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### Thin-shelled eggs

R H. Morris  
*Department of Agriculture*

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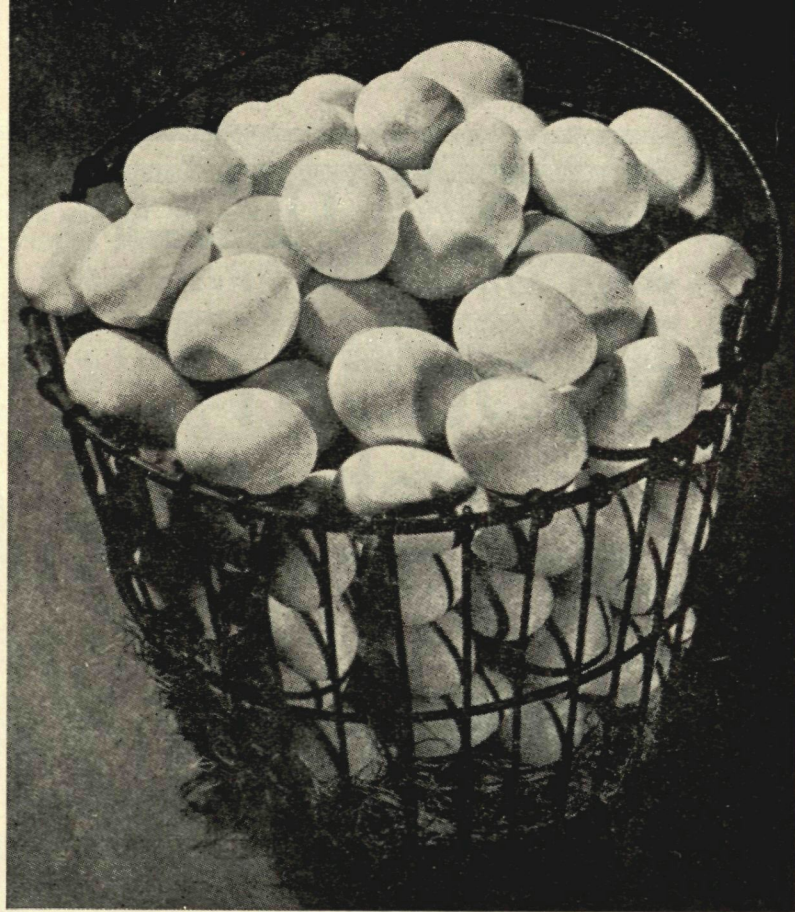
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# THIN-SHELLED EGGS

By

R. H. MORRIS, B.Sc. (Agric.)  
Officer in Charge, Poultry Branch

**T**HIN-SHELLED eggs are responsible for a loss of thousands of pounds annually to the West Australian poultry industry. To a very large extent the flock owner can control the percentage of thin-shelled eggs laid by his flock and this article outlines how this control can be exercised.



The shell of a thin-shelled egg is usually rough to the touch, and is thinner, weaker and more porous than that of a normal egg.

Thin-shelled eggs should not be confused with shell-less eggs as each are the result of a different set of circumstances. Shell-less eggs are usually laid while the birds are roosting and, as explained later in this article, it is not practicable to prevent the flock from laying shell-less eggs. It is however both practicable and possible to keep the number of thin-shelled eggs laid by any flock to a minimum.

## ECONOMIC IMPORTANCE

Thin-shelled eggs are an embarrassment to everyone connected with them, and are responsible for a loss to the poultry industry of thousands of pounds annually. The first loss occurs in the nest where, owing to their fragility, thin-shelled eggs are easily broken. As

a consequence fewer eggs are harvested, and a proportion of those harvested are soiled to such an extent by the contents of the broken eggs that their market value is materially reduced. Nest litter also becomes soiled and has to be frequently renewed.

Thin-shelled eggs are often the cause of a very serious vice, namely that of egg-eating, being initiated in a flock. This vice can have very serious consequences and every precaution should be taken to prevent its occurrence.

Thin-shelled eggs are apt to break on their way to market. This causes further financial loss through egg and filler soilage.

Even though a thin-shelled egg may withstand the journey to the grading floor, it must inevitably be graded as a "second quality" egg.

Apart from its inability to withstand normal handling, a thin shell encourages rapid evaporation of the moisture



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content of the egg, resulting in undue lowering of the air cell. Associated changes in the consistency of the thick albumen cause the yolk to have a cloudy appearance and this in conjunction with the low air cell gives the egg all the characteristics of a stale egg.

This excessive and rapid loss of moisture through the pores of thin-shelled eggs causes thousands of dozens of eggs to be downgraded annually. There are degrees of shell thickness but any shell thinner than that of a normal egg permits excessive evaporation.

To ensure a maximum return for his produce, every farmer should aim to produce as many sound-shelled eggs as possible. The most effective way of achieving this is to ensure that the hens receive correct levels of calcium and phosphorus in their diet throughout the year. These essential minerals are supplied in the proper proportions by adding to the mash correct amounts of sterilised bonemeal and oyster flour.

### SEASONAL INCIDENCE

Very few thin-shelled eggs are produced during the winter and early spring, and it is not until the late spring and summer months that they become prevalent. In the majority of cases where this trouble is experienced the cause can be traced to faulty feeding. By always providing fowls with a diet which contains the correct minerals in the proper proportions, it is a relatively easy matter to harvest a high proportion of sound-shelled eggs throughout the year.

When the ration is lacking in essential minerals, hens usually manage to lay eggs with sound shells during the winter and spring months by drawing on their skeletal mineral reserve. There comes a time, however (early summer) when this supply becomes exhausted and the fowls have no alternative but to lay thin-shelled eggs.

Consequently at this period each year the Western Australian Egg Marketing Board becomes concerned over the shell quality of eggs received from individual

growers. The deterioration in shell quality has, during recent years, been expressing itself progressively earlier in the season until this year (1952), consignments of thin-shelled eggs were received by the Egg Marketing Board as early as mid-October. This state of affairs can, I feel, be explained by the fact that generally speaking present day pullet flocks are giving a better account of themselves than their counterparts of a few years ago.

More eggs per bird means a bigger demand for minerals with which to make extra egg-shells and unless these minerals are supplied right throughout the year, high-producing flocks cannot be expected to lay a high percentage of hard-shelled eggs from November onwards.

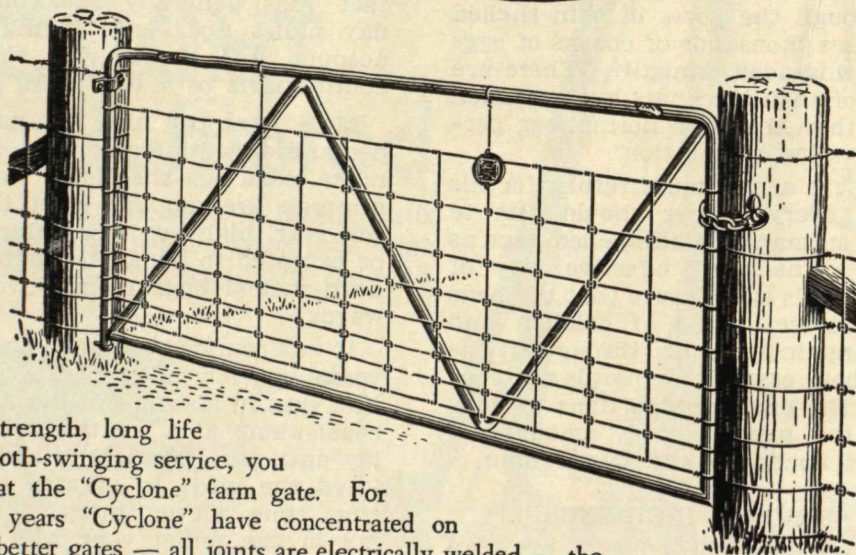
It was common, up until three or four years ago, for pullet flocks to lay their first eggs in March, April or May and to coast along at a relatively low rate of lay until the influence of spring stimulated the birds to greater efforts. At that time, eleven months' continuous lay in the pullet year was considered good. Now, however, many farmers, having learnt how to successfully overcome the "autumn lag" in production are demanding earlier-hatched chickens and are picking up their first pullet eggs in November or December. Their flocks are achieving a 60% lay within six weeks of the commencement of production and are maintaining this rate of lay for 12 months plus a 50% lay for a further two months.

Many flocks maintain this high rate of lay for 14 consecutive months without being excessively culled and lay a high percentage of eggs with strong shells throughout the full period, the shell strength being maintained through correct feeding.

Other flocks, that are incorrectly fed, commence laying soft-shelled eggs in November after laying for eleven consecutive months. By adjusting the mineral content of the diet the trouble can usually be rectified within a few weeks of first noticing a deterioration



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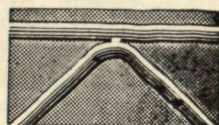
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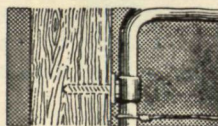
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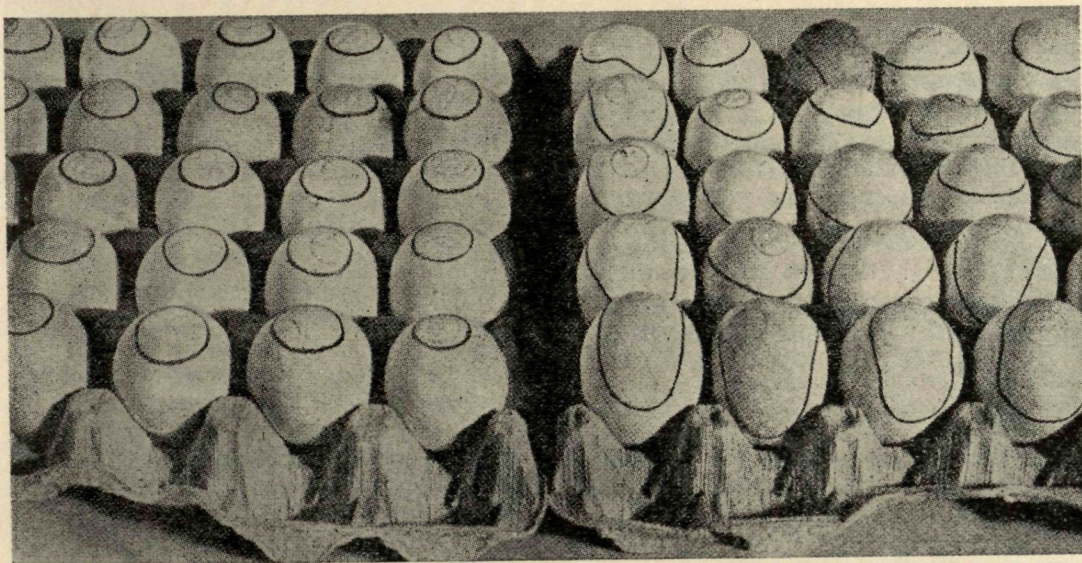
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Thin-shelled eggs encourage rapid evaporation of the moisture content of the egg, resulting in undue lowering of the air cell. The importance of this factor is illustrated in this photograph of normally-shelled eggs landed in London.

The air cells have been plotted on the outsides of the shells. The eggs on the left were oil-processed to seal the shells. Those on the right were not processed. Air cells in thin-shelled eggs would be even larger than those shown here.

in shell quality. In the meantime, however, the farmer has lost financially.

It might be appropriate at this stage to mention that it is almost impossible to achieve a state of affairs where all the eggs laid during the hot months of the year have perfect shells. A small percentage of thin and defective shelled eggs will be laid during the summer irrespective of how well the flock is treated.

The feeding of increased amounts of animal protein to poultry in this State during recent years has been one of the main factors responsible for the change in the pattern of egg production, and higher production per bird. Generally speaking egg producers have a good appreciation of the necessity of an adequate level of animal protein in the diet as an effective aid to increased egg production. But unfortunately the necessity of paying strict attention to the mineral aspect of the diet does not seem to be so well appreciated.

In order to obtain the maximum financial return for the eggs produced, it is necessary that each be encased in a sound shell. It is here that the mineral content and balance of the diet play an important part, and if eggs with sound shells are to be produced towards the close of the laying period it is vitally important that the birds' demands for minerals be met **right throughout the laying period.**

The causes of thin-shelled eggs may be grouped as follows:—

1. A deficiency, excess, or an incorrect balance of shell-forming minerals in the diet, the principal minerals concerned being calcium, phosphorus, and manganese.
2. A lack of vitamin "D". This vitamin is supplied through the direct rays of sunlight or by feeding a vitamin "D" rich supplement in the mash.
3. High environmental temperatures.
4. Length of time in production.
5. Inheritance.



6. Feeding certain drugs or medicines.

7. Diseases.

8. A defect in the physiology or anatomy of the reproductive organs including the abnormal functioning of certain of the endocrine glands which secrete hormones associated with egg formation.

# **1. A DEFICIENCY, EXCESS OR AN INCORRECT BALANCE OF SHELL FORMING MINERALS IN THE DIET.**

## **Calcium.**

Calcium is the most important mineral concerned with egg-shell formation, nearly 95% of the egg-shell being calcium carbonate.

The calcium which the hen uses in the construction of her egg-shells comes from two sources. Firstly, she obtains calcium direct from her daily ration and secondly she extracts this mineral from her bones. Normally, a good ration replenishes the calcium withdrawn from the skeleton day by day but if a ration low in calcium is fed, the hen continues to withdraw calcium from her bones until as much as 50% of her skeletal reserve is used. Under these

circumstances the egg-shells become progressively thinner but before the stage is reached where shell-less eggs are produced, egg production ceases.

As explained later, shell-less eggs are not the result of faulty nutrition, but usually the result of physiological imperfections within the bird concerned, and this latter condition usually rectifies itself within a short time.

A laying ration should contain in the vicinity of 2.3% calcium and this is best provided by including approximately 3% each of oyster flour and bonemeal in the mash where an all-mash diet is fed, and 4½% of oyster flour and 5 % of bonemeal in the mash where a mash-grain diet is fed. It is assumed that the grain is restricted to 1½ ounces per bird per day, this being equivalent to 9½ pounds per 100 birds per day. Mashers suitable for feeding to laying hens under an all-mash system which contain correct mineral levels and which are balanced in other respects are given below in Table 1.

Further information in connection with poultry nutrition is given in departmental leaflet No. 995, which is obtainable free of charge on application to the Department of Agriculture.

TABLE I.

| Ingredient.                 | Ration. |       |       |       |       |       |
|-----------------------------|---------|-------|-------|-------|-------|-------|
|                             | 1 lb.   | 2 lb. | 3 lb. | 4 lb. | 5 lb. | 6 lb. |
| Bran ....                   | 30      | 20    | 10    | 30    | ....  | 26    |
| Pollard ....                | ....    | 10    | 10    | 30    | ....  | 20    |
| Gristed Oats*               | 20      | 20    | 20    | 15    | ....  | 10    |
| Wheatmeal*                  | 42      | 37    | 50    | 15    | 80    | 36    |
| Blood Meal ....             | ....    | ....  | ....  | ....  | ....  | 2     |
| Meatmeal (50% protein) .... | 13      | 13    | 15    | 10    | 15    | 9     |
| Bonemeal ....               | 3       | 3     | 3     | 3     | 2     | 3     |
| Oyster Flour ....           | 3       | 3     | 2     | 3     | 2     | 3     |
|                             | 111     | 106   | 110   | 106   | 99    | 109   |

\* When oats are costly, all or part of the oat poundage given in Table I, for any one ration, can be replaced by an equal weight of wheatmeal without materially altering the nutritive value of the ration.

Where whalemeal is used to replace all or part of the meatmeal, substitute 5 lb. of whalemeal for every 5½ lb. of meatmeal.



### *Feeding Grain with the Mashers Listed in Table I.*

When grain feeding is restricted to 1½ ounces per bird per day (9½ lb. per 100 birds per day), 12 lb. of meatmeal, 3lb. of bonemeal and 2lb. of oyster flour should be added to the different total quantities of the mashers listed in Table I.

These amounts of meatmeal, bonemeal and oyster flour are necessarily added in order to maintain a satisfactory level of protein, phosphorus and calcium; namely, 16%, 1%, and 2.3%, respectively, over the total food intake.

Periodically, both oyster flour and bonemeal are difficult to purchase. Because of this, farmers are advised to keep a supply of both these feeding-stuffs on hand. Neither deteriorate on storage.

### *Shellgrit Not Recommended.*

A method of supplying calcium to laying birds which is not recommended is to provide the birds with shellgrit. The unreliability of this method is no doubt one of the causes for the too high incidence of thin-shelled eggs in this State. In the first place the quality of different samples of shellgrit vary. Some are practically all shell (calcium carbonate). Others contain a relatively high proportion of quartz and silica which do not assist eggshell formation. Secondly, for optimum results the calcium-phosphorus ratio in a laying ration must be kept within certain well-defined limits. This ratio is best maintained when the ration contains a fixed level of oyster flour and bonemeal and is likely to get out of balance if the birds are left to their own devices with respect to the amount of shellgrit eaten. An excessive intake of calcium will result in the laying of thin-shelled eggs in the same way as an insufficiency. Thirdly, birds do not like very coarse or very fine particles of shellgrit and where an uneven sample is fed, the birds eat ravenously of it for a short time until all the choice pieces have been eaten, thereafter refusing to par-

take of it. In consequence the farmer, on seeing the grit receptacle partly full of unpalatable grit is apt to assume that the birds are well provided for with respect to their calicum requirements, whereas in actual fact they are not.

### *Insoluble Grit is Important.*

While the feeding of soluble shellgrit as a source of calcium is not recommended, the importance of insoluble grit as an aid to better food utilisation cannot be overstressed. Laying fowls should have before them at all times a receptacle containing angular pieces of blue metal or granite chips. One-eighth screened blue metal is ideal for this purpose.

### **Phosphorus.**

The shell itself contains virtually no phosphorus (0.2%) and although phosphorus is not directly concerned in the formation of the eggshell, it is nevertheless important indirectly in that without it the birds cannot make full use of the calcium supplied in the diet. Phosphorus enables calcium to be deposited in the bones as a calcium phosphate compound and when calcium is withdrawn from the skeleton for eggshell construction purposes, phosphorus is withdrawn along with it. Once the phosphorus has assisted the release of calcium from the bones, there is no further use for it, and it is voided in the droppings.

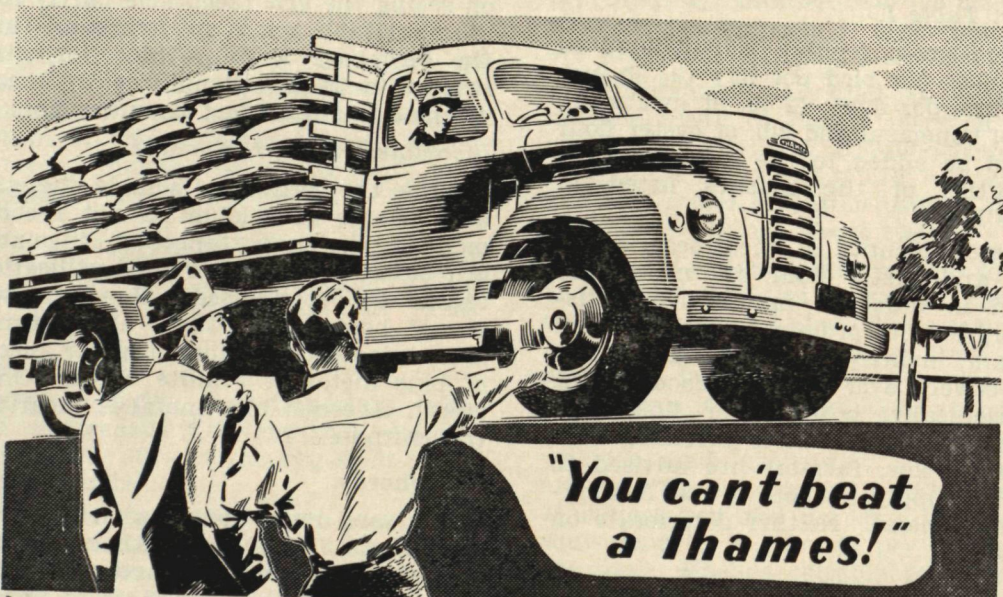
### **Manganese.**

The exact role which manganese plays in shell formation has not been established but it is known that small amounts are necessary in the diet if the breaking strength of the shells is to be maintained. Average West Australian rations contain sufficient of this mineral as grains and their by-products are relatively good sources of manganese.

## **2. A LACK OF VITAMIN "D"**

Vitamin "D" is essential to enable the birds to utilise calcium and phosphorus and if hens are deprived of vitamin





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"D" for extended periods, their eggshells become progressively thinner as happens when the birds are given insufficient calcium.

The main source of Vitamin "D" in this State is sunlight and most laying birds are adequately provided for with respect to Vitamin "D". However, where birds are intensively housed and deprived access to the **direct rays** of sunlight, a Vitamin "D" rich feeding supplement should be provided in the mash.

In Western Australia, vitamin "D" deficiency expresses itself very spectacularly on occasions when chickens are kept indoors during inclement weather for two or three weeks longer than usual. The chickens develop rickets and "go in the legs", otherwise they appear perfectly healthy and when fed a vitamin "D" supplement or are placed in the sunshine, their recovery within a matter of hours is just as spectacular as the onset of the complaint.

### **3. HIGH ENVIRONMENTAL TEMPERATURES**

High temperatures have been shown to result in the laying of thin-shelled eggs. This is due to the fact that during hot weather there is a significant drop in the calcium content of the hens' blood. This factor of temperature combined with the high rate of lay during the spring has an important bearing on the high incidence of thin-shelled eggs produced during the summer months.

To help overcome the heat factor, the laying sheds should be well ventilated and the birds kept as cool as possible. Provision of adequate shade, mist spraying and allowing the birds to burrow into moist cool earth or deep litter will help in this direction.

### **4. LENGTH OF TIME IN PRODUCTION**

There is a possibility that a long period of continuous laying has a fatiguing effect on the shell-making

mechanism, and that this results in a gradual thinning of the shells towards the end of the laying season. There is little we can do about this, apart from force moulting the hens in March and, with the assistance of electric lights, getting them back to a 50% lay within seven weeks of first putting the lights on. The shells will then be found to be greatly improved in shape and texture. This aspect should be of particular interest to breeders in this State who in the past have experienced difficulty in securing enough hatching eggs from second year birds to meet their requirements early in the hatching season.

Experiments carried out by this Department in 1952 on the poultry "pilot farms" and elsewhere with respect to force moulting and subsequent lighting of hens, were very encouraging and promise to have a far-reaching effect on breeding practices in this State.

### **5. INHERITANCE**

It has been shown that shell defects can be hereditary, therefore hens which continually lay eggs which are misshapen, ridged, excessively porous, chalky or thin-shelled should not be included in the breeding flock. Also it is well to remember that the modern incubator will hatch chickens from eggs that a broody hen would break. Because of this, it is essential that only strong-shelled eggs should be selected for hatching purposes. Modern incubators having done away with this natural safeguard, the poultry farmer relies on the hatcheryman to attend to this important factor.

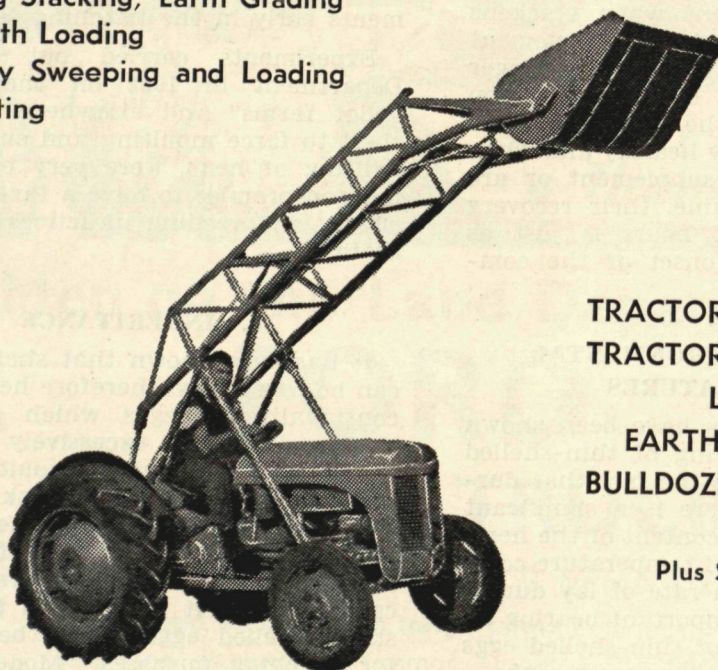
### **6. FEEDING CERTAIN DRUGS OR MEDICINES**

Certain drugs, notably some of the sulpha drugs and some medicines when fed to laying hens have been shown to adversely affect shell texture, but this factor is of little practical importance in Western Australia.



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## 7. DISEASE .

The dreaded "Newcastle Disease" which fortunately is not in existence in Australia, causes hens to lay soft-shelled eggs, but here again this problem is not of economic importance in this State.

## 8. DEFECTS IN THE PHYSIOLOGY AND ANATOMY OF THE REPRODUCTIVE ORGANS

Following ovulation of the yolk, from 24 to 30 hours are required to complete the formation of an egg. The thick white is added in the magnum region of the oviduct, the shell membranes in the isthmus and the shell and thin white in the uterus. About 20 hours are required for the shell to be secreted about the egg. This process of egg-shell secretion is delicate and complicated. A number of endocrine glands including the pituitary and parathyroids secrete hormones which are involved in the process. This hormonal set-up is in very sensitive balance and anything that tends to interfere with it may result in the laying of thin-shelled, or more frequently shell-less eggs.

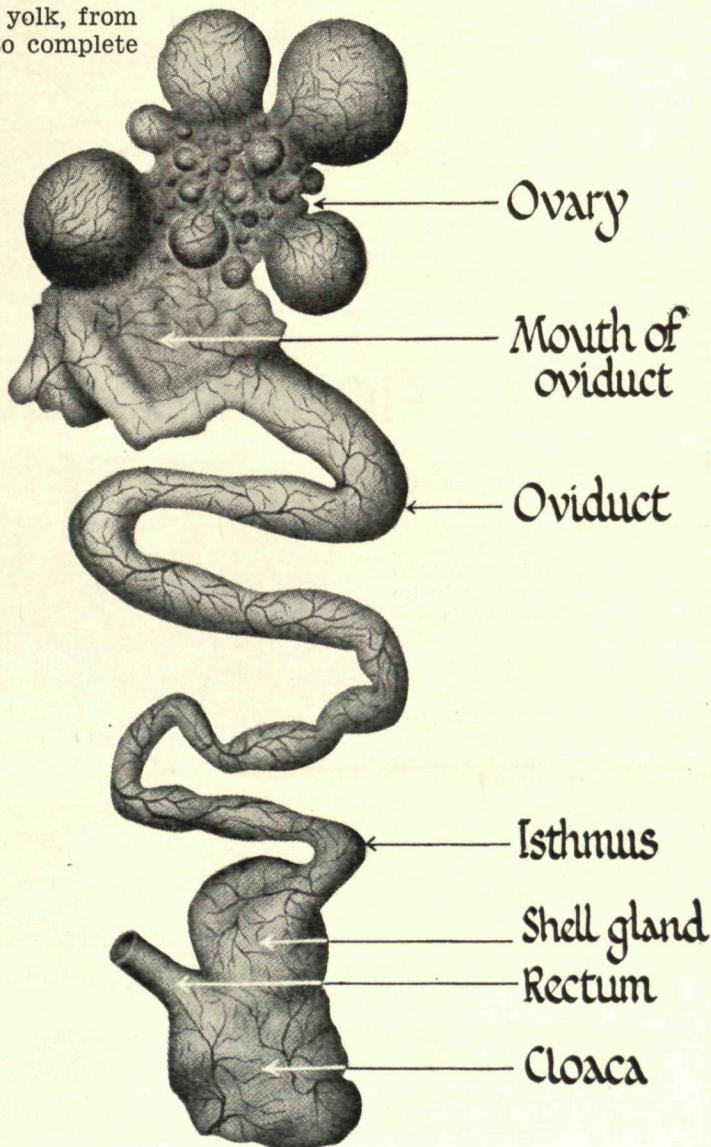
In considering the problem of thin-shelled eggs it is important that we differentiate between thin-shelled eggs and shell-less eggs and realise that while we can very often correct the thin-shelled condition, it is very difficult and usually impracticable to attempt to prevent the flock from laying shell-less eggs.

### SHELL-LESS EGGS

The outermost covering of a shell-less egg is merely

a soft membrane and with this class of egg there is no suggestion of calcification. An odd egg of this description may be found in the nest but the majority are laid during the night while the birds are roosting.

A flock of pullets when coming into the lay may lay up to 10% of shell-less eggs for many consecutive nights during the first few weeks of production and particularly is this condition seen



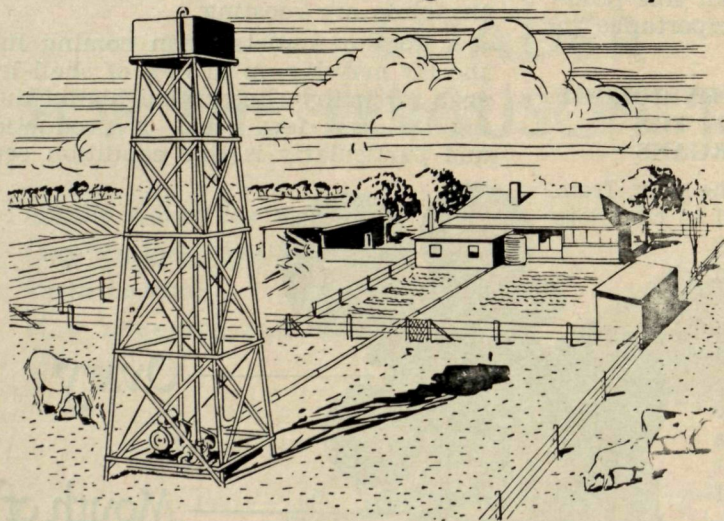
Reproductive system of the hen shown in diagrammatic form.



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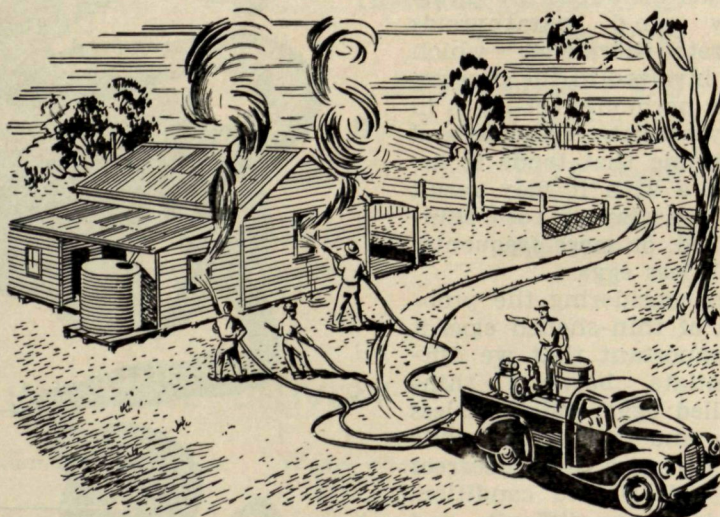
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in a flock which comes into production very quickly. For example, a flock which attains a 60% level of production within five weeks of laying the first egg (this pattern of production is typical of a good flock that has been raised and fed properly; the quicker a flock comes into lay after the first egg is dropped, the better) frequently lays a number of shell-less eggs. Their presence usually indicates that the flock is in good health, that the birds are being fed correctly and that many normal-shelled eggs will be produced during the forthcoming year.

In other words, their presence speaks well for the future and no attempt should be made to rectify the condition. Under no circumstances should the farmer believe that he is forcing his birds and as a consequence be tempted to reduce the level of animal protein in the hens' diet.

The term "forcing" is one about which we hear far too much. We should concentrate more on feeding our birds an adequate level of protein rather than seek excuses for leaving it out of the ration.

If more animal protein was fed on some farms, many more eggs would be forthcoming. Instead of being frustrated in the perfectly normal function of egg production, more birds would appreciate the opportunity of being

able to fully exploit their genetic capacity to produce more eggs while at the same time remaining in a perfectly healthy condition.

In the same way, laying birds should not be deprived of an adequate level of whalemmeal, meatmeal or whale solubles just because instances of protrusion are encountered or eggs with blood spots are laid. These troubles are usually hereditary in origin or peculiar to individuals in a flock and no good will result from starving the birds of essential nutrients.

Returning to the subject of shell-less roost eggs, we find that these result from the premature expulsion of eggs that normally would have been laid the next day. This same phenomenon can be produced experimentally by injecting laying hens with hormones from the pituitary gland. These hormones cause the muscles of the uterus or shell gland to contract, so expelling the egg. In other words, in young pullets the hormones sometimes get a "little mixed up" and as a result shell-less eggs are laid.

After the pullets have settled down to a steady lay the hormonal flow becomes more regular and fewer shell-less eggs are produced. However a flock that is laying well is apt to lay a small number of shell-less eggs throughout the year. Their presence should not be any cause for anxiety.

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