UNIVERSITY OF IDAHO
College of Agriculture

HIGH QUALITY EGGS
Producer to Consumer

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IDAHO Agricultural
Experiment Station

BULLETIN 379
July 1962

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Robert E. Black graduated from the University of Arkansas in 1950 and served as supervisor of the Arkansas Poultry Improvement Association from 1950 to 1952. He served in the same position for the state of Kansas from 1952 until February, 1954 when he accepted the position of Poultry Extension Specialist for Idaho and has served the Idaho poultry and related industries since that time.

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MAINTAINING EGG QUALITY

Poultrymen need to do everything possible to preserve the high quality of new laid eggs. Frequent gathering, immediate cooling, and marketing within the shortest possible time are essential. Adequate facilities, equipment, and handling methods are necessary.

Time, temperature, and humidity determine whether eggs maintain their high quality or lose it quickly. The three are most important to the producer during the time he holds eggs on the farm and during his marketing process. Quality loss due to holding time is shown in figure 4. High temperature causes rapid thinning of the egg's albumen due to loss of carbon dioxide. Low humidity — especially with high temperatures—results in enlarged air cells due to evaporation. Both contribute greatly in down-grading eggs. Temperatures of 50° to 55° F. and a relative humidity of 70 to 80 percent are the most desirable ranges for maintaining egg quality. Usually this requires an eggroom with mechanical refrigeration and humidifying equipment. Generally it is not practical to maintain eggroom temperatures below 50° F. since the cost of additional refrigeration more than offsets the small quality advantage. Hatching eggs should not be held at temperatures below 50° F.

Eggs will "sweat" due to moisture condensation from the air when removed from cold storage into an area where the temperature is more than 10 degrees higher than in storage.

THE EGG-COOLING ROOM

An egg-cooling room is essential in the modern egg-producing plant. The size of this room is determined by the size of flock, rate of egg production, and frequency of marketing. When you plan an egg-cooling room, plan it large enough to permit future expansion. Table 1 shows the approximate size of the eggroom based on flock size, production rate, and marketing frequency.

Table 1. Approximate size of egg-cooling room required for various flock sizes.* Cooler capacity in number of cases for:

Size Flock	1 delivery per week	2 deliveries per week	3 deliveries per week	No. of baskets cooled per day**	Minimum suggested inside dim. of cooler room with 7′ height	Cooling Unit Size (Ton)
1,000	15	8	6	5	5′ x 5′	¼
2,000	30	16	12	10	6′ x 6′	⅓
3,000	45	24	18	15	7′ x 7′	½
4,000	60	32	24	20	7′ x 8′	½
5,000	75	40	30	25	8′ x 8′	¾
6,000	90	48	36	30	8′ x 9′	¾
7,000	105	56	42	35	9′ x 9′	¾
8,000	120	64	48	40	9′ x 10′	1
9,000	135	72	54	45	9′ x 12′	1
10,000	150	80	60	50	10′ x 12′	1

* On the basis of 70 percent production
** Basket capacity—12 dozen

The size of the required refrigeration unit will be determined primarily by flock size and size of the egg-cooling room. Refrigeration equipment is usually rated on the number of British thermal units (BTU) of heat it can remove in 1 hour. Some systems are rated in tons with a ton of refrigeration being equal to 12,000 BTU per hour. Many equipment manufacturers recommend installation of multiple units in the eggroom when more than 1 ton of refrigeration is required. A method for arriving at the approximate BTU requirements for refrigeration unit is:

Floor area in square feet × 3 = --BTU/hr.
Wall and ceiling area in square feet × 4 = . . . --BTU/hr.
Number of baskets of eggs cooled per day × 233 = . . --BTU/hr.
Sub total . . . --BTU/hr.
To account for heat from lights, cooler, fan motor and infiltration add 20% of sub total . . . . --BTU/hr.
Total . . . . . --BTU/hr.

The preceding formula is good only when adequate insulation is used. This is set forth in construction details in this bulletin.

HUMIDITY

A supplemental source of moisture is usually necessary to provide adequate humidity. Small commercial humidifiers with automatic humidistat controls do an excellent job in the egg room. Evaporative coolers, if used without an outside air connection, will furnish adequate moisture and can also be controlled by a humidistat. Water in the drip pan of the refrigeration unit's evaporator can sometimes be used to supply additional humidity, but the feasibility of this depends on the unit's design.

Location of the cooling room near the laying house is important in reducing labor costs and decreasing egg breakage. At best, the room adjoins cleaning and grading facilities. It is often feasible and more economical to build the cold storage part into an existing structure.

Arrangement inside the cooling room is governed by location of the cooling unit. The basic idea is to have an air circulation pat-

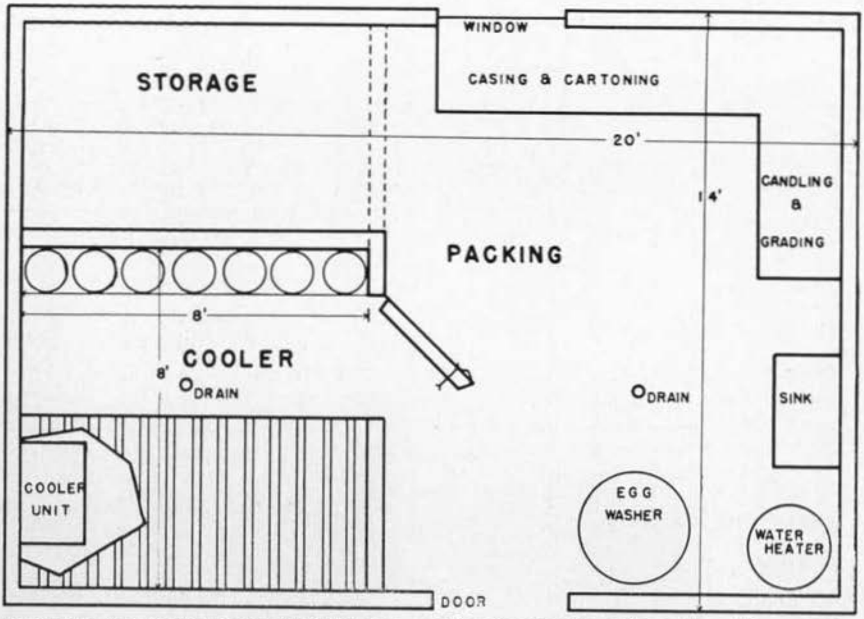

Figure 1. Suggested floor plan for egg-cooling room with adjacent packing room.

tern so that air leaving the cooling unit passes over cased eggs first and then around the baskets of eggs before it returns to the cooling unit. Pre-cooling eggs in baskets before casing them is good, standard practice in keeping egg quality. Shelves or hooks where basketed eggs can sit or hang are necessary for this.

Construction may be conventional frame type with 3 to 4 inches of either bat or loose-fill insulation in the walls and 6 to 8 inches in the ceiling. Place adequate vapor barriers of aluminum foil or plastic materials on both sides of the insulation. High humidity in the cooling room combined with seasonal temperature variation results in periodic higher temperatures inside the cooling room than outside. When this occurs, only a good vapor barrier prevents moisture from condensing inside the insulation. Once wet in this way, its insulating value is gone. Details are shown in figure 2.

Use waterproof material for interior walls. Seal and paint them an odorless paint to prevent moisture penetration. Exterior plywood or other building materials that will stand up under high humidity are good.

Build concrete floors 4 inches thick over 4 or more inches of gravel fill. If floors are wood, insulate them adequately. Floor drains are essential.

Use an insulated refrigerator door at least 3 feet wide. Seal it with weather stripping. Raised door sills are not recommended if eggs are handled on carts.

Locate the grading and packing room adjacent to the egg-cooling room. See that it is well lighted and contains an efficient egg cleaner and adequate egg-packing space. The ideal temperature is not more than 10 degrees above that in the cooling room. Candling and grading equipment are also needed if

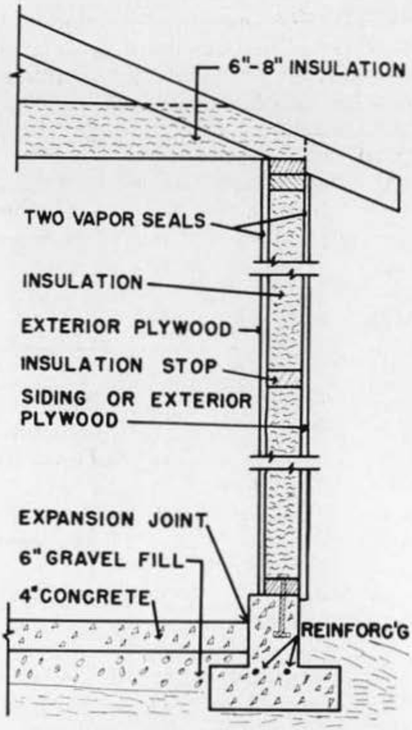

Figure 2. Detailed cross section of egg-cooling room.

eggs are to be graded. The size of the grading and packing room will depend to some extent on the size of the laying flock. However, the room must be large enough for efficient and convenient location of cleaning, grading, and packaging equipment. See figure 1.

Arrangement of equipment is important in facilitating movement of eggs from cleaner to storage to grader and finally back to storage. A 1- to 2-day supply of empty cases and cartons needs to be stored in the cooler. This gives them time to cool and absorb moisture. A suggested plan for the egg-cooling room with adjacent packing room is shown inside the front cover.

PROCESSING

Cleaning soiled eggs is not a substitute for good management in the production of clean eggs. At best, it is an expensive and time-consuming chore for most producers. Cleaning may result in serious spoilage problems. Clean eggs pay more profit than soiled eggs, and every poultryman strives to produce a high percentage that are bright and clean.

Dry cleaning with abrasives reduces spoilage hazards but is slow and tedious. The needed equipment is also expensive in terms of the volume of eggs than can be cleaned.

Washing eggs reduces the labor requirement but can lead to serious spoilage problems unless it is properly done. Certain hazards are still involved even when washing is done most carefully. Table 2 shows the results of washed eggs from four of Idaho's commercial poultry farms. Notice that spoilage appeared as early as 1 week after the eggs were laid and that **some** eggs from **every** farm were spoiled at 3 weeks of age.

Table 2. The incidence of green rot spoilage in farm washed eggs stored for 3 weeks at 50° F., 80% R. H.*

	Percent Spoilage		
Farm Number	1 week	2 weeks	3 weeks
1	0.0%	0.0%	1.1%
2	0.7	1.0	1.1
3	0.0	0.0	0.7
4	0.0	0.7	1.5

*Research results from Department of Poultry Husbandry, University of Idaho

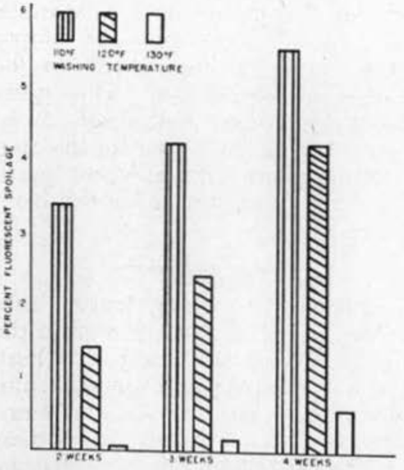

Figure 3. The effect of washing temperature on the incidence of green-rot spoilage through 4 weeks of storage at 50° to 55°, 70 to 80% R.H.

Higher washing temperatures generally reduce the incidence of spoilage in washed eggs. This is illustrated in figure 3. However, high washing temperatures result in excessive breakage in some egg washers. The use of washing temperatures up to 135° F. requires careful control of both time and temperature. High temperature produces a rapid rise in the internal temperature of the egg and may result in coagulation of the albumen. Proper washing of eggs is not detrimental to the interior quality as measured either by candling or by Haugh units.

Egg spoilage associated with washing is caused by bacteria which penetrate the wet shell immediately after washing. Off flavors are often noticeable to consumers before spoilage can be detected by candling. This results in dissatisfied customers and reduced egg consumption.

If you wash eggs—follow these suggestions:

1. Less spoilage and breakage occur when only soiled eggs are washed.

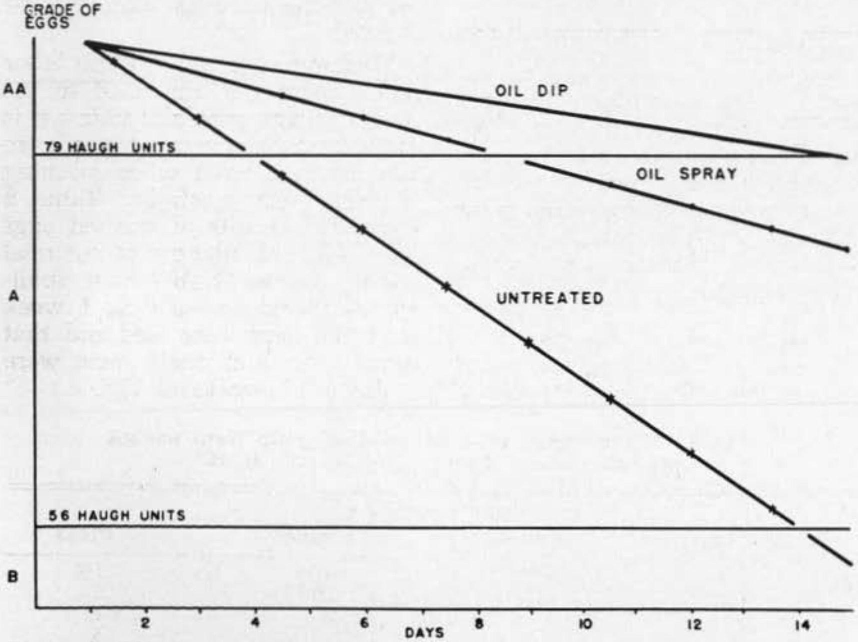

Figure 4. Effects of shell treatment on interior quality of eggs stored at 50° to 60°, 70 to 80% R. H.

Table 3. Summary of United States standards for quality of individual shell eggs specification for each quality factor

Quality factor	AA Quality	A Quality	B Quality	C Quality
Shell	Clean Unbroken Practically normal	Clean Unbroken Practically normal	Clean; to very slightly stained. Unbroken May be slightly abnormal	Clean; to moderately stained. Unbroken May be abnormal
Air Cell	⅛ inch or less in depth Practically regular	2/8 inch or less in depth Practically regular	⅜ inch or less in depth May be free but not bubbly	May be over ⅜ inch in depth May be free or bubbly
White	Clear Firm	Clear May be reasonably firm	Clear May be slightly weak	May be weak and watery. Small blood clots or spots may be present.*
Yolk	Well centered Outline slightly Free from defects	May be fairly well centered Outline may be fairly well defined Practically free from defects	May be off center Outline may be well defined May be slightly enlarged and flattened. May show definite but not serious defects	May be off center. Outline may be plainly visible. May be enlarged and flattened. May show clearly visible germ development but no blood. May show other serious defects.

* If they are small (aggregating not more than ⅛ inch in diameter)

For eggs with soiled or broken shells, the standards of quality provide three additional qualities. These are:

Dirty	Check	Leaker
Unbroken May be dirty	Checked or cracked but not leaking.	Broken so contents are leaking.

2. To prevent bacterial build-up, change the wash water after each 5 baskets when using single-basket washing.
3. Use a sanitizer detergent.
4. Use a washing temperature of at least 120° F. Higher temperatures up to 135° F. reduce spoilage, but the actual temperature used varies with the washing time and machine.
5. Do not hold washed eggs more than 3 to 5 days.
6. Clean and sanitize the egg washer daily.

Shell treatment seals the egg shell's pores with mineral oil or an oil emulsion to prevent loss of carbon dioxide and moisture.

Apply the oil in either of the following ways:

Oil dipping has been used for many years. It does a good job as shown in figure 4, but dipping has two disadvantages. It produces a shine on the shell, and preventing a bacterial buildup in the oil supply is difficult. Both are disadvantages.

Oil spraying applies a fine mist to the large end of the egg. An electric paint sprayer will do this effectively if you spray while the eggs are on flats. Spraying seals

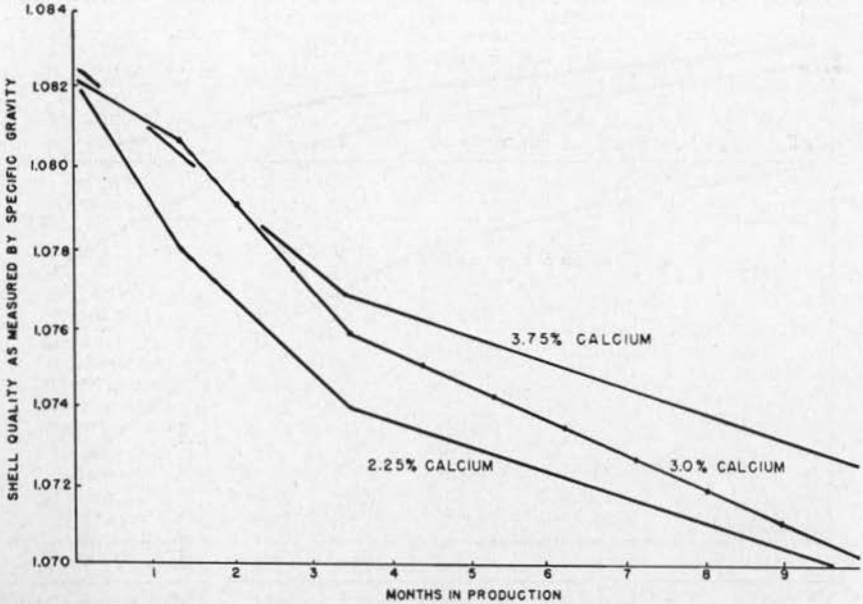

Figure 5. Effects of three calcium levels on the decline of shell quality.

about three-fourths of the shell's pores and is nearly as effective as dipping when eggs are marketed rapidly. Aerosol pressure cans are effective in spraying but are somewhat more expensive.

Oil eggs either before or after washing but do it as soon as possible after gathering.

Figure 4 shows the effect of various shell treatments on egg quality during storage. Note the rapid quality decline of untreated eggs.

Cartoning over-wraps of cellophane or other transparent plastics are a recent development in preserving egg quality as well as for more attractive packaging. They are nearly as effective as oil spraying in maintaining egg quality.

Frequent egg delivery is essential to high quality for the consumer. The sooner eggs reach the consumer, the higher their quality. Top-quality eggs reach the consumer no later than 1 week after they are produced. Figure 4 shows that even shell-treated eggs steadily decline in quality as they grow older.

GRADING EGGS

Candling shows the interior

Table 4. U. S. weight classes for consumer grades for shell eggs

Size or weight class	Minimum net weight per dozen	Minimum net weight per 30 dozen	Minimum weight for individual eggs at rate per dozen
	Ounces	Pounds	Ounces
Jumbo	30	56	29
Extra large	27	50½	26
Large	24	45	23
Medium	21	39½	20
Small	18	34	17
Peewee	15	28	

* National Research Council recommendation.

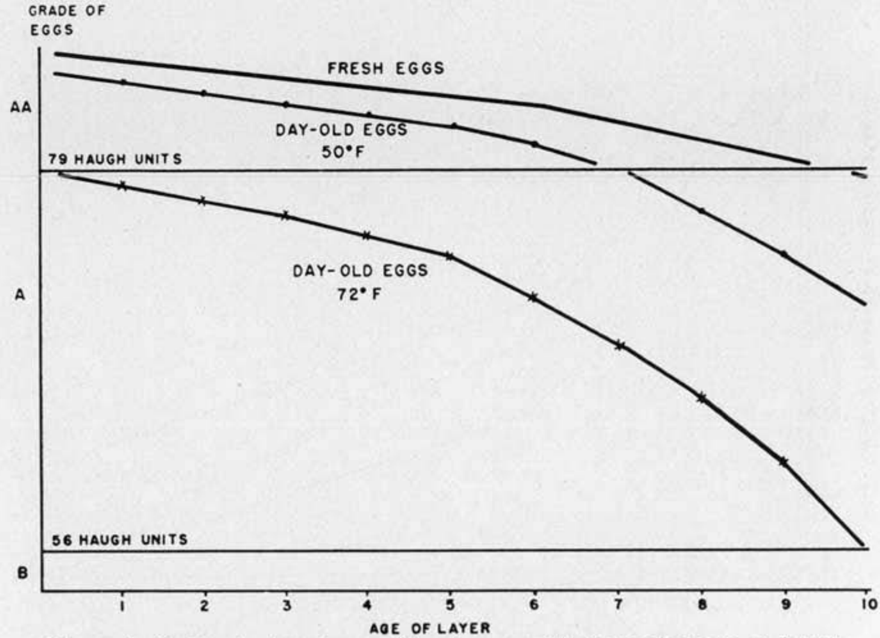

Figure 6. Decline in interior quality of eggs with increasing age of layers.

quality of an egg. The efficient egg grader knows the relationship between the egg's appearance before the candle and its actual quality when broken out. In general, the less detail seen in the egg as it rotates before the light the higher is its quality. Eggs with quality defects – blood and meat spots, large and irregular air cells, irregular or rough shells, or other abnormal characteristics – are separated from high quality eggs by candling.

U.S.D.A. grades and standards have been developed for market eggs and are the basis on which quality eggs are sold. Table 4 gives the weight classes of eggs, and Table 3 shows the various grades and the quality factors involved:

"Fresh Fancy Quality" is a new grade-label designation. It may be used on eggs produced under a federal-state quality - control egg-grading program. The program specifies the conditions under which eggs are produced and marketed and provides for quality certification for eggs meeting these requirements.

Quality - control conditions include uniform age of layers, refrigerated holding with constant temperature and humidity, and prompt marketing. Quality is determined by breaking out representative samples, measuring height of the thick albumen, and calculating the Haugh units.

PRODUCTION OF HIGH QUALITY EGGS

Essentials for production and maintenance of high quality eggs are:

1. Clean, dry litter in the laying house.
2. Clean, dry nesting material.
3. Not fewer than one nest for every four layers.
4. Gather at least three times daily. In warm weather, four times daily is better.

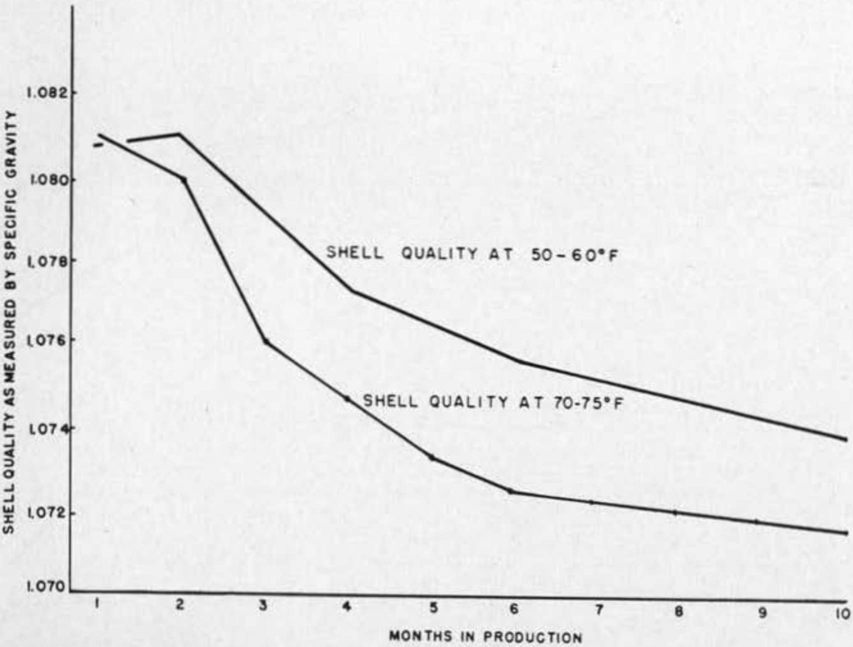

Figure 7. Effects of laying-house temperature on the shell quality of eggs.

5. Gather eggs in wire baskets. Move them immediately to the cooler for rapid cooling.
6. Keep layers confined at all times.
7. Feed high quality feed.
8. Keep an all-pullet flock.

Feeding affects egg quality in terms of yolk color, shell quality, and flavor. Specific feed ingredients such as corn and alfalfa meal contain carotene and xanthophyl pigments. These affect yolk color and may indirectly affect grade. In turn, grade affects price and the producer's income.

Feeding can affect shell strength. Most commercial rations today have adequate nutrients to maintain high egg production. However, recent work of the Idaho Agricultural Experiment Station shows that for maximum shell strength a feed's calcium level needs to be above the generally recommended 2.25 percent*. These findings are summarized in figure 5.

The age of hens and the length of time they have been in production affect both shell and interior quality. Figure 5 also shows the decline in shell quality as influenced by the layers' age. Figure 6 shows a similar decrease in interior quality. Particularly notice in figure 6 that the grade of fresh eggs is at the lower limits for grade AA after the hens have been laying for 10 months.

Figure 7 shows that laying-house temperatures above 70° F. will reduce shell quality.