Chicken Hatching Egg Production

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Foreword

Production of chicken eggs for hatching has been an important industry in Oregon for a number of years. Climatic conditions in much of the State are particularly well suited for the production of high-quality hatching eggs. To protect and further develop this phase of the poultry industry, the Oregon Agricultural Experiment Station has been conducting a research program in this field.

This bulletin, written in a non-technical manner, presents the results of this research. In addition, the author has drawn on the results of research conducted elsewhere in order to present a more complete bulletin for the benefit of hatching egg producers in the State.

F. E. Price

Dean and Director
Chicken Hatching Egg Production*

J. E. Parker
Poultry Husbandman

THE production of quality hatching eggs involves more than putting roosters with a flock of hens. Every condition for the efficient production of market eggs is required for the production of hatching eggs, and in addition there are many other requirements. In general only those poultrymen who have been successful in market egg production should undertake the production of hatching eggs. Inexperienced poultrymen considering the hatching egg business should become familiar with the principles of feeding, management, and disease control in laying flocks.

The prospective hatching egg producer also should compare carefully the advantages and disadvantages of producing hatching eggs with producing market eggs. Of course, the principal attraction of producing hatching eggs is that a premium is usually paid. When hatching eggs are sold 8 to 12 months a year, less premium will be required than when the hatchery takes them for only a few months. Against these premiums paid for hatching eggs the expense of keeping male birds, the higher cost of breeder mash, and in some cases the cost of Pullorum testing and flock selection must be charged. The strain or breed of chickens for which there is a good hatching egg market might not be the most efficient one for market egg production, and in case there is a difference in the rate of lay, this difference should be considered.

In addition to the premiums they receive for eggs, some poultrymen derive considerable pleasure and personal satisfaction from producing high quality hatching eggs.

The climate of much of Oregon is well suited for the production of hatching eggs. Mild winters and cool summers are conducive to relatively high fertility and hatchability. The fact that considerably over a million dollars worth of hatching eggs are shipped out of the state each year, in addition to the eggs required to hatch 12 million chicks in hatcheries within the state, indicates that many Oregon farmers are finding hatching egg production profitable.

*Information shown in Figures 3 and 6 and Tables 3 and 4 is from investigations at the Oregon Experiment Station, financed in part by the American Poultry and Hatchery Federation.
**Selection of Breeding Stock**

**Selecting a strain**

High egg production is an important factor in the economical production of hatching eggs as well as market eggs and emphasis must be placed on this trait. Flock owners are aware that some strains are much more efficient layers than others. No flock owner is going to be satisfied with a strain of mediocre egg producers, regardless of its other desirable qualities, unless the hatcheryman pays a sufficient premium to compensate for the lower production.

Hatcherymen selling chicks for replacements in commercial egg flocks have already learned that they must supply chicks of a strain that will not only lay well, but in addition will lay eggs that have desirable size and shape, shell texture, and interior quality. A most important factor is that they have good livability.

Commercial broiler raisers are very discriminating. They are constantly looking for chicks that will grow and feather faster and utilize feed more efficiently. In the last ten years great progress has been made by a number of breeders in improvement of meat production qualities of chickens. Hatcherymen supplying chicks to the broiler trade must have a strain that is bred for meat production. Unfortunately many of the meat production strains are inferior egg producers. Developing a strain that excels in both egg production and meat production qualities is a challenge to poultry breeders.

Strains vary also in hatchability. Hatchability is inherited. Many breeders have developed strains that will hatch considerably above the average for the breed. It is to the advantage of the hatcheryman to have high hatchability strains in his hatching-egg supply flocks.

For many years there was a notion that although hatchability of fertile eggs was inherited, fertility was not. However, as many hatcherymen have observed, there are distinct differences between strains in fertility of eggs. Recent research has shown that fertility, like both egg production and hatchability, is inherited.

**Inbreeding and crossbreeding**

As a general rule close inbreeding of chickens results in a decrease in hatchability. While there is considerable experimental data to back up this statement, many hatching egg producers have an unfounded fear of inbreeding to the extent that they want males of a different strain every year. Unless your flock is less than 100 to 150 birds you need not be particularly concerned about inbreeding because the degree of inbreeding in larger flocks usually is inconsequential.
Crossbreeding often increases hatchability. When hatchability in a strain is low, crossing it with another breed or strain usually results in an increase in hatchability, but when hatchability in a strain is high crossbreeding may result in little if any improvement.

![Figure 1. Chickens selected for breeders should conform to breed and varietal characteristics and be vigorous and free from any apparent disease condition.](image)

**Selecting individuals**

Too much care cannot be taken in selecting the individual birds to make up the breeding flock. Both males and females should conform to breed and varietal characteristics, and be free from such serious defects as crooked backs, beaks and breasts, knock-knees, and gray eyes with irregular pupils. Underweight individuals, as well as those showing symptoms of a diseased condition, should be taken out of the flocks. When yearling hens are to be retained for breeding purposes, only those that show evidence of past heavy egg production should be selected. Hatching egg producers should be familiar with contents of Oregon Extension Bulletin 673, “Culling the Poultry Flock.”

In flocks producing hatching eggs for broiler chicks, the breeding stock, particularly the males, should be examined at broiler weights as well as at maturity. Select for breeders those individuals
which showed rapid growth and feathering and good fleshing at broiler weights. Considerable progress can be made in improving the inheritance of chickens by selecting and breeding from individuals that excel in these qualities.

Select the most vigorous males as breeders. Less vigorous males are apt to be dominated and do little to increase the fertility of the flock.

**Pullet versus hen flocks**

Regardless of the advantages claimed for chicks from old hens, most of the hatching eggs produced are from pullet flocks. Pullet flocks not only lay more eggs but they produce eggs with better shells. Although experimental data on comparative hatchability of hens and pullets do not all agree, they indicate that pullet eggs hatch more chicks.

![Figure 2. Experiments with growing chickens demonstrate inherited differences in rate of growth and rate of feathering. Both chicks above are from the same brood. Breeding stock of the meat breeds should be examined at broiler weights for feathering and rate of growth.](image)

**Blood testing**

Flocks used to produce hatching eggs should be free from Pul- lorum disease. Birds that are to be used as breeders should come from Pullorum-free flocks and should be blood tested for Pullorum
disease. Hatcherymen may supervise the blood testing of flocks producing eggs for them, or in some cases the flock owners may arrange to have their own flocks blood tested. For further information on Pullorum disease see Oregon Agricultural Experiment Station Bulletin 451.

Management of Breeders

Feeding

In addition to supplying all the nutrients required by the breeder hens, a good breeder ration should provide the eggs with all nutritive factors required to develop and hatch the chick. Eggs lacking or deficient in any of the essential nutrients may result in either the failure of the egg to hatch or inability of the chick to live or develop normally.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Ration 1</th>
<th>Ration 2</th>
<th>Ration 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat mixed feed</td>
<td>250</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Wheat, ground</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Corn, ground</td>
<td>400</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Oats, ground</td>
<td>200</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Barley, ground</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Alfalfa meal</td>
<td>150</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>250</td>
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<td>300</td>
</tr>
<tr>
<td>Meat meal</td>
<td>50</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Fish meal</td>
<td>80</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>Skim milk, dried</td>
<td>40</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Whey, dried</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distilled dried solubles</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oystershell flour</td>
<td>40</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Steamed bone meal</td>
<td>30</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Salt, iodized</td>
<td>20</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Fish oil (400 D, 3,000 A)</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Irradiated animal sterol</td>
<td></td>
<td></td>
<td>1.25</td>
</tr>
<tr>
<td>*Manganese sulphate</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>*Riboflavin, synthetic</td>
<td>1 gram</td>
<td>1 gram</td>
<td>2 grams</td>
</tr>
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</table>

Total ingredients, pounds ...... 2,000 2,000 1,980

Calculated analysis

<table>
<thead>
<tr>
<th></th>
<th>Per cent</th>
<th>Per cent</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>18.0</td>
<td>21.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Fat</td>
<td>4.5</td>
<td>4.3</td>
<td>4.7</td>
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<tr>
<td>Fiber</td>
<td>6.0</td>
<td>5.7</td>
<td>6.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.9</td>
<td>2.4</td>
<td>2.0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>.9</td>
<td>1.1</td>
<td>1.2</td>
</tr>
</tbody>
</table>
A good laying ration is not necessarily a good breeder ration. Considerably more of certain nutrients, such as riboflavin, manganese and Vitamin B$_{12}$ are required for the production of hatching eggs. It is most important that hatching egg producers use a good breeder mash. In most instances a commercial mash prepared by a reliable feed company will be used, but in case the flock owner wishes to mix his own mash, the formulas shown in Table 1 are suggested.

Many breeder mashes are compounded to be fed on a 50-50 weight basis with scratch grains and for that reason the flock owner should be careful not to feed too much grain. Observations at the Oregon Agricultural Experiment Station have shown that when scratch grains are fed free-choice with a mash containing 20 per cent protein some flocks consume as much as 65 to 70 per cent scratch grain. Unless the manufacturer indicates that scratch can be fed free-choice with his breeder mash, try to keep the consumption of scratch to not over 50 per cent, by weight, of the ration. Each 100 chickens in the breeder flock will eat approximately 25 pounds of mash and scratch daily; therefore not more than 12 to 13 pounds of scratch should be fed to each 100 breeders per day. The amount of feed required daily will depend upon body size and rate of production. Large breeds eat more than Leghorns and heavy layers eat more than poor layers.

To insure maximum feed consumption allow 32 lineal feet of hopper space for each 100 breeders. A hopper 8 feet long which permits the birds to eat from both sides provides 16 lineal feet of feeder space. Two such hoppers provide feeding space for 100 layers.

*Remember that many of the vitamins and minerals and most of the protein required for the embryo to develop and hatch into a vigorous chick are in the mash, not in the scratch feed.*

It is a good plan to feed the breeder ration for 3 or 4 weeks before starting to save hatching eggs. Such a practice is especially desirable in cases where regular laying mash has been fed previously to flocks in reasonably high production.

Experimental evidence has shown that on some rations, particularly those lacking in animal protein supplements, hatchability was greater in flocks on deep or built-up litter. Chickens obtain riboflavin and Vitamin B$_{12}$ from deep litter, both of which have a beneficial influence on hatchability. Because of wide variations possible in its nutritive content, the hatching egg producer should not, however, count too heavily on deep litter making up for deficiencies in the ration. He should feed a good breeder mash irrespective of the type of litter used.
Housing

Chicken breeder flocks should be comfortably housed but expensive or elaborate houses are not necessary. The houses should provide plenty of fresh air and floor space. It has been shown that 3 to 4 square feet of floor space per hen is required for maximum egg production. Results at the Delaware Experiment Station showed that varying the amount of floor space from 3 to 5 square feet per bird had little or no influence on hatchability, but flocks of New Hampshires with 4 square feet laid more eggs than those with 3 square feet.

In the more rigorous climates houses should protect breeders from extremes in temperature. Extreme cold may result in a drop in egg production and in a drop in fertility, particularly if the combs and wattles of the males are frozen. Also, in extremely hot weather egg production, fertility, and hatchability decline. Experiments at the Southwest Experimental Station of the U. S. Department of Agriculture at Glendale, Arizona, clearly demonstrate the effect of high temperatures on fertility and hatchability. See Table 2.

Table 2. Fertility and Hatchability when the Environmental Temperature of Chickens Is High.*

<table>
<thead>
<tr>
<th>Average maximum air temperature</th>
<th>Mean air temperature</th>
<th>Fertility</th>
<th>Hatchability of fertile eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Degrees F.</td>
<td>Per cent</td>
<td>Per cent</td>
</tr>
<tr>
<td>82.8° F.</td>
<td>64.4</td>
<td>92.5</td>
<td>78.8</td>
</tr>
<tr>
<td>86.2° F.</td>
<td>65.7</td>
<td>92.4</td>
<td>79.3</td>
</tr>
<tr>
<td>93.0° F.</td>
<td>76.9</td>
<td>91.6</td>
<td>78.5</td>
</tr>
<tr>
<td>97.5° F.</td>
<td>81.4</td>
<td>86.8</td>
<td>72.2</td>
</tr>
<tr>
<td>101.8° F.</td>
<td>87.1</td>
<td>80.4</td>
<td>67.9</td>
</tr>
<tr>
<td>106.8° F.</td>
<td>93.0</td>
<td>73.8</td>
<td>55.1</td>
</tr>
</tbody>
</table>

* Southwest Experiment Station, U. S. Department of Agriculture.

Since clean, uncracked eggs are desirable for hatching, the flock owner should provide nests of proper construction and enough of them. For each 5 hens allow one single-unit nest, or if community-type nests are used allow approximately one square foot nesting area for each 5 layers. There should be an adequate amount of nesting material and it should be replaced when soiled. Wood shavings, rice hulls, straw, and excelsior are commonly used for litter in hens' nests. Having a broody coop handy will keep broodies out of the nests, making them available for the layers, and will also aid in keeping nest litter clean.
Artificial lights

Artificial lighting causes more eggs to be laid during the fall and the early winter months as compared with unlighted flocks. Since eggs are usually higher in price in the fall and since lights have no harmful influence on fertility or hatchability, most flock owners use artificial lighting during the fall and winter when the days are short. Use that amount of artificial light necessary to provide 13 to 14 hours of total light per day.

Range versus confinement

Advances in poultry nutrition make it possible to produce quality hatching eggs in confinement. Although breeding stock may derive benefit from a good pasture range, many hatching egg producers either do not have enough acreage to provide sanitary ranges or do not find them practical. Results of experiments at the Delaware Station showed that fertility and hatchability of crossmated flocks (Barred Rocks x New Hampshires) kept in confinement were no different from those of similar flocks with range.

Improving Fertility

An egg is fertile when a sperm has united with the female reproduction cell located on the yolk of the egg. The egg is fertilized in the front part of the oviduct just after the yolk has been ovulated and approximately 24 hours before the egg is laid. As every hatcheryman knows, not all eggs that are fertile hatch into chicks—some may die a short time after fertilization and others die at various stages of the incubation period. In general practice, fertility is measured by incubating eggs and candling them. The clear eggs are termed infertile. Actually some of these clear eggs will contain embryos that died at an early age.

A number of factors have been found to influence fertility of hens' eggs; some of these, such as age and inheritance, have already been pointed out. Some other things that affect fertility are discussed in the following paragraphs.

Ratio of males to females

Investigations at the Oregon Agricultural Experiment Station over a three-year period on the influence of the relative number of males used in chicken breeder flocks have yielded interesting results. With the New Hampshire breed 6 to 7 males per 100 hens are enough to insure consistent high fertility. See Figure 3. In many instances, as few as 3 to 5 males fertilized a high percentage of the eggs. In two flocks in which a single male was mated to approxi-
Figure 3. Effect of relative number of males in New Hampshire breeder flocks on fertility of eggs. For consistent high fertility 6 to 7 males per 100 females are required.

mately one hundred hens the fertility of eggs was 73 and 83 per cent. This shows that in the case of especially valuable males, their progeny may be greatly increased by mating them to large numbers of hens.

Results with White Leghorns have shown that highly fertile hatching eggs can be produced using 5 males per 100 hens. Using a greater number of males is likely to reduce fertility, especially in confined flocks, because of interference and fighting.

In crossmated flocks (Dark Cornish males x New Hampshire females) 5 to 6 males per 100 hens gave just as high fertility as using as many as 11 to 12 males per 100 hens.

When it is desirable to use breeding males of a strain or variety different from his flock, the flock owner should purchase them as
hatching eggs or day-old chicks. Start two or three cockerel chicks for each breeding male you expect to use. In cases where it is necessary to bring mature males onto the farm, caution should be taken against introducing a disease.

**Onset and duration of fertility**

Usually a reasonably high percentage of fertile eggs can be expected a week after the males are put in the flock but maximum fertility will not be reached until approximately two weeks after adding males. Results at the Oregon Agricultural Experiment Station show that the time required for flocks of New Hampshire breeders to reach maximum fertility ranged from 9 days when 9 males were used per 100 hens to 16 days with 4 males per 100 hens. See Table 3.

**Table 3. Relation of the Number of Males Used in New Hampshire Breeder Flocks to the Time Required for Maximum Fertility to Be Attained.**

<table>
<thead>
<tr>
<th>Average number of males per 100 hens</th>
<th>Days after males put in the flock for maximum fertility</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>7.3</td>
<td>11</td>
</tr>
<tr>
<td>5.4</td>
<td>14</td>
</tr>
<tr>
<td>3.7</td>
<td>16</td>
</tr>
</tbody>
</table>

On a number of occasions, chicken hens have laid fertile eggs for as long as 30 days following mating or artificial insemination. Fertility usually starts to decline 3 to 4 days after mating, however, and declines rapidly after 7 days. Satisfactory fertility in flock matings will not persist for more than a week after the males are removed. Except under unusual conditions the males will be kept in the breeder flocks as long as hatching eggs are being produced.

**Dubbing**

Dubbing, or the removal of the comb and wattles from males, is a practice that is being used by an increasing number of hatching egg producers. Figure 4 shows dubbed and undubbed males. With breeds having large combs and wattles, such as New Hampshires and Leghorns, dubbing males will prevent frost injury to comb and wattles, which may result in greatly reduced fertility. Also, dubbed males can eat more readily from many types of feeders and they are not as scared or wary of other males as are undubbed males.

It is best to dub the males while young (8 to 12 weeks old) but older males and even mature males can be dubbed satisfactorily. A
Figure 4. Dubbing the combs and wattles of the breeding males causes them to be less wary of other males, makes it easier for them to eat out of certain types of feed hoppers, and eliminates frost injury to combs and wattles.

Pair of scissors or small tin snips may be used to cut off the comb and wattles. Some poultrymen use a hot iron to sear the cut surfaces to reduce the amount of bleeding. Do not dub and vaccinate males at the same time. Also, do not dub males immediately before or during hatching season as it may take a few weeks for males to regain completely their vigor and fertilizing capacity.

Age of males

Breeding males should be at least six months of age before being used in breeder flocks. Some of the early sexually maturing strains of Leghorns and New Hampshires may fertilize a high percentage of eggs at younger ages whereas males of some of the slower maturing strains of these two breeds and other breeds will not reach maximum fertility until 7 to 8 months of age. In developing cockerels those with the largest combs reach sexual maturity sooner than the others.

Season

During the late summer and fall months, fertility in yearling flocks often declines. Evidence to date indicates that the drop is due partially to the fact that hens which have been laying for a long time
are difficult to fertilize. Also, sperm production in yearling males declines during the fall. In old cocks high fertility may not be regained until spring. This is one reason for using cockerels instead of older males in breeder flocks.

**Selection of Hatching Eggs**

Certain physical characteristics of eggs are related to hatchability. For best results hatching eggs should be neither too large nor too small. They should be of normal shape with strong clean shells.

**Egg size**

Size or weight of eggs is related to hatchability. Most of the time average size eggs will hatch better than eggs that are considerably larger or smaller than the average for the flock. See Figure 5. Eggs weighing between 24 and 26 ounces per dozen are preferred. Although average size eggs usually hatch best, eggs from some individuals and from some flocks weighing up to 30 ounces per dozen hatch satisfactorily.

Chicks hatched from small eggs are smaller than chicks hatched from large eggs and as a general rule they do not grow as rapidly or

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**Figure 5.** Influence of egg weight upon hatchability of hens' eggs. Eggs of medium weight hatch best. (Plotted from data of Godfrey, U. S. Department of Agriculture.)
utilize their feed as efficiently. Results of experiments at the Arkansas Experiment Station have shown, however, that chicks hatched from small eggs of pullets just coming into lay, while smaller at hatching time, were about as heavy at broiler weights as chicks hatched from larger eggs of older females. For best results the small chicks from pullet eggs should not be brooded together with large chicks.

Shell thickness

Eggs with thick, strong shells hatch better than eggs with weak shells. At the Oregon Agricultural Experiment Station egg shell thickness is measured by floating eggs in salt solutions of various concentrations. The specific gravity of eggs thus observed is highly correlated with the thickness of the shell. Figure 6 shows the relationship of specific gravity to hatchability of hens' eggs.

![Figure 6. Eggs with thick shells hatch best. The above figure shows the relation of specific gravity, a measure of egg shell thickness, to hatchability. (From data of C. E. Stotts, Oregon Agricultural Experiment Station.)](image-url)
It is difficult to select eggs for thickness of shell by sight—even with the aid of an egg candling device. Only the extremely thin shelled eggs and eggs with rough or abnormal shells can be detected by appearance. Of course, these eggs should not be incubated. Checks or cracked eggs can be detected either by candling or tapping the small ends of two eggs together and noting the sound.

A rather common belief is that eggs with shells that appear mottled before the candle do not hatch well. Results obtained at the Missouri Station showed that eggs with mottled shells hatched as well as the others.

**Egg shell color**

With breeds of chickens that lay brown shelled eggs there is a relationship between the degree of shell pigmentation and hatchability. There is a tendency for the medium and dark colored eggs to hatch better than the light colored ones. Table 4 shows the relation of color to hatchability of New Hampshire eggs. In view of the data and in view of the fact that uniform shell color is desirable in market eggs it would appear that hatcherymen would do well to select hatching eggs for a uniform color—any color from medium brown to dark brown, with breeds that lay brown eggs.

Hatching eggs from Leghorns and other white shelled breeds should be chalk white. Since the tendency to lay tinted or creamy eggs may be inherited, hatcherymen should not put such eggs in their incubators.

**Table 4. Influence of Egg Shell Color on Hatchability of New Hampshire Eggs.**

<table>
<thead>
<tr>
<th>Color</th>
<th>Hatchability of fertile eggs</th>
<th>Hatchability of all eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Per cent</strong></td>
<td><strong>Per cent</strong></td>
</tr>
<tr>
<td>Very light brown</td>
<td>71.1</td>
<td>64.1</td>
</tr>
<tr>
<td>Light brown</td>
<td>76.1</td>
<td>66.9</td>
</tr>
<tr>
<td>Medium brown</td>
<td>78.9</td>
<td>70.5</td>
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<tr>
<td>Medium dark brown</td>
<td>81.8</td>
<td>76.0</td>
</tr>
<tr>
<td>Dark brown</td>
<td>84.1</td>
<td>74.5</td>
</tr>
<tr>
<td>Very dark brown</td>
<td>78.6</td>
<td>72.5</td>
</tr>
</tbody>
</table>

*Courtesy C. E. Stotts, Oregon Agricultural Experiment Station.*

**Egg shape**

Although variations in egg shape ordinarily encountered have not been observed to affect hatchability, hatching eggs should have
Figure 7. Double yolk and abnormally shaped eggs should not be used for hatching. (1) Double yolk, (2) ridges in shell, (3) irregular shape, (4) pointed egg, (5) round egg, and (6) long eggs are common types of abnormal eggs. Eggs 7, 8, 9, 10, 11, and 12 have desirable normal and reasonably uniform shape. Egg shape like egg size is hereditary.

Eggs of abnormal shape and double yolk eggs hatch poorly and should not be kept for hatching purposes.

Care of Hatching Eggs

Improper care of hatching eggs on the farm can greatly reduce their hatchability. Hatching eggs should be gathered frequently—preferably three times daily under usual conditions and more often during subfreezing weather.

Handling

Hatching eggs should be handled with care at all times. Rough handling may result in disorganization of the interior of the egg or cracked shells. Either will reduce the number of chicks hatched. All eggs, whether for hatching or market, should be placed in the case with the small end down. Placing them with the large end down often results in tremulous air cells. Such eggs have reduced hatch-
Figure 8. Hatching eggs should be held in an egg-storage room and should be turned daily if they are stored longer than one week.

ability. To avoid soilage use clean—preferably new—fillers and flats; to avoid breakage use strong egg cases.

When hatching eggs are delivered to the hatchery once a week it is not necessary to turn them. When stored for longer periods they should be turned once daily. A simple method of turning is to lean the egg case at a 45° angle against a wall and reverse the ends of the case daily. See Figure 8.

Clean eggs

Because of the labor required to clean soiled eggs, and because of a possibility of reducing hatchability with most methods of cleaning eggs, the hatching egg producer should make every effort to produce a high percentage of clean eggs. With proper management, only a small number of hatching eggs produced will require cleaning. When it is considered necessary to clean eggs they may be either carefully hand buffed with sandpaper or washed with clean warm water. Whenever hatching eggs are washed it is important that the water be warmer than the eggs. Dirty eggs cleaned by any method are apt to be inferior to eggs that are produced clean and kept clean.

Storage

Results of experiments at the U. S. Department of Agriculture Research Center and at the University of Missouri and elsewhere show that eggs hatch best when they are stored at temperatures of 50° to 60° F. before they are incubated. See Figure 9. While it
CHICKEN HATCHING EGG PRODUCTION

Held 1-7 Days

Held 8-13 Days

Figure 9. The effect of holding temperatures on hatchability of hens' eggs. Eggs should be held at 50 to 60°F prior to incubation. (Courtesy of E. M. Funk, University of Missouri.)

may not be practical for all flock owners to provide storage within this temperature range at all times, hatching eggs should not be subjected to temperatures above 80°F or below freezing for any appreciable length of time.

Although temperature is the most important factor in hatching egg storage, humidity, or moisture, also is related to hatchability. Experiments at the Oregon Agricultural Experiment Station have shown that eggs hatch best when the humidity of the storage room is 80 to 90 per cent. High humidities reduce moisture loss from the eggs. A humidified egg room similar to that described in Station Circular 138 will assist the producer in providing proper storage conditions for his hatching eggs.

Hatching egg producers usually deliver eggs to the hatchery at least once a week. Unless storage conditions on the farm are very good, hatchability will decline after eggs are a week old. When eggs are stored under ideal conditions, however, they may be saved for 10 days to two weeks and still hatch reasonably well but it should be kept in mind that few flock owners have ideal hatching egg storage conditions. When hatching eggs are to be shipped considerable distances and spend several days in transit, storing eggs on the farm for periods less than 7 days may be desirable.