follows:

<u>Classification</u>	<u>Number</u>	<u>Per cent</u>
*Number birds put into brooder houses	5,527	
Total mortality	1,082	19.5
Causes:		
Accident	17	.30
Cannibalism	29	.52
Crooked neck	127	2.29
Cripples	88	1.59
Digestive disorder	59	1.06
Weak legs	3	.05
Smothered	15	.27
Unknown	744	13.46
Total	1,082	19.54
Birds taken to holding pens at end of brooding period	4,328	78.30
Birds unaccounted for (escaped)	117	2.11
Totals	5,527	99.95

*NOTE: Includes the 512 birds hatched at a turkey ranch near Corvallis July 7 and brought to the Eugene Game Farm July 8 to be brooded. Excludes the 30 chicks from the July 5 hatch which were put into the feather brooder for experimental purposes.

The following tables give the mortality record for hatches during the 1937 season.

Classification (1937 season)

Date of hatch	May 14	May 22	May 25	May 28	May 30	June 2	June 9
Number birds put into brooder houses	505	550	639	348	644	630	513
Number days brooded	43	43	42	42	42	42	42
Total mortality	$\frac{\text{No.}}{49}$ $\frac{\%}{9.7}$	$\frac{\text{No.}}{68}$ $\frac{\%}{12.3}$	$\frac{\text{No.}}{95}$ $\frac{\%}{14.8}$	$\frac{\text{No.}}{34}$ $\frac{\%}{9.7}$	$\frac{\text{No.}}{69}$ $\frac{\%}{10.7}$	$\frac{\text{No.}}{63}$ $\frac{\%}{10.0}$	$\frac{\text{No.}}{33}$ $\frac{\%}{6.4}$
Causes:							
Materials (as wild carrot, grass root) lodged in crop or gizzard	12 2.37	11 2.00	11 1.72	7 2.01	5 .77	3 .47	5 .97
Accident	6 1.18	3 .54	3 .46	2 .57	2 .31	3 .47	7 1.36
Cannibalism	4 .79	8 1.45	8 1.25	1 .28	29 4.50	20 3.17	6 1.16
Crooked neck	2 .39	4 .72	4 .62	3 .86	2 .31	4 .63	4 .77
Slipped tendons	2 .39						
Cripples	1 .19	4 .72	1 .15	7 2.01	2 .31	3 .47	1 .19
Digestive disorders	1 .19	2 .36			1 .15		1 .19
Colds		6 1.08	8 1.25				
Weak legs		1 .18					
Chilled							
Small, undeveloped birds							
Blind							
Broken neck							
Broken leg							
Smothered							
Injured eye							
Unknown	21 4.15	29 5.27	60 9.38	14 4.05	28 4.34	30 4.76	9 1.75

Classification (1937 season)

Date of hatch	July 2	July 10	July 12	July 16	July 21	July 28	August 1
Number birds put into brooder houses	462	560	534	409	491	277	444
Number days brooded	42	41	43	42	42	45	41
	<u>No.</u> <u>%</u>						
Total mortality	88 19.0	56 10.0	65 12.1	75 18.3	99 20.1	116 41.8	104 23.4
Causes:							
Materials (as wild carrot, grass root) lodged in crop or gizzard	1 .21	1 .17					
Accident	2 .43	3 .53	4 .74	1 .24	3 .61		1 .22
Cannibalism							
Crooked neck	4 .86	9 1.60	9 1.68	8 1.95	7 1.42	4 1.44	3 .67
Slipped tendons	1 .21		2 .37		7 1.42	1 .36	
Cripples	4 .86	5 .89	5 .95	9 2.20	5 1.01	6 2.16	1 .22
Digestive disorder	3 .64	5 .89	1 .18	4 .97		5 1.80	2 .45
Colds				27 6.60	25 5.08		
Weak legs	9 1.94			2 .48		2 .72	1 .22
Chilled						75 27.07	
Small, undeveloped birds	29 6.27						
Blind	1 .21						
Broken neck		1 .17		1 .24			1 .22
Broken leg				1 .24	2 .40	1 .36	
Smothered		1 .17					13 2.92
Injured eye							2 .45
Unknown	34 7.40	31 5.53	44 8.23	22 5.37	50 10.18	22 7.94	80 18.01

NOTE (Tables on pages 72 and 73) - Some birds from each hatch were put into feather brooders for the six weeks brooding period.

The May 28 and July 28 hatches were hatches in the forced-air circulation incubator; the rest were hatches in the still-air incubators.

July 2 hatch - The small, undeveloped birds in this hatch were killed at three weeks of age. The power went off during a thunderstorm while this incubator was hatching. The birds in the July 2 hatch did not have the vitality of the other hatches.

The summary of the mortality at the end of the brooding period and its causes for birds hatched in the still-air incubators for the 1937 season follows:

<u>Classification</u>	<u>Number</u>	<u>Per cent</u>
Number birds put into brooder houses	6,381	
Total mortality	864	13.46
Causes:		
Materials (as wild carrot, grass root) lodged in crop or gizzard	49	.76
Accident	38	.59
Cannibalism	75	1.17
Crooked neck	60	.94
Slipped tendons	12	.18
Cripples	41	.64
Digestive disorder	20	.31
Colds	66	1.03
Weak legs	13	.20
Small, undeveloped birds	29	.45
Blind	1	.01
Broken neck	3	.04
Broken leg	3	.04
Smothered	14	.21
Injured eye	2	.03
Unknown	438	6.86
Total	864	13.46
Birds taken to holding pens at end of brooding period	5,460	85.56
Birds unaccounted for (escaped)	57	.89
Totals	6,381	99.91

The summary of the mortality at the end of the brooding period and its causes for birds hatched in the forced-air circulation incubator (May 28 and July 28 hatches) for the 1937 season follows:

<u>Classification</u>	<u>Number</u>	<u>Per cent</u>
Number birds put into brooder houses	625	
Total mortality	150	24.00
Causes:		
Materials (as wild carrot, grass root) lodged in crop or gizzard	7	1.12
Accident	2	.32
Cannibalism	1	.16
Crooked neck	7	1.12
Slipped tendons	1	.16
Cripples	13	2.08
Digestive disorder	5	.80
Chilled	75	12.00
Weak legs	2	.32
Broken leg	1	.16
Unknown	36	5.76
Total mortality	150	24.00
Birds taken to holding pens at end of brooding period	469	75.04
Birds unaccounted for (escaped)	6	.96
Totals	625	100.00

As will be seen in the two preceding tables, the average mortality of the hatches from the forced-air circulation machine was greater than that of the hatches from the still-air incubators. However, this increase in mortality can not be laid wholly to the fault of the incubator, because some of the birds in the July 28 hatch became chilled and losses occurred, as seen in the mortality record under the heading "chilled". The May 28 hatch in the forced-air circulation machine had a low mortality comparable to that of hatches in the still-air machines. It is doubtful if the fact that the birds were hatched in the forced-air circulation machine would have any effect on the resultant product, except of course as is obvious that the better the

hatch, the better will be the chicks.

The summary of the mortality at the end of the brooding period and its causes for birds hatched in all incubators during the 1937 season follows:

<u>Classification</u>	<u>Number</u>	<u>Per cent</u>
*Number birds put into brooder houses	7,006	
Total mortality	1,014	14.16
Causes:		
Materials (as wild carrot, grass root) lodged in crop or gizzard	56	.79
Accident	40	.57
Cannibalism	76	.85
Crooked neck	67	.95
Slipped tendons	13	.18
Cripples	54	.77
Digestive disorder	25	.35
Colds	66	.94
Weak legs	15	.21
Chilled	75	1.07
Small, undeveloped birds	29	.41
Blind	1	.01
Broken neck	3	.04
Broken leg	4	.05
Smothered	14	.19
Injured eye	2	.02
Unknown	474	6.76
Total	1,014	14.16
Birds taken to holding pens at end of brooding period	5,929	84.62
Birds unaccounted for (escaped)	63	.89
Totals	7,006	99.67

*NOTE: Of the 8,374 chicks hatched during the 1937 season 7,006 were brooded with electric brooders. The remainder or 1,368 plus 8 additional chicks hatched from eggs in the wild were put into feather brooders for the six weeks brooding period, making a total of 8,382 chicks brooded on the farm.

SUMMARY AND CONCLUSIONS

Ring-necked pheasants can be raised very successfully by artificial incubation and brooding. The variety of pheasant raised at the State Game Farms in Oregon on a commercial scale is not the pure Chinese ring-necked pheasant, but a mixture of the Chinese and Mongolian varieties. The Corvallis State Game Farm is the present location of Oregon's artificial incubation and brooding unit for the propagation of ring-necked pheasants for liberation.

The ratio of cocks to hens during the breeding season was maintained at approximately 1:6. During the 1937 season the breeding birds were brailed and kept in large open pens. The laying season began shortly after the first of April and extended to about the middle of July.

Five electric still-air incubators and one forced-air circulation machine were in use during the 1936-37 seasons. Two of these incubators were hot-water and four were hot-air machines. They each were of 540 hen-egg capacity. The still-air machines held 880 pheasant eggs and the forced-air circulation machine 825 eggs. The egg trays were covered with one-eighth inch mesh hardware cloth.

Experiments in artificial incubation and brooding of ring-necked pheasants were carried on to determine the most suitable incubation conditions and brooding practices to be followed. It was necessary to perform these experiments

in conjunction with the general seasonal production of pheasants, and the results were necessarily included in the seasonal report.

Operation of the still-air machines at a temperature of 102° Fahrenheit throughout the incubation period with a moisture of 84° wet bulb temperature was found to produce best hatching results. The forced-air circulation machine was run at 100° Fahrenheit for one hatch and 99° Fahrenheit for another for experimental purposes.

The eggs were culled and sorted for the following physical defects: cracks, metallic shells, small size, irregular or odd shapes, thin shells, and very light shell color. Eggs of various shapes, colors, and shell texture were set as an experiment to determine the relative hatchability of these different groups. Results indicated the importance of culling the eggs to obtain better hatching results; particularly was this true of the egg group, metallic shells.

The eggs were turned twice daily beginning the fourth day of incubation and three times daily on the ninth day and thereafter. They were tested on the eighth and nineteenth days for fertility and dead germs. No cooling of eggs was practiced. The incubators were closed on the twentieth day for hatching.

It is desirable to set the eggs as soon as possible in order to reduce the time for holding to a minimum.

Keeping the eggs only two or three days is very desirable, as each additional day elapsing before setting decreases hatchability. If possible, the eggs should not be held for a longer period than a week.

The birds were brooded at the Eugene Game Farm in stationary houses, each nine feet by nine feet in size with a wire-covered cement run and an additional runway onto a clover plot. The brooder houses at the Corvallis Farm were portable, each 10 feet by 12 feet in size with a wire-covered yard 24 feet by 24 feet in size. Allowing one square foot of floor space per bird proved to be the optimum.

The birds were brooded in the brooder houses for a period of six weeks; they were then taken to the holding pens on the Farm. An electric radiant-heat type of brooder was used. The temperature under the brooder was maintained at 98° to 100° Fahrenheit for the first two weeks of the brooding period, then lowered to 95° Fahrenheit and gradually cut at the rate of three degrees every two days until it was 75° Fahrenheit when the birds were five weeks old. This temperature was varied to a certain extent according to weather conditions, the primary purpose being to keep the chicks comfortable.

Finely ground peat moss was considered a very satisfactory litter and superior to straw.

A wet feed, crumbly moist, comprised the basic portion

of the feeding ration during the brooding period. This was composed of a commercial "chick starter mash", 50 per cent; "pheasant meal", 10 per cent; chopped lettuce or onion tops, etc., 20 per cent; curd, 10 per cent; hard boiled egg, 5 per cent; and ground boiled liver, 5 per cent. This was fed three times daily on feed boards, which were scraped each time before the next feeding. In addition dry "chick starter mash" and water were kept before the birds. When the chicks were ten days old, chick scratch, charcoal, and commercial grit were added to the ration. Gravel was kept before the birds in the yards. Green feed (lettuce) was also supplied. Whole wheat was fed when the birds were five weeks old and a "developing mash" was gradually substituted for the "starter mash".

Experiments in feeding showed that pheasants can be raised on exclusive dry feed with more rapid gain in weight and lower mortality than on the wet feed ration. The dry feed ("pellets") with a protein content of 26 per cent by analysis, designated as dry feed number 2 in this report, proved superior to the wet feed ration. With the exclusive dry feed the birds were fed only once daily. They were given water and green feed (lettuce) as with the wet feed ration. Commercial grit was added when the birds were ten days old and chick scratch when they were three weeks old. Gravel was kept in the yards. When the chicks were five weeks old, "developing pellets" were substituted

for the "starter pellets" and whole wheat was added. In comparison with the birds on the wet feed ration, the birds fed the exclusive dry feed number 2 were characterized by more rapid growth, lower mortality, uniformity of size, smoothness of feathering, and greater activity and wariness not as apparent in the birds fed the wet feed ration. The use of exclusive dry feed eliminated the labor necessary in preparing the wet feed and scraping the feed boards before each feeding, reduced the number of feedings to one instead of three times daily, and lessened the danger from spoiled feed which is always more or less prevalent when a moist mash is used.

Results on the fertility and hatchability of eggs from incubator-hatched and hen-hatched breeding birds were recorded. No difference was noted between the relative merits of the two groups of birds as breeders. The eggs from both groups produced very similar hatching results as pertained to fertility, dead germ tests, dead in shell, cripples, and per cent net or total hatch.

The forced-air circulation machine did not give as high an average hatch as did the still-air machines. It is planned to experiment further during the 1938 season by incubating eggs in the forced-air circulation machine and transferring them to a still-air machine for the hatching period, a procedure which has proven popular to poultrymen and turkey raisers. The conclusions drawn as to the

hatching results in the forced-air circulation machine apply only to this particular forced-air circulation machine and are not indicative of such machines in general as the machine used was of small capacity and the number of eggs set limited.

The fertility of the eggs at the first and last of the season was approximately the same with a high point reached during the middle of the season. Likewise the same was true with the hatchability of the eggs.

The average fertility in the brail pen for the 1937 season was 92.1 per cent with a high peak of 95.1 per cent reached in the early part of June. At this time the eggs hatched from 85 to 90 per cent of fertile eggs.

A brief summary of the hatching and brooding data for the 1936-37 seasons follows (results of experiments performed throughout the two seasons were necessarily included in the seasonal summary):

1936 season:

Total number eggs set	10,094
Average per cent infertile	12.5
Per cent net hatch of total eggs set	49.9
Per cent net hatch of fertile eggs	57.1
Maximum per cent net hatch of total eggs set (July 5 hatch)	63.9
Maximum per cent net hatch of fertile eggs (July 5 hatch)	73.2
Average per cent mortality at the end of the brooding period	19.5
Minimum mortality at the end of the brooding period (May 21 hatch - 347 chicks brooded)	11.5

1937 season:

Total number eggs set	12,198
Average per cent infertile	8.3
Still-air incubators:	
Per cent net hatch of total eggs set in the still-air incubators	71.7
Per cent net hatch of fertile eggs	78.0
Maximum per cent net hatch of total eggs set (May 25 hatch)	82.8
Maximum per cent net hatch of fertile eggs (May 25 hatch)	88.7
Forced-air circulation incubator:	
Per cent net hatch of total eggs set in the forced-air circulation incubator (2 hatches)	48.7
Per cent net hatch of fertile eggs (2 hatches)	54.2
Maximum per cent net hatch of total eggs set (May 28 hatch)	51.8
Maximum per cent net hatch of fertile eggs (May 28 hatch)	56.8
All incubators:	
Per cent net hatch of total eggs set in all incubators	68.7
Per cent net hatch of fertile eggs	74.8
All hatches:	
Average per cent mortality at the end of the brooding period	14.16
Minimum mortality at the end of the brooding period (June 9 hatch - 513 chicks brooded)	6.4

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