February 12, 1975

PRODUCTION-MANAGEMENT FACTORS ASSOCIATED WITH EGG SHELL QUALITY

INTRODUCTION

In its broadest sense, the term "shell quality" includes breaking strength, shell texture, shell cleanliness, shell color, and egg shape. However, the primary focus of this paper will be on breaking strength, although our discussion may diverge to include other aspects of the shell quality problem, too.

Numerous estimates have been made of the extent of egg breakage occurring between oviposition and the final sale of the product to, the consumer in the supermarket. Average values range all the way from 6 to 7 percent to as high as 14 to 15 percent. Damage sustained by individual lots of eggs or eggs from individual flocks, of course, would cover an even wider range. A 1970-71 study conducted in the North-eastern states of mechanized cage management systems (1) revealed that an average of 12.15 percent of all eggs produced were shell damaged during production and processing. Additional checks and losses could be anticipated during transporting and handling prior to final sale. Dr. Froning in the July 1974 issue of Egg Industry (2) gives an estimate of $70 to $100 million annual national loss from egg breakage.

In the Northeastern study (1), shell damage from cage to cooler averaged 4.98 percent. This is equivalent to a breakage loss of about one dozen eggs per hen per year in the production phase. If a differential of 15 cents per dozen between sound shells and checked plus loss eggs is assumed, then producer income per hen is reduced by 15 cents. That is four to five times the annual net profit earned by our commercial egg producers in California over the past seven years. On a national flock basis of 300 million hens, 15 cents per bird totals $45 million. That figure would have to be at least doubled or possibly tripled to cover all losses from the cage to the consumer's refrigerator.

Needless to say, the shell quality problem is a serious one—and not for the producer only. Every segment of the industry shares in the losses. Egg breakage occurring in the washer or on the grading and cartoning line slows up operations and costs the processor money. When the housewife finds broken eggs in her retail carton, she is far from happy and often retaliates by using fewer eggs.

If the shell breakage problem is getting worse instead of better, there may be several logical reasons. Back in 1940, average annual production per layer was only 134 eggs. Today, good commercial producers expect 230-240 eggs per hen or more. Presented by Milo R. Swanson at the Egg Science Seminar, August 3-5, 1974, Morgantown, West Virginia, under sponsorship of the American Egg Board.

COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS, U.S. Department of Agriculture and University of California cooperating.
That is a considerably higher stress on the bird. Not only is today's hen laying at a higher rate, but she is also laying over a longer period of time. Breeders have developed strains capable of good production for 14 to 16 months or longer. High pullet replacement costs and low salvage values for spent hens encourage producers to keep birds for as long a time as economically feasible. These practices accentuate the shell quality problem.

Today's bird is also putting out more eggs with a smaller body size. Breeders have reduced body weight so that a lower proportion of feed intake is used for body maintenance. A 4-pound hen laying 20 dozen eggs per year produces 30 pounds of egg product, which is 10 times the edible food solids in her own body. A rate of food production not exceeded by any other animal, pound for pound. Smaller body size means less nutrients for maintenance and therefore greater efficiency, but it also means more stress on the bird.

Not only are we stressing the hens but the eggs, too, through more mechanical handling. At the producer level an increasing proportion of egg gathering is being automated. Washing, sizing, and cartoning at the processing plant put additional physical stresses on the egg shell. The need for better shell quality is more urgent today than ever before.

The remainder of this paper is devoted to a review of those factors affecting shell strength and shell damage associated with egg production and flock management. Normally such a review would include the nutritional aspects of the problem, but we will confine our remarks at this time to factors other than layer nutrition related to shell quality. We will be drawing on two previously published reviews (3,4) but will also include references to more recently reported research results.

**STRAIN - AGE - MOLT**

**Strain**

Geneticists can take a common population of chickens and, by selecting for strong and weak shells, develop within a few generations two divergent shell quality lines. Thus, the importance of breeding in improving breaking strength is easily demonstrated. A look at the Random Sample Egg Production Tests gives added support to the fact that there are strain differences among today's commercial stocks, although those differences are not necessarily large. The 1973 report (5) covering 2 test years (1971-1973) shows a range in regressed means of specific gravity values from 1.0799 to 1.0855 with an overall mean of 1.0835 for the 44 strains represented from 29 breeders and laboratories.

There is little doubt that we need the assistance of the geneticist to help us solve the shell quality problem, but we cannot rely solely on that approach. The breeder's goal is to supply his customers with a bird that will maximize profits. This means that there must be a balance of desirable hereditary traits affecting production rates, egg size, likability, feed efficiency, interior egg quality, and other factors determining economic returns. If a breeder were to put all of his selection pressure on shell strength, he could make faster progress, but his competition would eventually put him out of business since his strain would soon drop in overall performance.

**Age**

As the laying cycle progresses and the flock increases in age, shell thickness and strength decline. This is so well documented that we need to spend little time on it here. In the Northeast regional study (1), for example, egg damage at the point of
lay for the first few weeks of production was at a low 1 to 2 percent level, but as
the flock age increased, breakage increased linearly at about 0.46 percent per month
to reach the 8 to 9 percent level after 80 weeks of lay.

The reasons for the decline in shell quality with increasing production are not
fully understood. There appears to be a loss in physiological efficiency, but the
mechanisms involved need further researching. Shell deposition involves a very
complicated series of metabolic functions with the endocrine glands and their hor-
mones playing important roles. It would be easy to speculate that declining shell
quality is merely the result of reduced enzyme and hormonal activity, or in laymen's
terms, the bird's system grows tired with time and work. Some basis for this
assumption can be round in the fact that a bird's efficiency in shell deposition is
partially restored after a rest period.

Molt

Rising can be induced by putting a flock through a forced molt (6). This is accom-
plished by subjecting the birds to a severe nutritional-environmental stress for a
short time. For example, one commonly used method is to withdraw feed for a 10-day
period. Force molting stimulates a rapid shedding of feathers and growth of new
plumage. More importantly, the flock uniformly goes out of production and returns
to a high rate of lay and improved egg quality, both interior and exterior (7).

If a flock is molted only once and the molt is initiated at about 8 weeks of age,
the level of shell quality on return to production at the start of the second lay-
ing cycle will be equivalent to approximately that prevailing at 40 to 50 weeks of
age. Significant improvement in both shell thickness and texture is normally noted.

However, flocks which are kept in production until they are 80 weeks of age before
being sold or molted will produce a significant number of poor quality shells dur-
ing the last quarter or third of the first laying cycle. To avoid this, it is recom-
manded that multiple molting be practiced and the laying cycles shortened. One
such program is called the 8 - 8 - 8 plan (8,9). The first molt is initiated after
only 8 months of lay, the flock is molted a second time 8 months later, and the
flock is sold after a third laying cycle of 8 months (or at about 30 months of age).

Processors and dealers frequently look with disfavor on eggs from force molted
flocks, believing that their shell quality is automatically inferior to that pro-
duced by all-pullet flocks. Molting programs can be mismanaged in that the laying
cycles, including the first one, are too extended and both interior and exterior
quality are below standard. But we believe that a properly managed replacement
program which includes force molting, such as the 8 - 8 - 8 plan, can result in a
level of overall shell quality that equals or exceeds that of all-pullet flock.

HOUSING

Temperature

With increasing environmental temperatures, shell thickness and breaking strength
decline, particularly above 85° to 90°F. Daily high temperatures may not be as im-
portant as the number of hours per day that the temperature exceeds a given level.
Layers can tolerate short periods of elevated temperatures without affecting perfor-
ance but are more sensitive to continuous subjection to high temperatures. There
is good evidence that shell thickness and breaking strength of eggs produced with a
cycling diurnal temperature are superior to those laid under conditions of constant
temperature (10). Young pullets can also withstand higher temperatures than older
layers without showing detrimental effects on shell quality (11). Sudden rises in
temperature have been reported to produce sudden decreases in shell thickness com-
pared to a slower temperature change (12).
High temperatures generally depress feed consumption because the bird requires less energy for body maintenance. With lower feed consumption, there is also a lower intake of calcium, phosphorus, and other nutrients essential for shell formation unless the feed formula is appropriately adjusted. This lower intake of essential nutrients and failure to make the necessary feed formula changes could account for much of the shell quality problem encountered in hot weather. But there is also research which indicates that individual birds maintained at high temperatures and having a high calcium intake produce eggs with the same shell thickness as those having a low calcium intake (15). There may be some direct effects of temperature on metabolic processes which lower the efficiency of feed utilization and/or shell deposition.

Some have speculated that the reduction in shell deposition under heat stress could be the result of accelerated egg formation or premature expulsion of the egg from the shell gland. But it has been recently discovered that the time of egg formation actually increases, being 2.1 hours longer at 90°F than at 70°F. The added time was accounted for by the egg spending about 2 extra hours in the shell gland (16).

Humidity

High temperatures reduce feed consumption, but high temperatures combined with high relative humidity have a further depressing effect on feed intake (15). However, humidity must be considered a less important factor than temperature in its effect on shell quality. A recent report indicated no adverse effect from increasing relative humidity from 55 percent up to 65 percent (11).

Air Movement

The detrimental effects of high temperatures on layer performance can be partially offset by increasing the movement of air around the birds (15). In one trial, at a temperature regime of 81 to 95°F, increasing the air movement at bird level from 7.3 to 20.1 meters per minute resulted in a 10 percent increase in shell thickness and a 9 percent increase in breaking strength.

Cages

Caged layers generally tend to produce more checked eggs than floor birds, but studies indicate that there is little or no difference in the inherent shell strength of eggs produced in cage and floor operations (16). Therefore, the cage must place more stress on the egg as it is laid and rolls into the collection tray.

One group of British researchers feel that cage design and bird behavior in cages are more important factors in determining incidence of cracked eggs than shell thickness, egg shape, egg weight, production rate, or strain of birds (17). For example, some birds tend to drop their eggs from a standing position, permitting the eggs to fall several inches before striking the cage floor. Others will lay their eggs from a sitting position so that little impact stress is put on the shell. Laying behavior tends to be consistent with individual birds and closely associated with the incidence of cracked eggs.

The British group has also noted that the heavier and stiffer the wire used in constructing the cage floor, the greater the shell damage (16). This is true because the resistance of the cage floor to acceleration by the egg depends on the local effective mass of the floor and therefore on its construction. One study (10) showed a much lower incidence of cracked eggs on wire netting floors than on welded wire. Another indicated reduced checking by coating the cage floor wires with plastic (polyvinyl chloride). Plastic added mass to the wire, but its relative softness and cushioning effect more than counteracted the mass effect (19). Zinc coating increased shell damage.
Slopes of the cage floor is important, too, for about two-thirds of the checks occur when eggs collide with each other in the front of the cage or with the side of the collecting tray (18). In a test comparing a 14° slope with one of only 3°, the breakage was 28 percent and 2 percent, respectively. Bending up the front 1 to 1½ inches of the cage to slow down the speed of the egg substantially reduced checking in a standard cage with 9½° slope. Another study showed a drop in cracked eggs from 14 to 5 percent when the egg tray was fitted with foam plastic strips to soften the impact of the rolling egg (17).

Failure of the egg to roll out of the cage immediately after laying could also increase its chances to be broken by being stepped on by the hens or pecked. Again, British workers observed that nearly 50 percent of all eggs rolled out at once after laying and 75 percent were in the collection tray within 2 minutes (20). However, 9 percent remained in the cage for 5 minutes, and 3 percent required more than 10 minutes to reach the egg tray.

Increasing bird density in cages will cause some decrease in shell quality and increase in shell damage. Part of the increased breakage can be attributed to more legs and feet to step on eggs and impede their roll to the egg tray. But two studies have shown that increased bird density also results in rougher shells (21, 22). When perches are added to cages to increase bird capacity, the incidence of egg breakage goes up (23, 24).

Disease

Respiratory

It is well established that Newcastle disease and infectious bronchitis adversely affect both interior quality and shell quality of eggs laid following an outbreak in a laying flock. Birds normally go out of production and then on recovery produce eggs which are often misshapen and soft or thin-shelled. Newcastle disease is less devastating in that the effect on shell quality is usually temporary. On the other hand, flocks which have had bronchitis may never fully recover in egg quality.

There is also evidence that exposure to infectious bronchitis during the brooding or growing period can permanently damage the ovary so that, as layers, the birds lay eggs of inferior quality (25, 26). Flocks which are not properly vaccinated for the respiratory diseases so as to establish a good immunity may experience, as layers, mild outbreaks in which the only clinical symptom is a decline in egg quality.

Rough shells are sometimes considered a sign that a flock has experienced a disease break. However, a recent report indicates that rough shells are also produced by pathogen-free flocks in the latter part of the laying cycle. Therefore, rough shells are not necessarily disease-related (27).

Drugs

The effect on shell quality of drugs commonly used for the treatment or control of poultry diseases and parasites is minimal. With the exception of sulfanilamide, which does cause thinning of the shell, most studies have had negative results. Likewise, attempts to improve shell quality by drug additives have met with little success. DOT, which has been implicated in the shell thinning problems of some wild bird species, does not appear to affect chickens, within limits (25).
Egg Gathering

Equipment

An increasing percentage of eggs are being mechanically gathered. A high proportion of new operations are completely automated in both feeding and egg handling. There are several reasons for the trend. Labor costs are rapidly rising and competent labor is often difficult to find. In addition, considerable improvement has been made in the design of mechanical gathering equipment, making it a more attractive alternative.

Data have been gathered on the extent of shell damage for both hand and mechanical gathering systems (1,29,30,31,32), but these have been separate studies with no direct, controlled comparison between the two. In California we have been surveying egg ranches to evaluate different types of gathering systems for the past two months. The study is still in progress, but we have observed that the extent of egg breakage is closely related to the operator’s ability to keep the mechanical equipment in good repair and proper adjustment. The same conclusion has been reached by other investigators (33).

Further improvements in equipment design can be anticipated which will lower egg shell damage. Results of the Northeast regional study did show that higher damage occurred in a flat-deck compared to stair-step systems (1), probably because in the flat-deck system, a single belt generally collects eggs from two cage rows.

Egg Handling

Careless handling of eggs and stacks of egg flats can greatly increase numbers of checked and loss eggs (26). In hand gathering, too high a gathering rate can easily double the incidence. When eggs are stacked more than six flats high, undue pressure is put on the lower flats. Carelessness in handling stacks of filled flats transfers the pressure to the eggs rather than to the support posts of the flats. Oversize eggs should be separated out because, without special handling, these eggs are subject to breakage in flats of mixed sizes. Breakage of extra-large and jumbo eggs can generally be attributed to their oversize rather than to poorer shell quality (34).

SUMMARY

Shell damaged eggs represent one of the major economic losses in the egg industry. Additional research is needed in the areas of nutrition, physiology, disease control, genetics, and equipment design. But the extent of shell breakage could be substantially reduced, we feel, if good management practices were followed in the production and handling of eggs. We offer the following suggestions to producers of market eggs:

- Select a strain of birds that lays a high quality shell and performs well under the conditions to which it will be subjected.
- Follow a layer replacement program that will maximize overall shell quality. This may involve a shortening of the laying cycle to eliminate poor quality eggs normally produced toward the end of more extended cycles.
- Minimize environmental stresses on the layers by avoiding prolonged periods of high temperature (above 85°F) and high humidity. Provide good air movement.
- Follow a planned disease prevention program (effective vaccination, good security management) to eliminate respiratory infections.
Feed rations that provide all essential nutrients at levels required for good shell formation.

Select well-designed cages and egg gathering equipment to minimize mechanical "insults" to the egg shell. Keep the equipment in good adjustment and repair.

Handle eggs carefully. Careless handling can break any egg, regardless of its shell quality.

REFERENCES


CORRESPONDENCE COURSE ON RABBIT RAISING OFFERED

The following news release was received from Herbert Jordan, Extension Poultry Specialist at Pennsylvania State University:

"Anyone seeking information on raising rabbits commercially should write to Correspondence Courses, Room 307, Agricultural Administration Building, The Pennsylvania State University, University Park, PA 16802. Author Herbert C. Jordan offers lessons on Management, Nutrition, Breeding, Housing, Marketing, Processing, and all phases of production. This course, Number 109, may be obtained for your office reference or you may complete the course for a certificate. Send a check for $3.50 payable to The Pennsylvania State University to the address above. This correspondence course is designed for small herd rabbit growers and beginners who wish to grow into large commercial rabbit producers. Current references on rabbits are quoted in the course for the opportunity of further education and information on rabbits."

COMING EVENTS

. February 26-28 ......................... PaFa Convention, Anaheim
. March 15 ................................. Game Bird Workshop, Davis
. March 16-17 .............................. Avian Adenoviruses and Avian Mycoplasma Workshops, Davis
. March 18-19 .............................. Western Poultry Disease Conference, Davis
. March 20 ................................. 9th California Poultry Health Symposium, Davis
. March 19 (p.m.)-21 ........................ Poultry Farm Advisors' Training Conference, Davis
. April 5 ................................. Game Bird Workshop, Riverside Campus

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RECENT PUBLICATIONS

How to Dispose of Dead Birds, AX-406-6, University of Calif. (4 pp).

4-H Pigeon Manual, 4-H-AG-48, Univ. of Calif. (10 pp).

Physical Properties of Farm Animal Manures, Bull. 867, Univ. of Calif. (12 pp).


Sloping Wire Floor in Poultry Houses, Bull. 795, Penn State Univ. (127 pp).


Poultry Waste. Georgia’s 30 Million Dollar Forgotten Crop, Leaf. 206, Univ. of Georgia (4 pp).

Table Egg Room Safety Chart, Univ. of Georgia (1 pp).

Hatching Egg Room Safety Chart, Univ. of Georgia (1 pp).

1974 Georgia Poultry Management Workshop, Nov. 6 & 7, Univ. of Georgia (36 pp).


Fowl Pox, Q-353, Univ. of Arizona (2 pp).


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The University of California’s Cooperative Extension programs are available to all, without regard to race, color, or national origin.
There are recent indications that egg quality problems arising from the use of excessive levels of cottonseed meal (CSM) or CSM of poor quality (higher than normal percentages of gossypol and cyclopropenoid compounds) should once again be a concern of California's egg industry. In the last month we have personally seen two suspect samples of eggs, and the State Department of Food and Agriculture reports that the free gossypol level of CSM at analysis is frequently running considerably higher than the maximum standard of 0.04 percent set for "low gossypol" or "degossypolyzed" meals.

CSM and Egg Quality

Gossypol is fat soluble and therefore is found in the yolk of the egg. When it reacts with the iron of the yolk, an olive-brown discoloration is formed that gives the yolk a mottled appearance. At high gossypol levels the defect can be present in the freshly laid egg. At low or moderate levels, the discoloration may not develop for several days or weeks. A rise in pH hastens the gossypol-iron reaction and is the basis for the screening test which uses ammonium hydroxide fumes. (See January 19, 1973 issue of POULTRY PARADE for more details.)

Malvalic and sterolic acid are normal constituents of cottonseed. These acids contain the cyclopropenoid radical and, when present in CSM in excessive amounts, can add further to the egg quality problem. They increase the permeability of the vitelline membrane, thereby accelerating the rise in the pH of the yolk and the gossypol-iron reaction. The greater permeability of the yolk membranes also permits iron to pass from the yolk into the white where the iron reacts with cycloprotenoid to produce a pink pigment. Finally, these acids cause the yolk to be abnormally viscous. (See May 1, 1968 issue of POULTRY PARADE for a more complete discussion of the CSM-egg quality problem.)

Gossypol and Cotton Varieties

If we have an increasing gossypol problem, it may be because of changes occurring in varieties of cotton being planted. For a number of years the seed type known as 442 was the one most commonly grown. It had a total gossypol content of approximately 0.9 percent. More recently 442 has been largely replaced with a newer variety, SJ2, which has a total gossypol level of about 1.3 percent. In 1974, SJ2 constituted 90 percent of California's cotton acreage. Since SJ2 has more than a 40 percent higher gossypol content than 442, it is logical that many lots of CSM no longer qualify as low gossypol meals.

 Breeders of cotton are constantly striving to improve cotton yield, fiber quality, and oil content. Gossypol level has not always been a top priority because of economic considerations. In 1974, ten percent of the California cotton crop was a newer variety, SJ3, which has a gossypol content of about 0.9 percent.

A still more advanced variety, SJ4, has been developed which has about 8 percent more oil and a better quality cotton than SJ2. Furthermore, its total gossypol level is down to about 0.8 percent.
Poultry Parade

In 1976 there will be enough seed of this promising variety to plant about 30 percent of the California crop and 100 percent in 1977. Development of cotton varieties is under the leadership of Dr. Robert D. Cooper, Jr., at the U. S. Cotton Research Station, Shafter, California.

Glandless varieties of cotton, which are very low in free gossypol, have been under test for a number of years, but their future is still in question. Compared to the SJ series, the yield of glandless cotton is about 10 percent lower and it is more insect susceptible and more sensitive to water and fertilzer management. Research continues to improve yield and develop more precise management practices, but GSN in quantity from glandless cotton is several years away, at best.

Short- vs Long-term Answers

The switch to SJ4 in 1976-77 and further cotton breeding research to develop still better varieties hold promise for the future but do not solve the 1975 situation.

There are several alternatives for the short term. One would be to increase the temperature in processing the meal. This would tie up more gossypol, but it would also lower the available level of lysine. Therefore, it is not an acceptable solution.

Another way to bind gossypol is to add an iron salt, e.g., ferrous sulfate, to the ration in a 4:1 iron:gossypol ratio. Research has shown this to be least partially effective in preventing yolk discoloration, but apparently there has been little adaptation of this knowledge by the industry. This may be the time for mills to initiate the practice as a temporary measure where it has not been heretofore used. (See Poultry Science, 52:20-28 for a recent research report on the subject.)

Not all lots of GSN are identical in gossypol content. Some may be lower than others because of variety or local soil and climatic conditions. Therefore, the possibility exists for the processor of identifying the lots with the lowest gossypol content for use in the poultry industry. Some of the GSN firms have indicated they will be doing this for their 1975 sales. This should be of considerable help.

Also, there needs to be strict adherence to the labeling requirements so that meals with gossypol levels over 0.04 percent do not carry a degossylized or low gossypol tag. The California Department of Food and Agriculture recommends that feed mills and other users carefully review the label of each purchase of GSN intended for layer formulas. If the label does not indicate the material is a low gossypol meal guaranteed not more than 0.06 percent free gossypol, a nutritionist should be consulted for advice on use levels.

Further Precautions

The usual recommendations on the use of GSN in layer rations is that the maximum level be limited to 10 percent if it is a low gossypol meal (0.04 percent or less free gossypol). There are times when price relationships between alternative protein sources make it tempting to use higher levels, but to do so only invites trouble.

If the label does not guarantee that the meal contains 0.04 percent free gossypol or less, obviously the level of GSN in the layer ration should be greatly reduced. This is where the advice of an experienced nutritionist is needed.

Finally, it should be said that not all mottled yolk problems are attributable to excessive levels of gossypol. Tannins, for example, can also cause discolorations as can Nicarabin (a coc-cidiotstat), piperoxane (a wormer), and raw soybean meal. If an egg quality problem is encountered, assistance should be sought in identifying the cause before remedial measures are taken.

M. W. S.

May 1, 1975
A number of national and regional commercial firms associated with the poultry industry publish excellent newsletters on a weekly, monthly, or quarterly basis. Below is a listing of those we are currently receiving. If you know of other such publications not listed, we would appreciate getting names and addresses from you.

M. H. S.

**Advances in Animal Health and Nutrition**
Merck Technical Service
Merck Chemical Division
Tahway, NJ 07865

**APWA Bulletin**
American Feed Manufacturers' Assn.
1701 No. Pt. Meyer Drive
Arlington, VA 22209

**Arlor Acres Review**
Arlor Acres Farms, Inc.
Glastonbury, CT 06033

**ASI Newsletter**
American Scientific Laboratories
Madison, WI 53701

**Brookhurst Mill Reports**
3315 Van Buren Avenue
Riverside, CA 92503

**Cobb Minute Man**
Cobb, Incorporated
P.O. Box 280
Concord, MA 01742

**DeKalb Management News & Views**
DeKalb AgResearch, Inc.
Syngenta Road
DeKalb, IL 60115

**Frontiers in Nutrition Supplement**
Danes Laboratories, Inc.
450 State Street
Chicago Heights, IL 60411

**H & N Scope**
H & N, Inc.
15305 NE 40th Street
Redmond, WA 98052

**Hotline**
Poultry & Egg Institute of America
52 East 63rd Street
Kansas City, MO 64110

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**HyLine Service Bulletin**
Customer Service Section
HyLine Poultry Farms
Lillas Center, IA 50063

**HyLine World**
HyLine International
1206 Mulberry Street
Des Moines, IA 50309

**Market Summary**
Sell Grain & Milling
P.O. Box 758
Perrius, CA 92370

**Marketing Report**
Ruaid Foods, Inc.
P.O. Box 5318
San Leandro, CA 94577

**New Bulletin-California Egg Program**
555 Capitol Mall, Suite 425
Sacramento, CA 94814

**Nicholas Turkey News**
Nicholas Turkey Breeding Farms, Inc.
P.O. Box Y
Sonoma, CA 95476

**The Practicing Nutritionist**
Dow Chemical - Ag Organics Dept.
2020 Dow Center
Midland, MI 48640

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**Shaver Focus**
Shaver News
Shaver Poultry Breeding Farms, Inc.
Cambridge, Ontario, Canada

**Trade Bulletin**
Pacific Egg & Poultry Assn.
5420 W. Jefferson Blvd.
Los Angeles, CA 90016

**United Voices**
United Egg Producers
1001 International Blvd., Suite 1105
Atlanta, GA 30354

**Whitmoyer Research Review**
Whitmoyer Laboratories, Inc.
Myerstown, PA 17067
Raising Geese, 75-LH/2225 (Rev. of AKT-289), Univ. of Calif. (5 pp).


Proceedings of 1975 Game Bird Workshops, Univ. of Calif. (32 pp).


Rodent Control on Poultry Farms, L-1351, Texas A & M Univ. (6 pp).

Chemical Control of Poultry Pests, Q-354, Univ. of Arizona (3 pp).

Control of Poultry Insect Pests-1975, EM7-28, Univ. of Ky. (3 pp).


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RABBIT WORKSHOPS

Riverside Campus - May 10

Davis Campus - May 17

Enclosed with this newsletter is an announcement of two rabbit workshops to be held this month. We would appreciate your help in publicizing these meetings and urging those you know with interest in rabbit production to attend.

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The University of California's Cooperative Extension Programs are available to all, without regard to race, color, or national origin.
The tables on pages 3-5 of this newsletter summarize the poultry industry data appearing in the 1974 Agricultural Commissioner reports. In 37 of the state's 58 counties there was sufficient income from either eggs or poultry to warrant inclusion in the respective county reports. Although there may be some variation in their accuracy, these are the only current data we have available on an annual basis to assist us in pinpointing the geographic location and shifts of the industry within California.

**Fryers**

According to the county data, fewer fryers (<0.5 percent) were produced in 1974 than in 1973. USDA figures indicate an 8.7 percent increase (table A). The USDA total is also higher by 35 million. Since fryers are in the hands of a small number of firms, accurate information should not be difficult to obtain and, therefore, closer agreement in USDA and county totals might have been expected.

Stanislaus replaced Merced as the leading fryer producing county, although the two were practically tied for 1st and 2nd ranking (table C). These two counties accounted for 66 percent of the state's total fryer production. Tulare experienced a substantial drop and fell from 4th to 5th place, with Fresno County retaining the No. 3 position. Los Angeles, with nearly a 60 percent production loss, dropped all the way to 10th place in the top 10-county ranking. Southern California produced only 4.2 percent of the state's fryers in 1974.

**Turkeys**

As in the case of fryer numbers, the USDA figure for turkey production is considerably higher (1.9 million more) than the county total (table A). USDA statistics show a small increase for 1974 over 1973; county data indicate nearly a 5 percent decrease.

Despite nearly a 25 percent decrease in turkey production in 1974, Fresno County easily retained its 1st place ranking. Merced dropped even more percentagewise (43 percent) but held on to second place. Tulare, with a gain in production, moved ahead of Kings County. Likewise, Stanislaus and Placer trades places held in 1973. In the south, Los Angeles increased production by more than one-third and moved ahead of its neighboring county, San Bernardino. The proportion of the state's turkey crop produced in the southern counties increased from 19.9 percent in 1973 to 22.9 percent in 1974.

**Poultry Income**

Combined income from the sale of fryers, turkeys, spent and cull hens, ducks, pheasants, and other poultry species dropped by 8.1 percent in 1974. The principal contributing factor was the substantial decrease in turkey prices (38.4 cents per pound in 1973 vs. 27.4 cents in 1974).

Stanislaus County moved into 1st place in the top ten with an income of over $43 million. In 1973 it was in 3rd place. The top three counties (Stanislaus,
Merced, and Fresno) accounted for nearly half (48.7 percent) of the state's poultry meat income. Ventura is ranked 4th, but the report for this county gave a combined figure for poultry meat and egg products income. On the basis of poultry meat alone, Ventura would not have ranked in the top ten. Sonoma County, which did not make the top ten in 1973, replaced Riverside in 10th place. However, the percentage of the state's poultry meat income generated in southern California increased from 21.6 percent in 1973 to 23.3 percent in 1974.

Layers and Egg Income

There was only one change between 1973 and 1974 in the rankings of the top 10 counties in layer numbers. Ventura moved from 8th to 6th place with a reported 94.2 percent increase. All other counties held their relative 1973 positions. The three leading counties (Riverside, San Bernardino, and San Diego) with 20 million layers accounted for 51.1 percent of the state's total. Southern California's proportion of the industry increased from 60.0 percent in 1973 to 64.6 percent in 1974 with respect to layers, but there was essentially no change in its share of egg income (60.8 vs. 61.0 percent).

Orange County continued to show a decline in layers (-12 percent), but all other counties in southern California reported some increase. In contrast, all of the northern California counties in the top ten, with the exception of Sonoma, experienced a decrease. Egg income was down in nearly every major producing county of the state because of the drop in average egg price of 5 to 6 cents per dozen from 1973 to 1974.

Cross Income

Income at the ranch level for all segments of the poultry industry dropped 5.1 percent from the record high of 1973, lower prices rather than decreased production accounted for most of the change. However, the poultry and egg industry remains one of the state's major commodities in terms of product value.

Stanislaus County, which had slipped to 3rd place in 1973 in gross income, regained 1st place ahead of Riverside and San Bernardino. San Diego moved up one notch to 4th place, changing places with Merced. Ventura County, with the largest percentage increase, moved from 8th to 6th, and Los Angeles County pushed Orange out of the top rankings to gain 10th place behind San Joaquin, Fresno, and Sonoma.

M. H. S.

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THE HAUGH UNIT

The "Haugh unit" is today's most widely used and accepted measure of albumen quality. The method was developed by R. R. Haugh and first described by him in a paper published in 1937 (U.S. Egg and Poultry Magazine 43:552-555 and 572-573).

Haugh noted that "observed" albumen quality varied as a logarithm rather than as a linear function of albumen height. Thus, for example, a change in height from 10 mm to 9 mm (a difference of 1 mm) in relatively less important from a quality standpoint than a change from 3 mm to 2 mm (also a 1 mm difference).

Therefore, Haugh proposed that albumen height as a quality measurement be improved upon by taking its log and multiplying by 100 to convert to whole numbers (Haugh units = 100 log H, where H is the height of the thick albumen in millimeters). Observed albumen quality now varies as a linear function of Haugh units, making averaging and other statistical manipulations of albumen quality data possible.

Haugh went one step further and modified his formula for the effect of egg size on observed quality. If two eggs of unequal size have the same albumen height, the smaller egg will appear to be of better quality. Haugh's formula became a very complicated one:

(continued on page 6)
### TABLE A: 1973-74 POULTRY AND EGG STATISTICS FOR CALIFORNIA

<table>
<thead>
<tr>
<th>Item</th>
<th>Ag. Commissioner Co. Totals</th>
<th>USDA Totals - California</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>millions</td>
<td>percent</td>
</tr>
<tr>
<td>Fryers</td>
<td>87.2</td>
<td>86.8</td>
</tr>
<tr>
<td>Turkeys</td>
<td>16.6</td>
<td>15.8</td>
</tr>
<tr>
<td>Poultry Income</td>
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<td>$210.2</td>
</tr>
<tr>
<td>Layers</td>
<td>38.8</td>
<td>39.2</td>
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<tr>
<td>Egg Income</td>
<td>$362.5</td>
<td>$347.5</td>
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<tr>
<td>Gross Income</td>
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<td>$557.7</td>
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* Layers on hand January 1, 1974.

### TABLE B: POULTRY INDUSTRY DISTRIBUTION BETWEEN NORTHERN AND SOUTHERN CALIFORNIA

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<th>Item</th>
<th>Northern California</th>
<th>Southern California*</th>
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<td>millions</td>
<td>percent</td>
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<tr>
<td>Fryers</td>
<td>82.6</td>
<td>93.6</td>
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<td>Turkeys</td>
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<td>54.8</td>
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* Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, Orange, and San Diego Counties.
### TABLE C: TEN TOP COUNTIES IN POULTRY MEAT PRODUCTION IN CALIFORNIA - 1974

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<td>Fresno</td>
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<td>-1.0</td>
<td>Fresno</td>
<td>27,527</td>
<td>- 20.8</td>
<td>Stanislaus</td>
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<td>+ 54.1</td>
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<td>Fresno</td>
<td>27,527</td>
<td>- 20.8</td>
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<tr>
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<td>Sonoma</td>
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<td>+ 1.0</td>
<td>L.A.</td>
<td>1,530</td>
<td>+ 34.4</td>
<td>Ventura</td>
<td>17,974</td>
<td>+ 85.4</td>
<td>1.53</td>
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<td>Ventura</td>
<td>17,974</td>
<td>+ 85.4</td>
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<tr>
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<td>1.36</td>
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<tr>
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<td>0.89</td>
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<td>Kings</td>
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<td>L.A.</td>
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<td>Sonoma</td>
<td>5,787</td>
<td>- 11.2</td>
<td>L.A.</td>
<td>1,035</td>
<td>+ 59.3</td>
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### TABLE D: TEN TOP CALIFORNIA COUNTIES IN EGG PRODUCTION/GROSS INCOME - 1974

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<tr>
<th>Rank</th>
<th>Co.</th>
<th>No.</th>
<th>Change</th>
<th>Co.</th>
<th>Dollars</th>
<th>Change</th>
<th>Co.</th>
<th>dollars</th>
<th>Change</th>
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<th>percent</th>
<th>Co.</th>
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<td>1</td>
<td>Yrsde.</td>
<td>7,411</td>
<td>+ 2.5</td>
<td>Yrsde.</td>
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<td>- 9.3</td>
<td>Stanislaus</td>
<td>87,910</td>
<td>+ 20.9</td>
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<tr>
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<td>S.Bano.</td>
<td>6,600</td>
<td>+ 1.0</td>
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<td>- 10.5</td>
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<td>65,617</td>
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<td>S.Diego</td>
<td>6,000</td>
<td>+ 7.7</td>
<td>S.Diego</td>
<td>46,740</td>
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<td>S.Diego</td>
<td>47,340</td>
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<td>S.Diego</td>
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<td>Stanislaus</td>
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<td>47,340</td>
<td>- 7.6</td>
<td>44.37</td>
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<td>43,769</td>
<td>- 18.2</td>
<td>S.Diego</td>
<td>47,340</td>
<td>- 7.6</td>
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<td>S.Joaquin</td>
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<td>Ventura</td>
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<td>- 20.1</td>
<td>Fresno</td>
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<td>- 5.1</td>
<td>Fresno</td>
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<td>L.A.</td>
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<td>+ 8.7</td>
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<td>No. of</td>
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<td>Egg Income</td>
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<td>6,176,000</td>
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<td>*</td>
<td>98,900**</td>
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1/ Dressed poultry meats including chickens, turkeys, pheasant, duck, etc. Does not include chicks or poult.
2/ Includes market eggs and hatching eggs.
3/ Includes replacement pullets.
4/ Includes turkey hatching eggs.
5/ Income for poultry meat adjusted to reflect liveweight price.
6/ Includes some egg products.

* Not reported separately.
** Number of layers not reported in Commissioners reports calculated on the basis of 19 doren eggs per hen per year.

Source: Agricultural Commissioners reports.
Poultry Parade

## HAUGH UNITS (continued from page 2)

\[
\text{H.U.} = 100 \log \left( 1 + \frac{H}{W - 100} \right) = 3.7
\]

where H.U. = Haugh units, \( H \) = height of thick albumen in mm, \( W \) = weight of the egg in grams, and 3.7 is the gravitational constant (32.2). 

## RECENT PUBLICATIONS

- **Methods of Measuring Feed Consumption in Poultry Flocks**, 75-12/2324, Univ. of Calif. (4 pp).
- **Building a Chick Brooder House (2-H)**, Univ. of Calif. – SJV Ag. Res. & Ext. Center (Ralph G. Host). (7 pp).
- **California Waterfowl and Its Management**, 75-12/2247, Univ. of Calif. (32 pp).
- **Egg Pricing and Marketing Arrangements at the Producer Level in New York State**, A.E.Res. 75-3, Cornell Univ. (54 pp).

## The Broiler Industry: Status and Potential
- Bell, 823, Mississippi State Univ. (8 pp).

## Direct Egg Marketing: Farm to Retail Stores

## Impact of Changes in Delivery Procedures on Fresh Shell Egg Futures Contract
- Special Report 156, Univ. of Missouri (24 pp).

## A Study of Fresh Shell Egg Futures Deliveries and General Observation of Futures Contract Deliveries
- S. R. 154, Univ. of Mo. (50 pp).

## Eggs in Family Meals

## Quail Management
- Inf. Sheet 626, Miss. State Univ. (2 pp).

## Wood Duck in Mississippi
- Inf. Sheet 643, Miss. State Univ. (2 pp).

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Ralph G. Host

Milo H. Swanson

Extension Poultry Specialist

Extension Poultry Specialist

Davis Campus

Riverside Campus