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Seasonal Variation in Egg Quality

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This investigation was designed to measure variation in quality of eggs throughout the year. Physical characteristics—egg weight, shell thickness, albumen height, volume of thick and thin albumen, and blood and meat spots—were measured in whole and broken samples.

REVIEW OF LITERATURE

Apparently, Parker, Gossman, and Lippincott (1926) were the first to investigate the effect of season on egg quality. These investigators found no definite seasonal trend in yolk color of eggs laid by birds on a uniform ration and held in confinement. Hunter, Van Wagenen, and Hall (1936) and Wilhelm (1938) confirmed the results of Parker *et al.*

Effect of Season and Temperature on Egg Weight.

Jull (1924) found an increase in egg weight from December through February; from February to April, there was a gradual decrease; and from April through September the egg weight remained low. Egg weight increased again in October and November.

Bennion and Warren (1933) noted a sharp decline in egg size when the temperature rose above 85° F. The average egg size decreased 15 to 20 percent under higher temperatures. The decrease in egg size was much faster at high temperatures than the rate of increase under low temperatures.

Funk and Kempster (1934) reported that eggs of maximum weight were produced during the months of February and March while smaller eggs were laid during the summer months of June, July, and August. They reported a tendency for the domestic fowl to lay larger eggs during the natural breeding season if hatched during the previous spring months.

Bruckner (1936) reported that heating a room in which the layers were kept to a mean temperature of 65° F tended to reduce egg size.

Warren (1939) collected data from various experiment stations of the world. In most instances, egg size increased rapidly for the first few months as a result of approaching physiological maturity. Low temperatures did not appear to have any effect on egg size; but after the daily maximum temperatures exceeded 70° F for a period of a few days or more, egg size fluctuations usually showed a close relationship with temperatures. In countries where summer temperatures were high, the summer egg weight was greatly depressed; and the bird was prevented from expressing its maximum possible egg size. If temperature dropped below 70° F, the egg size increased rapidly indicating there was no fatiguing effect as a result of a long period of production.

Jeffrey (1941) found that January and April hatched pullets produced a higher percentage of large eggs. November and January hatched pullets produced more pullet and pewee eggs than did birds hatched in April, June, and September. Jeffrey concluded from his work that egg weight of birds of the same breeding at any particular time was determined by the interaction of age, temperature, and body size. Jeffrey and Platt (1941) found if birds had not reached large egg size before the advent of hot weather they tended to have trouble reaching it on a yearly basis.

Warren *et al.* (1950) kept birds under closely controlled climatic conditions. Their data indicated that a constant temperature of 65° F was more favorable in two of three summers for maximum egg weight. Egg size was smaller under constant 65° F temperature than in uncontrolled environments in the winter. This work disagrees with the earlier work of Warren (1939) in which 70° F was found to be the point affecting maximum egg size.

Skoglund *et al.* (1951), on the basis of a two-year study, reported that hatches with the best egg weights were those starting production during the *cool months.* This was in agreement with the earlier work of Jeffrey (1941).

Hutchinson (1953) concluded that short periods of heat stress above 99° F from 107 to 214 minutes would reduce egg weight. The reduction was greater than when the birds lived continuously in a warm climate of 85° F or 90° F during the day and 80° F at night. Strain and Johnson (1957) reported that eggs laid by pullets hatched in February and March increased in size from October to June.

The Effect of Season and Temperature on Egg Shell Thickness.

Jull (1924) reported a seasonal trend in shell thickness. His work showed the percentage of shell in relation to whole egg increased through February. There was a tendency for percentage of shell to decrease from February through May, with an upward trend the rest of the year.

Miller and Bearse (1934) observed a seasonal trend in degree of smoothness, mottling, and percentage of shell of total egg weight. The average percent of shell declined from December to October as did the shell smoothness index. These workers reported the egg shell quality of the individual hen retains its relative position with respect to the egg shell quality throughout the year.

Blasket *et al.* (1937) obtained maximum shell strength in March, after which there was a progressive weakening of the shell until July. After the low point in July, shell strength improved until another maximum shell strength was reached in October.

Conrad (1939) found that when the temperature was raised from 70° F to 90° F the blood calcium level decreased 25 to 30 percent. He concluded, therefore, that the decreased blood calcium was the chief cause of thinner egg shells during the summer months.

Wilhelm (1940) observed a definite correlation between shell thickness and maximum temperature. The average shell thickness increased from October through March. After March a steady decline in shell thickness was encountered until the end of the experiment in September. Wilhelm concluded that shell thickness was significantly correlated with percentage of shell, total egg weight, and dry weight of the shell, and was not independent of egg weight.

Warren and Schnepel (1940), using a somewhat controlled environmental room, found a striking decrease in shell thickness at a temperature of 90° F. The decrease in shell thickness as a result of increased temperatures was immediate; there was always a recovery of shell thickness, although less rapid, when the temperature was lowered. These workers also observed a corresponding decrease in blood calcium as the temperature increased.

Berg *et al.* (1944) reported the data contrary to the earlier work of Warren and Schnepel (1940) and Wilhelm (1938). In this study, there was a decrease in shell thickness which started during the early spring months before the average maximum daily temperatures were greater than 65° F. Since there was a gradual thinning of the shells with practically no change in average maximum temperature, it would appear as if factors in addition to changes in temperature were responsible for the production of thinner shells during the summer months.

Heywang (1946) found an association between thin shells and high temperatures. He also compared different sources of calcium in hot weather; none were observed to be superior in preventing a decline in shell thickness.

Berg and Bearse (1947) presented data that showed egg shells becoming smoother and thicker following a forced molt. It was questionable, however, whether improvement was due to the rest provided by the molt or to decreased temperatures following the molt.

Warren *et al.* (1950) studied egg quality characteristics under rather closely controlled environmental conditions. Birds in controlled 65° F environment produced eggs with thicker shells during the summer. The birds in the controlled environment produced thinner shells in the winter than the birds in uncontrolled conditions. This indicated that 65° F was above optimum temperature for shell production. These workers concluded that, although temperatures do depress shell thickness, some of the thinning is due to metabolic changes in the bird itself.

Pope and Watts (1955) measured the percent shell and specific gravity of the whole egg. Spring hatched pullets came into production with high shell quality and continued producing eggs with high shell quality until February.

After February shell quality decreased. Fall hatched pullets began producing eggs with poor shell quality and continued to do so until December. In December, environmental temperatures dropped below 70° F. Johnson and Merritt (1955), using specific gravity as a measurement, observed a steady decline in specific gravity from November to July and August.

The Effect of Season and Temperature on Albumen Quality.

Knox and Godfrey (1934) reported a seasonal variation in interior quality with the poorest eggs being produced in June.

Hunter *et al.* (1936) observed the interior quality of fresh eggs produced under constant management conditions. They found that the eggs of highest quality were produced from November to March; and beginning with March or April, a decline was noted, continuing through the summer months.

Wilhelm and Heiman (1938) used yolk color and albumen index as measurements of interior quality. These investigators observed a constant drop in egg quality from the time the hen came into production until a low point was reached in July. After July there was a slight improvement in egg quality. These workers could not directly associate temperature in the pen with albumen quality.

Jeffrey (1941) reported a progressive decrease in albumen index throughout the pullet year of lay.

Henderson *et al.* (1941), using albumen index as a criteria of egg quality, observed higher quality in March than in June or September.

Lorenz and Newlon (1944) made a survey of 38 ranches in five counties of the state of California. Their studies indicated the greatest loss in quality occurred during the first 24 hours after an egg was laid. Observations also showed higher quality eggs being produced by pullets than by hens. A significant seasonal trend was attributed partly to increased age of the flock and partly to more severe environmental conditions.

Berg and Bearse (1947) studied the effect of forced molting on egg quality. After the molting period, the hens laid eggs with an average albumen index of 91, compared with 71 before molt. Following this period, the albumen index dropped steadily for 4 months. The average albumen index after forced molt never did approach the corresponding pullet index of 145.

Johnson and Cavers (1948) studied quality of eggs produced by various farm flocks. These workers concluded that much of the seasonal drop in egg quality, occurring on many farms, could be largely eliminated by proper methods of management.

Warren *et al.* (1950) found no consistent differences in albumen quality of eggs laid by hens in different environments. Birds in a controlled environment of 65° F showed a more consistent decline than birds in uncontrolled environments. Since quality declined in both controlled and uncontrolled environments, the decrease in quality was explained as being caused by factors within the hen herself; and these factors were acting independently of environment. Since much of the decline took place in the early part of the season, the factor was probably not a fatiguing effect.

Stadelman and Jensen (1951) observed that 83 percent, 90 percent, and 94 percent of all eggs marketed in spring, summer, and fall, respectively, were in the top two grades. The reason for the higher quality eggs in the summer was attributed to new pullets coming into production at that time. Using albumen index as a measurement, the effect of age was also studied and the following results were reported.

Age (Months)	*Albumen Index*
5 ½- 6 ½	123.4
7 - 8	116.5
9 -10	107.5
11 -13	92.8
17 -18	82.7
21 -22	84.1

The results above clearly indicate a decline in egg quality as the hen gets older. This work further confirms the earlier studies of Jeffrey (1941) and Lorenz and Newlon (1944).

Jensen and Stadelman (1952) measured 16,000 eggs as they moved through market channels. Their work showed that much of the summer decline in quality could be eliminated under proper handling conditions.

From two egg laying tests, Brant *et al.* (1953) measured eggs which were held for three days. In March an average Haugh unit of 76.1 was obtained; but in August, the Haugh units had dropped to an average of 69.5.

Sauter *et al.* (1954) reported winter eggs to be significantly superior to summer eggs in their keeping quality for 1 to 5 weeks at 72° F with respect to physical quality, functional properties, and flavor.

King and Hall (1955) found only 65 percent of the eggs produced in the fall graded AA on a broken out basis. By March the AA percentage was down to 40 and by June, it was no more than 20 percent.

Pope and Watts (1955) measured interior quality by Haugh units and observed a decrease in egg quality each succeeding month throughout the experimental period. Johnson and Merritt (1955), using albumen height as a measurement of albumen quality, reported a similar seasonal decline in egg quality.

Strain and Johnson (1957) reported that in eggs produced in Manitoba by layers that were hatched in February and March, albumen quality (Haugh units) declined an average of 7.1 units from October to February and 4.5 units from February to June.

Effect of Season on the Percentage of Thick Albumen.

Jull and Byerly (1934) stated that a pullet's first eggs were higher in percentage of thick white than the succeeding eggs. They explained this by suggesting that the hen's egg increased in weight of yolk and liquid white, whereas the weight of the firm white increased relatively little.

Knox and Godfrey (1934) reported that neither the number of eggs nor the weight of eggs had any significant influence upon percentage of thick albumen. It was noted, however, that as the pullet's laying year advanced from the fall of one year to the spring of the next, the percentage of thick albumen progressively decreased.

Hunter *et al.* (1936) considered 25 percent apparent thin albumen as indicative of a good quality egg. Most of their eggs from November through March were good or above average eggs. Beginning in April, there was a marked decline which reached its lowest point in July. There was a slight improvement in August and September.

Lorenz and Almquist (1936) gathered eggs within 15 minutes after being laid and held them at various temperatures for 24 hours. These workers found the percentage of firm white to be lowered by higher air temperatures during the hours immediately after the egg is laid, resulting in an apparent seasonal variation in internal egg quality. The increase in weight of liquid white of later eggs from the same bird was explained as likely due to the seasonal increase in temperature resulting in greater liquefaction of firm white. No interrelationship between percentage of firm white and egg size was indicated. These results were contrary to the earlier work of Jull and Byerly (1934).

Knox and Godfrey (1938) presented data showing a higher percentage of firm albumen during July and August than during May and June. These workers pointed out that the temperature was lower in June than in July and August. Pullets showed a gradual lowering of percentage of firm albumen from November to June. These researchers also compared percentages of thick albumen in eggs of pullets and hens; older hens were found to possess a higher percentage of thick albumen. Older hens followed a yearly trend similar to that of the pullets.

Ringrose and Morgan (1939) observed an increase in the percentage of firm albumen between January and May followed by a decrease in June. Paulhaus and Gwin (1940) reported similar results, noting a sharp decline of percentage of thick albumen in May and June.

Effect of Season and Temperature on Blood and Meat Spot Incidence.

Lerner and Smith (1942), obtaining blood spot incidence by candling, noted a lower percentage of blood spots before April 1 than after April 1.

Nalbandov and Card (1944) observed a decrease in blood spots with increasing age of the bird. Their results were as follows:

First year-44 percent
Second year-26 percent
Third year-22 percent

Eggs of hens kept in confinement were found to have twice as many blood spots in July as in December. Jeffrey (1945) observed a marked seasonal decline in the incidence of blood spots from December through August.

Lerner and Taylor (1947) conducted studies on birds in the pullet year of lay. They found that the blood spot incidence increased from the beginning of production to a June peak. After June the incidence dropped steadily until September.

Denton (1947) reported no seasonal differences in blood and meat spot incidence.

Warren *et al.* (1950) observed little difference in occurrence of blood spots in eggs from birds in controlled 65° F environment and those from birds in uncontrolled environments. There was a gradual increase in the incidence of blood spots in both groups during the latter part of the laying year. These workers concluded that physiological trends within the laying year, rather than season, probably influenced the incidence of blood spots.

Sauter *et al.* (1952) found percentage of blood spots to be lowest at the beginning of their experiment (mid-December), after which it increased to a peak in February or early March.

Johnson (1956) reported that the incidence of meat and blood spots increased from the first part of production (November-December) to the spring and summer months as follows:

		Percentage of Spots by Periods				
	Breed	Nov.-Dec.	Jan.-Feb.	March-April	May-June	July-August
Blood Spots	W.L.	1.93	4.67	8.07	13.79	12.52
	B.R.	2.08	3.56	5.28	8.31	5.81
Meat Spots	B.R.	5.85	13.92	25.02	25.83	25.21

Strain and Johnson (1957) reported a seasonal trend in meat and blood spots in eggs produced by Leghorn pullets hatched in February and March. The incidence of these spots was low during October and increased until the spring months and then declined in most groups.

Cage and Floor Layer Comparisons.

Jeffrey and Pino (1943) compared blood spot incidence of caged and floor birds. Their work showed eggs from caged birds to have a lower incidence of blood spots than those from birds kept on the floor. The incidence of blood spots in eggs of caged birds was 4.01 percent, compared with 11.09 percent for eggs of the birds raised on the floor. Jeffrey (1945) reported contradictory results when Rhode Island Reds in cages produced a higher percentage of blood spots than did the floor birds.

Gowe (1955) reported no significant differences in egg weight of caged and floor layers. Lower egg production was observed in the caged layers than in the birds on the floor.

Lowry *et al.* (1956) reported higher production in floor birds. The caged birds showed significantly lower mortality, heavier eggs, and a higher incidence of blood spots.

Grotts and Funk (1956) reported higher egg weight and increased incidence of blood spots in eggs of caged birds. Albumen quality and shell thickness were also studied, but no differences were observed in these characteristics.

EXPERIMENTAL PROCEDURE

1954-1955 Tests

The eggs were produced by April-hatched purebred White Leghorn pullets. The birds were reared together on range and housed in early September.

Twenty-five of the pullets were placed in a 10′ X 20′ open front floor pen where temperatures varied with outside weather conditions. Artificial lights were employed beginning October 1; the lighting period was increased 15 minutes a week until the pullets were receiving 14 hours of light a day. Trapnests were used for egg identification and production records.

Twenty-four pullets, full sisters to those housed on the floor, were placed in 10″ x 18″ x 15″ individual laying cages in a 20′ x 20′ basement. No attempt was made to control the temperature; although, the fluctuations were neither as rapid or as extreme as the temperature fluctuations in the floor pen. Artificial lights were left burning constantly. Eggs laid by the caged hens during the day remained in the "roll-out" wire trough at the front of the cage until about 4:00 p.m. when they were collected and identified in the same manner as the floor eggs. One caged bird died before egg measurements began. She was not replaced and no other mortality occurred in either group of birds during the year.

Both groups of birds received the same all-mash laying ration throughout the experiment.

Eggs were saved for measurements beginning on the first day of the month and continuing until the last day of the month when necessary. Measurement records on hens not laying nine eggs within the month were left incomplete rather than have the seasonal effect extend over too long a period. Measurements were taken in the months of October, December, February, April, June, September, and November.

All eggs collected during the day were taken to a 50° F holding room at about 4:30 p.m. There they were sorted and placed in one of the three holding conditions employed for this experiment.

Nine eggs from each hen in production in the season were observed. The first three eggs obtained were placed on filler flats and held for three days at 50° F before being broken out and measured. These are referred to in this report as *controls.* The next three eggs obtained from each hen were placed on filler flats in an incubator to be held for 10 days at 80° F. These are referred to as *heated* eggs. The third three eggs obtained from each hen were placed in a fiber case and held for 90 days at 30° F. These are referred to as *storage* eggs.

On the day that eggs were due for measurements they were removed from their holding environments and placed on the laboratory table. They were left on the table about three hours before breaking to allow them to adjust to room temperature.

Measurements obtained were: egg weight in grams, shell thickness, height of thick albumen, volume of thick albumen, volume of thin albumen, pH of thick albumen, and pH of thin albumen.

Egg weight was obtained immediately prior to breaking. A balance scale, accurate to 0.1 gram, was used. Each egg was then cracked on a knife edge and opened onto a level glass plate mounted on a four-legged stand. While the egg contents lay on the glass the height of the thick albumen was measured in mm. with a tripod micrometer described by Brant and Shrader (1952). A sharp edge was used to cut the thick albumen several times to permit escape of the inner thin albumen. The glass was tilted to pour the egg into a separator where the yolk was caught and discarded. The albumen was poured into a one-eighth inch wire mesh strainer which retained the thick albumen while allowing the thin albumen to pass through (Holst and Almquist, 1932) to be caught in a metal cup. Volumetric quantities were measured separately in a glass cylinder graduated in milliliters.

Shell thickness was measured with a paper gauge having rounded contact points. Only one measurement was taken, near the center section of the shell, with the membrane in place (Brant and Shrader, 1952). Thickness was recorded in thousandths of an inch.

The pH readings were obtained with glass electrodes (Sauter *et al.,* 1954). After each reading the electrodes were rinsed with distilled water and wiped dry with lens paper before taking the next reading.

Blood spot incidence was observed in five seasons, beginning with February. No distinctions were made as to size and every bright red spot was classified as a blood spot. Chi-square (Snedecor, 1953) was employed to test the seasonal trend and environmental differences of blood spot incidence.

Measurements obtained from a hen's group of three eggs held under each condition were averaged in every season. These averages were used to make all subsequent calculations.

The percentage of thick albumen was calculated from the volume measurements. Haugh units (Haugh, 1937) were determined according to the method described by Brant *et al.* (1951). Analysis of variance (Snedecor, 1953) was used to test the seasonal behavior of egg weight and Haugh units as well as differences between environments. The April eggs were not included in the analysis because the April storage eggs were not observed due to lack of assistance when they were to be broken out.

1955-1957 Tests

From November, 1955, through March, 1957, interior quality measurements were made on a total of 1563 eggs. Forty-eight April-hatched, Single Comb White Leghorns were used. On November 1, 1955, 24 of these pullets were housed in cages and 24 on the floor in the same room. Seventeen of the 24 pairs housed were full sisters. During the experiment, six of the caged birds and four of the birds on the floor died.

All birds were fed a medium high energy, all-mash ration containing 16 percent protein.

The room in which the layers were housed was a windowless, insulated 20′ x 20′ room. An overhead fan was installed in the ceiling to aid ventilation. Although this was not strictly a controlled environmental room, the temperature was maintained more uniformly than the normal laying pen. The temperature on the hottest summer days never exceeded 90° F in the room. In the winter, a heat unit in the room switched on automatically at 45° F. Light in the room was maintained on a 14-hour basis throughout the year.

The 24 caged layers were placed in 10″ x 18″ x 15″ individual laying cages. An 8′ x 10′ corner of the same room housed the 24 floor birds.

Beginning in November, eggs were broken in alternate months until March, 1957. From November through May, eggs were allowed to remain in the cages until 4:00 p.m. The floor birds were trapnested hourly and their eggs allowed to set on a filler flat in an outer egg room until 4:00 p.m. At 4:00 p.m., eggs from both groups were stored in a 55° F cooler.

Commencing in July, a new procedure of gathering was introduced. This new procedure involved gathering the eggs four times daily and placing them directly in a 55° F cooler.

Three eggs per hen per month were saved for measurements. The following measurements were made:

1. Egg weight in grams.
2. Shell thickness (thousandths of an inch).
3. Albumen height (mm.).
4. Volume of thick and thin albumen (ml.).
5. Blood and meat spots.

After three days of storage, eggs were taken directly from the cooler and observed for interior quality.

Egg weight was obtained to the nearest tenth of a gram on a simple trip balance. Immediately after obtaining the egg weight, the egg was broken with a breaking knife; the contents were placed on a flat glass plate supported by a metal stand.

Shell thickness was ascertained with a paper thickness gauge (Brant and Schrader, 1952). Measurements were made around the periphery of the shell in 3 places and the average was recorded in thousandths of an inch.

Albumen height was observed with a tripod micrometer as described by

Brant and Shrader (1952).

Volume of thick and thin albumen was obtained as reported by Holst and Almquist (1932). After the albumen height was determined, the thick albumen was cut with a knife, allowing the inner thin albumen to flow outwardly. The glass was tipped to about a 45° angle, permitting the egg to flow down and be caught by a yolk separator mounted over a mesh screen placed in a cup. The thin albumen passed on through the screen and the thick albumen remained in the screen. Volume was measured in milliliters in a glass cylinder. The percentages of thick albumen were determined from the volumes obtained.

All eggs were examined closely for blood and meat spots. Spots were considered blood spots only when they were bright red in color. Any other spots were recorded as meat spots. Blood or meat spots smaller than one-eighth inch were reported as "small" and those larger than one-eighth inch were reported as "large".

A total of 1,398 eggs were broken for comparison of blood and meat spot incidence in caged and floor layers. Eggs from the following hatches were used in this study.

Hatch Date	*Months Included*
April, 1954	May, 1956 and July, 1956
April, 1955	May, 1956 through March, 1957 (alternate months)
April, 1956	September, 1956 through March, 1957 (alternate months)

All of these birds represent full sister comparisons.

The April, 1955, hatch was employed in a study of seasonal fluctuations in blood spot and meat spot incidence. Blood and meat spot incidences for both environment and season were analyzed statistically by the chi-square method (Snedecor, 1953).

Albumen height and egg weight were used to compute Haugh units (Haugh, 1937). A circular calculator, described by Brant *et al.* (1951), was employed for Haugh unit computation. Haugh units and egg weight were analyzed statistically for both season and environment by employing analysis of variance (Snedecor, 1953).

Egg production was calculated on a hen-day basis. Egg production of the caged layers averaged 224 eggs, whereas the floor layers averaged 237 eggs.

Local climatological data were obtained from the Columbia, Mo., Weather Bureau.

RESULTS

Egg Weight.

The size of eggs produced by hens in cages in 1954-55 increased from October to June and declined from June until September. The eggs produced in 1954-55 by layers housed on the floor reached maximum size in April and then declined until September. The fact that the birds in cages continued to lay larger eggs until June may be explained by the fact that in 1954-55 these birds were in a basement room where the temperature was lower than where the floor birds were housed. The results obtained in 1954-55 on egg weight are presented in Table 1.

TABLE 1--SEASONAL VARIATION IN WEIGHT (GRAMS) OF EGGS LAID BY APRIL HATCHED PULLETS (SISTERS) IN CAGES AND ON THE FLOOR; 1954-55

	Held 3 Days at 50° F		Held 90 Days at 30° F		Held 10 Days at 80° F	
	Cages	Floor	Cages	Floor	Cages	Floor
October	52.2	51.5	52.3	51.3	52.5	51.5
December	57.1	54.8	56.9	55.0	54.5	51.7
February	59.6	57.9	59.8	58.7	58.0	57.3
April	61.0	59.6	---	---	59.2	57.8
June	62.2	58.4	60.6	56.8	59.6	56.6
September	59.3	55.6	59.6	54.1	57.5	53.1
November	60.5	60.6	57.3	57.7	57.0	55.7

In 1955-57 egg size increased from November to May and then declined until July. From July to January, egg size increased. The changes in egg size were similar for layers in cages and on the floor (both groups in the same room). See Figure 1.

Seasonal variation in market sizes of eggs produced by the layers hatched in April, 1955, (Table 2) indicated that birds in their second year of production laid a relatively high percentage of extra-large eggs.

Albumen Quality.

Quality of the albumen of fresh eggs, as measured by Haugh Units, declined from October, 1954, about 17 percent of the initial measurements by November, 1955. In 1955-57, when the birds were housed in an insulated and fan ventilated room, the changes in albumen quality (Figure 2) were not as great as in 1954-55 nor was there a constant decline throughout the period.

The height of the thick albumen declined from 7.0 mm in October, 1954, to 5.5 mm in November, 1955. Eggs laid by the same hens showed a decline from November, 1955, until May, 1956 (6.2 mm to 5.3 mm). After May the eggs were gathered four times daily instead of once daily. From July, 1956, to March, 1957, there was very little change in the height of the thick albumen.

During this three-year study there appeared to be little or no change in the percentage of thick albumen in eggs laid throughout the year.

There was a decided decline in AA grade eggs from October, 1954: from 98 percent AA to 17 percent AA the following September and November. It should be observed, however, that at the end of one year of production the hens were still producing 98 to 100 percent A and AA quality eggs as determined by Haugh Units.

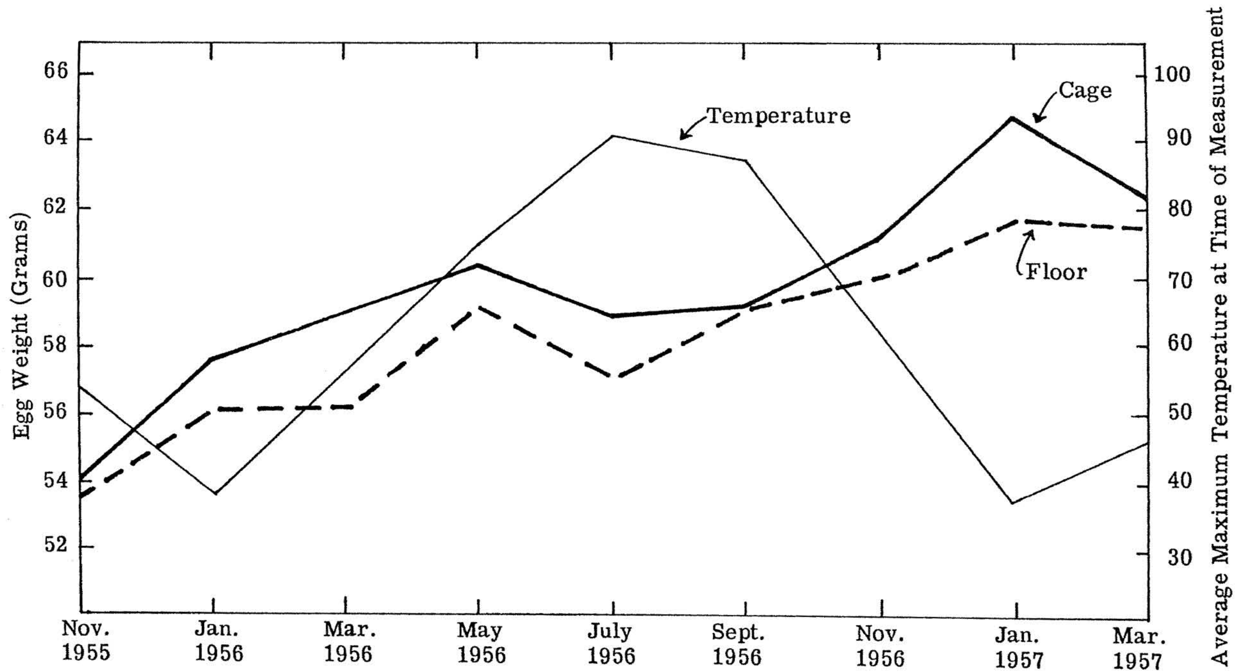

Fig. 1—Seasonal Variation of Egg Weights for Hens in Cages and Sisters Kept on the Floor.

TABLE 2--SEASONAL DISTRIBUTION (%) OF THE VARIOUS MARKET SIZES OF EGGS FROM CAGED LAYERS AND SISTERS HOUSED ON THE FLOOR

Market Size	Nov. '55	Jan. '56	March '56	May '56	July '56	Sept. '56	Nov. '56	Jan. '57	March '57	Average
					Caged Layers					
Small (18-20.9 oz.)	9.8	7.8	6.3	---	4.5	---	---	---	2.4	3.8
Medium (21-23.9)	66.7	29.5	27.1	20.0	31.1	25.6	13.9	7.7	11.9	27.3
Large (24-26.9)	23.5	54.9	58.3	57.8	44.4	61.6	61.1	41.0	50.0	49.7
X-Large (27 up)	---	7.8	8.3	22.2	20.0	12.8	12.8	51.3	35.7	19.2
					Floor Layers					
Small	13.7	---	2.2	---	4.5	---	---	---	---	2.6
Medium	76.5	60.4	55.6	16.7	53.3	23.8	21.4	6.1	9.1	38.5
Large	9.8	37.5	42.2	81.2	42.2	71.4	64.3	69.7	63.6	51.9
X-Large	---	2.1	---	2.1	---	4.8	14.3	24.2	27.3	7.0

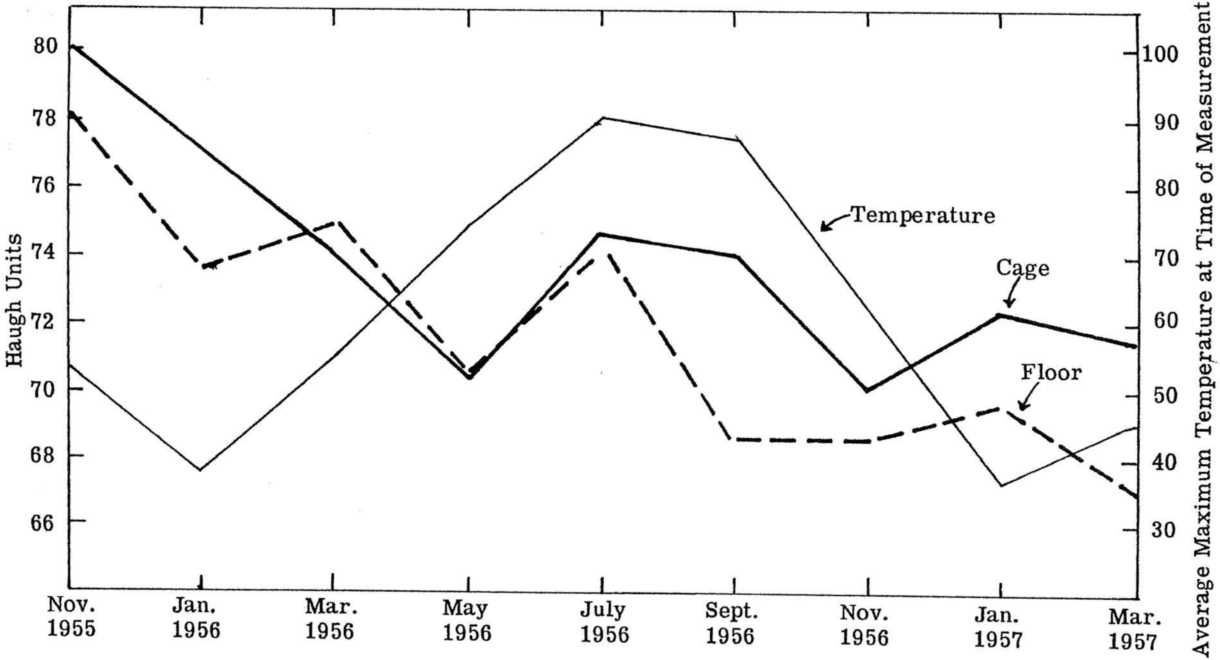

Fig. 2—Seasonal Variation of Haugh Units in Eggs Laid by Hens in Cages and Their Sisters Housed on the Floor.

pH of Thick Albumen: There was very little change in the pH of the albumen of fresh eggs laid during the year-long period, October, 1954, to November, 1955. See Figure 3. However, eggs held 10 days at 80° F or 90 days at 30° F showed much lower pH values (8.9 compared to 9.2) for the thick albumen.

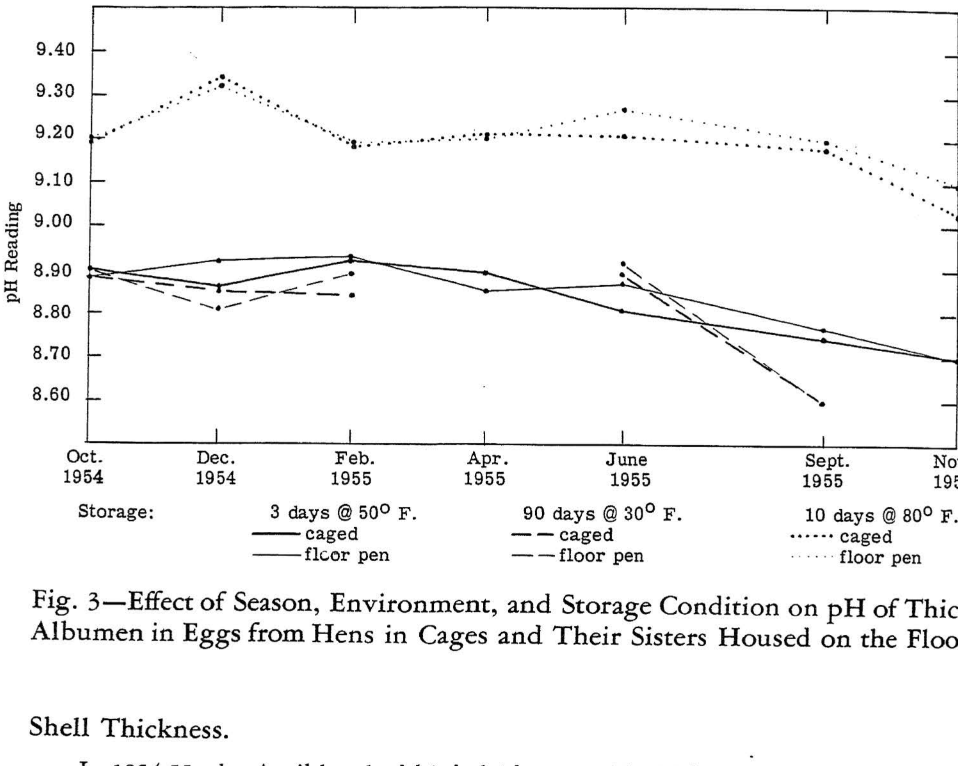

Fig. 3—Effect of Season, Environment, and Storage Condition on pH of Thick Albumen in Eggs from Hens in Cages and Their Sisters Housed on the Floor.

Shell Thickness.

In 1954-55, the April-hatched birds laid eggs with thickest shells (0.0163 in.) in December and the thinnest shells (0.0130 in.) in June.

During the period November, 1955, to March, 1957, birds hatched in April, 1955, produced eggs with the strongest shells from November to May. From May to July the shell thickness of eggs laid by birds on the floor declined from 0.0164 in. to 0.0135 in. and remained about the same until the following March (See Fig. 4).

Blood and Meat Spots.

In 1954-55 there appeared to be a seasonal variation in blood spots varying from 2.17 percent in February to a low of 0.48 percent in June and then to 2.65 in September and 4.83 in November. Observations made by breaking out 651 eggs laid from May, 1956, to March, 1957, by birds hatched in April, 1955, showed a higher incidence of large spots in November and March and a high incidence of small spots in September and March. See Table 3.

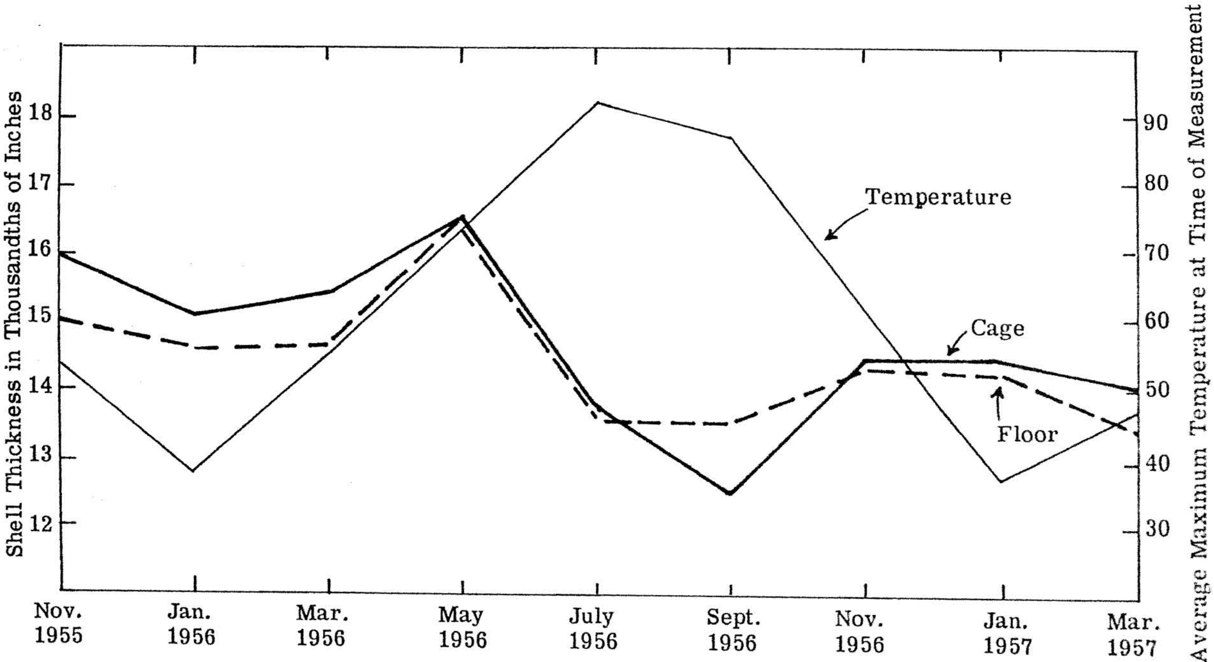

Fig. 4—Seasonal Variation of Shell Thickness in Eggs Laid by Hens in Cages and Their Sisters Housed on the Floor.

TABLE 3--SEASONAL VARIATION IN THE INCIDENCE (%) OF MEAT AND BLOOD SPOTS; 1955-57

	Blood Spots				Meat Spots				Total Spots			
	Small		Large		Small		Large		Small		Large	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
May, 1956	1.6	---	1.6	---	3.2	1.5	---	---	4.8	1.5	1.6	---
July	---	1.6	---	---	3.3	3.2	---	1.6	3.3	4.8	---	1.6
September	5.6	3.7	---	---	3.7	1.9	1.9	---	9.3	5.6	1.9	---
November	2.0	7.4	3.9	---	---	---	3.9	---	2.0	7.4	7.8	---
January, 1957	---	2.4	2.1	2.4	2.1	---	2.1	---	2.1	2.4	4.2	2.1
March	7.4	2.4	3.7	4.8	1.9	2.4	3.7	2.4	9.3	4.8	7.4	7.2

SEASONAL VARIATION IN THE QUALITY OF EGGS ON A FARM ROUTE PICK-UP

With Kraft cooperation data were gathered on the broken out albumen quality (Haugh units) of eggs picked up daily at the farm and those purchased from local egg dealers. Figure 5 shows the relationship of the quality of the eggs received on the pick-up routes with that of eggs received from local dealers from March to October, 1957. Quality was relatively high during March and April when it was cool but declined very rapidly as the temperature increased during May, June and July. Cooler weather in the fall improved egg quality. The quality of the eggs secured on the pick-up routes was superior to that obtained from local egg dealers, especially during hot weather.

CONCLUSIONS

The following conclusions are based on observations made on eggs produced by April hatched White Leghorns.

The size (weight) of eggs in Midwest states varies with season, as has been observed by many investigations. Egg size increased as the birds advanced in production, attaining the largest size during the spring months and then declining when warm weather occurred. When cooler weather came in the fall, egg size increased again and the birds laid larger eggs during the second year than during the first laying year.

The quality of albumen, as measured by Haugh Units, declined throughout the first test year (1954-55) but this decline was not as constant in 1955-57. The height of thick albumen tended to decline during the first six or seven months of production and then remain about the same.

The percentage of AA grade eggs as measured by Haugh Units declined from 98 percent in October to 17 percent in September but even in September 100 percent of the eggs were grade A or better when laid.

The pH of the albumen of fresh laid eggs was constant at about 9.2 throughout the year.

Shell thickness tended to decline from fall until summer (hot weather) and then remain about the same during the next laying year.

This investigation indicated a higher incidence of meat and blood spots during the spring with a low incidence during the summer.

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Fig. 5—Seasonal Variation in Quality of Eggs as Measured by Haugh Units.

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