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Watery Whites of Eggs.
Report of Preliminary Investigations.

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INTRODUCTION.

THE egg industry has in the last few years assumed great importance to South Africa. The result has been that more and more eggs have been exported overseas, and the poultry farmer has been able to augment his annual income somewhat.

Egg production can be divided among three groups of producers: (*a*) The man who keeps a few fowls in his back yard for egg production for his own domestic purposes; (*b*) the man who keeps a fair number of fowls for breeding high production strains of birds and for rearing day-old chicks for sale to (*c*) the poultry farmer proper who keeps large numbers of fowls intensively for the production of eggs for sale in the Union and for export overseas.

With high production come many problems. Eggs must be of such a quality that when the housewife buys them they must be fit to be eaten. They must be of such a quality that they will stand storing, being sent overseas, and still be fit for human consumption. In South Africa eggs for consumption are sold from the producer direct to the consumer or to a store or finally to the big co-operative egg circles for disposal. At the egg circles where very large numbers of eggs are handled all eggs are tested prior to sale to the public. Testing consists mainly in the use of the " candle ". By this means they have come to recognize in eggs such conditions as blood clots, meat spots, grass eggs, and " watery white " eggs, etc.

At the request of the Natal Co-operative Egg Circle we decided to investigate this last condition, especially as it appeared to be on the increase. Again, eggs that had passed the test here were found at the time of testing on arrival in England to show the typical " watery white " appearance.

DEFINITION OF CONDITION KNOWN AS " WATERY WHITE " EGG.

One has difficulty in drawing up a definition of this condition, and the description that is given below may have to be modified as our knowledge of the causation of " watery white " eggs increases.

However, as a definition of a term that is still used rather loosely, it is probably quite satisfactory. According to the wholesale egg trade firms it is defined as—

(1) an egg showing over the candle a trembling or vibrating membrane holding the albumin,

(2) an egg showing over the candle a rupture of this membrane with subsequent mixing of the albumin with the air of the air sac—bubbles may be seen or the entire air from the air space may move in one mass all round the egg, being always uppermost.

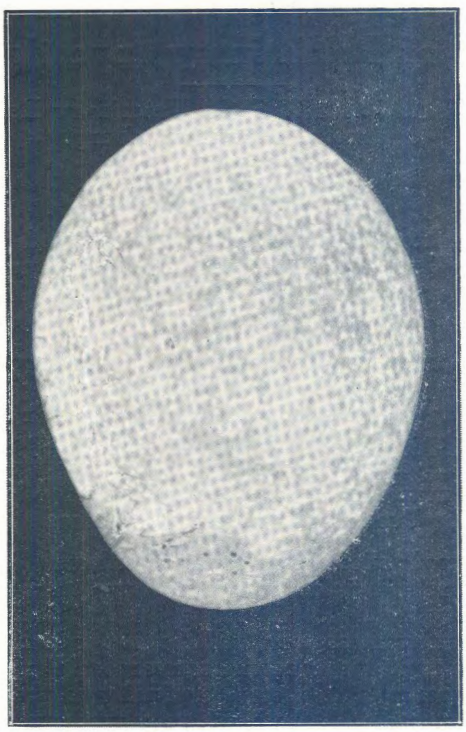


Fig. 1. The poultryman's so-called porous shell. Taken over the candle.

According to the housewife or user of the eggs, it is an egg showing (1) a very watery condition of the albumin, usually accompanied by a spreading yolk due to a weakened yolk membrane. These yolks frequently break when the eggs are poached; they in fact simulate a preserved egg. In some cases an egg showing a high percentage of dense albumin, which nevertheless flows more easily than usual, is also classed as a watery white egg.

To combine the views of both groups of people with our own one would state that a watery white egg is one which shows over the candle a tremulous or ruptured membrane holding the albumin, and which, when broken open, shows a watery appearance of the albumin associated with a weak yolk membrane.

There are, however, many eggs which, over the candle, show a normal appearance, but on being broken open may have the albumin and yolk sac affected, as described above; these should for the present, at any rate, also be regarded as watery white eggs. The wholesale egg trade firms rely mainly on the use of the " candle ". This statement is borne out by St. John, J. L., and Flor, I. H. (1931), who say: " As far as the wholesale trade is concerned ' watery whites ' seem to be identified almost entirely through candling ". In view of the results obtained in this work, it will be seen that candling is not an altogether reliable method for the detection of watery white eggs.

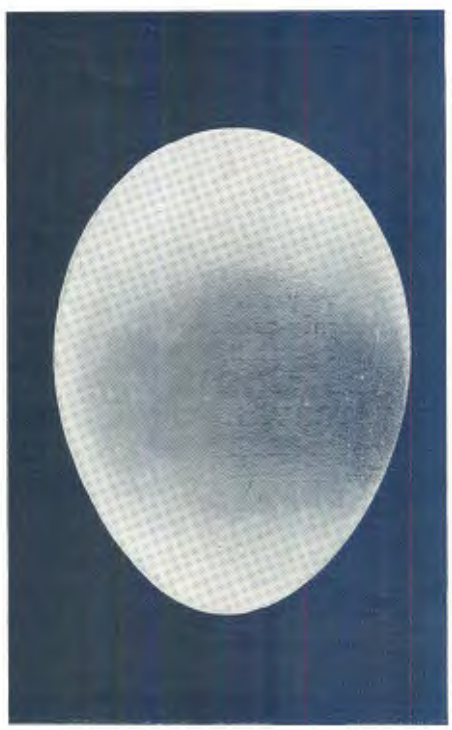


Fig. 2. Normal shelled egg. Taken over the candle.

GENERAL OBSERVATIONS.

This condition is very common in the Orange Free State and in Natal, in both places being noted by the writer; and it is quite likely that it is present throughout the Union. One will now and then see it commented on in the English poultry press.

One sees it at its height during the warm summer weather, although odd affected eggs occur the whole year through.

The egg circle in Durban, which is perhaps the chief depot of Natal, gets almost the major portion of its eggs from the outlying districts. These consignments usually have a trip by wagon first to the nearest siding or station; if they are before train-time, they are

placed either under shelter or left in the sun. The eggs are packed in thick, wooden, felt-lined boxes, for the most part. Such cases are packed in hot vans, and have a short or a long journey to Durban. From Durban station they are carted by trolley, probably never covered against the sun's rays, to the egg circle. Many affected eggs reach this depot.

The egg circle at Pietermaritzburg caters more for the local egg producers, who, for the most part, live only a few miles away. These eggs are brought in two or three times a week in the producer's car and in it are sheltered from the direct rays of the sun. Only very few affected eggs reach this depot.

When one comes to consider the prevailing state of affairs on the poultry farm, a number of conditions are observed.

Many poultrymen have too few nests, with the result that if eggs are only collected once a day, a large number are kept hot for almost twelve hours by the different hens that enter the nests to lay their eggs. Where broody hens are not seen, a similar state of affairs prevails. Eggs, when collected, are not often cooled, but are placed in egg houses, which in summer are too warm and are not well ventilated.

The aim of the poultry-man these days is to obtain fowls that lay their 300 and more eggs per season, but they appear to lose sight of the fact that such a highly-producing " machine " hen must give in in time from the intense strain, despite adequate feeding.

LABORATORY INVESTIGATIONS.

(*a*) Description of Eggs which on Candling are known as Watery White Eggs.

Such an egg when examined prior to candling usually has a normal appearance. On moving it or shaking it slightly, one sometimes hears movement inside the shell; at times even a slight swish of liquid can be heard. On placing this egg on the " candle ", one sees no air space at the broader end, but a large bubble—or one large and several small bubbles—lying uppermost in the shell, according to how the egg is placed. Whatever way the egg is placed this bubble always remains uppermost.

Eggs of this description were X-rayed in order to make certain that the bubbles were air bubbles. This was checked by taking test tubes and filling two with the normal thin albumin part of an egg and two with the thick albumin part of an egg. All these tubes had at least one air bubble. These were X-rayed and then shaken well, so as to break up the bubbles. These were again X-rayed. Then watery white eggs showing one large bubble were shaken and X-rayed; and we found, similarly to the albumin in the test tubes, that the large bubble was split up. (See photographs 12 to 16.)

In the commencing stages of this condition one will often see, when an egg is placed over the candle, a very large and regular or irregular air space. On rotating such an egg a trembling of the membrane enclosing the albumin is noted. No typical watery white movable bubble is seen. If such an egg is shaken lightly, movement

is heard, and if a more vigorous shake be given, one hears a sudden flop, and on recandling one observes the typical bubble of the watery white egg.

This one would interpret as the early stages in the formation of an egg that may be a watery white egg. On carefully cracking and examining an egg that shows on being candled, this trembling of the air space one finds the membrane lining the shell intact, but the membrane enclosing the albumin is not tense and stretched from side to side showing a well-defined air space as in a normal egg, but is relaxed or partially collapsed and may be actually resting on the albumin.

Figure 3.

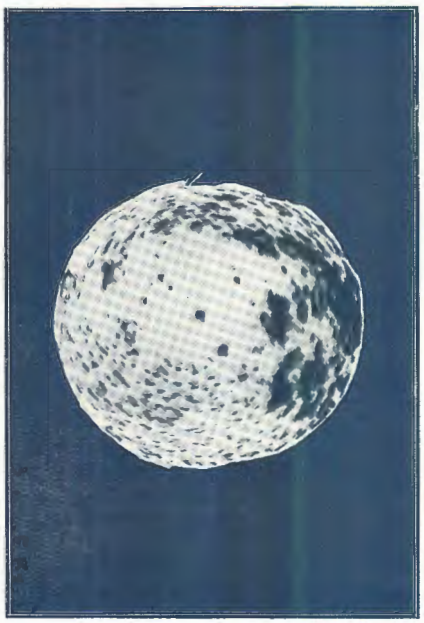


Figure 4.

Fig. 3. Outer surface of egg shell after being immersed in stain.
Fig. 4. Inner surface of same shell showing areas that have taken up stain.

Jordaan extracted in a Weekly Press Service to the South African farmers on 6th September, 1932, a preliminary investigation by Halnan, E. T., of the Animal Nutrition Institution, Cambridge, on watery white eggs. His views were that two types of watery white eggs were present and describing what undoubtedly is the commencing stage of such an egg as a definite type. Our observations on this subject were made as far back as the beginning of 1932.

Candling of Watery White Eggs.

This is the method in vogue among graders in the large egg circles and wholesale businesses. Any egg that shows the movable air space or the tremulous membrane is classed as a defective egg. Handling large numbers of eggs as these firms do this is the only test they can carry out, and yet many eggs are classified as watery

white eggs which are decidedly not weak albumin eggs. Further, many eggs which on candling are passed as normal eggs have decidedly watery albumin and should be discarded. Proofs of these statements will be given farther on. The only conclusions one can draw are that one cannot rely on candling alone for recognizing this condition and yet what other method can be used for testing intact eggs.

(*b*) The Shells.

Texture of Shells.

During the examination of many eggs by means of the candle, one's attention is often drawn to the fact that many of these eggs have shells which are classed by poultrymen and egg-traders as markedly porous shells. Instead of the light coming through evenly as in a so-called good shell, it shows numerous small areas of bright light. (See figures 1 and 2.)

In other eggs the light of the " candle " comes through very distinctly, making it very evident that such shells are weak shells. A number of such shells show very fine cracks, which are not very evident away from the " candle ".

Another group of shells will, over the candle, appear as good, normal shells.

When one examines eggs that have been tested and given as normal eggs one will just as frequently meet with all these changes described above, so that one is forced to the conclusion that if a watery white egg has such a supposedly porous shell it is simply a coincidence. It was decided to test out many of these shells for the so-called excessive porosity. Weston, W. A. R. D., and Halnan, E. T. (1927), working on Black Spot in eggs, described a method of staining the pores with starch solution and alcoholic solution of iodine. Hays, F. A., and Sumbardo, A. H. (1927), in an article on shell pore studies, describe another method of staining that consist of the use of alcoholic eosin and allowing exposure to this for about six hours.

Both these methods were tried out with varying success. In addition to eosin other stains were used such as methylene blue (aqueous and alcoholic), alcoholic neutral red, rose aniline violet, May Grünwald and Giemsa. Of all these stains the ones giving the best results were May Grünwald and Giemsa. Two methods were adopted: (*a*) breaking of shell and staining one half by filling with stain and the other half was allowed to float in the stain—staining usually took place in about 10 minutes: (*b*) immersing of intact egg before being broken in the stain. Here again staining usually took place within 10 minutes.

As a result of the first method it was found that the majority of eggs in which the stain was placed in the shell showed very many pin-point areas of stain, some very numerous and in some of these many appeared quicker than others. Shells from both normal and " watery white " eggs were tested. Results showed that both groups of shells stained almost similarly, and the differences between them were negligible. When we came to those egg-shells that were floated on the stain quite another picture was observed. Some eggs showed

nothing on the outside when the shell was washed, and yet inside very large numbers of small areas of stain or a few large areas of stain were present. In view of this one decided to immerse all eggs for from 3 to 5 minutes in undiluted stain.

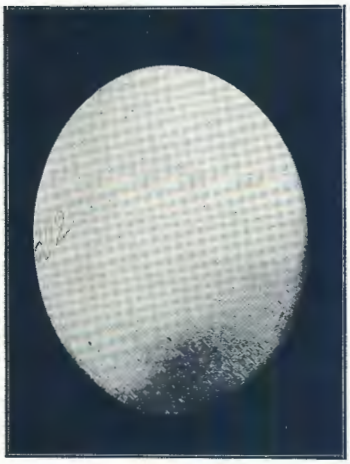


Figure 5.

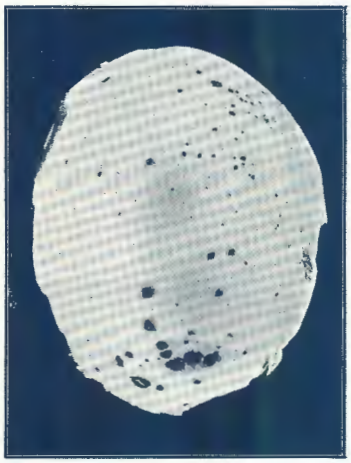


Figure 6.

Fig. 5. Outer surface of egg shell after being immersed in stain.
Fig. 6. Inner surface of same egg showing stained areas.

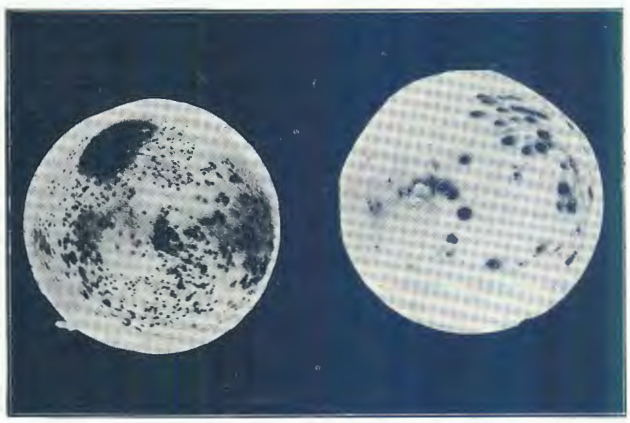


Fig. 7. Internal surface of same egg shell showing stained areas, outer surface showed nothing.

Normal Eggs.—Eggs from the same hens examined within 12 hours of laying day after day for almost two months show sometimes a very few pin-point areas of stain, otherwise nothing; on some days they are perhaps more numerous than others. When these eggs are kept any time over a week at room temperature and stained these pin-point stained areas are more numerous. This appears to indicate a form of drying out of the shell.

Watery White Eggs (Candle Test).—Such rejected eggs were sent me from the Natal egg circle at Durban. Many of these showed very numerous pin-point stained areas, more so in very many cases than did old normal eggs. Others again showed very numerous large areas. So much stain was in some cases taken in that the albumin had a slight bluish tinge. These eggs, even after immersion for 10 to 15 minutes in undiluted Giemsa, when washed showed hardly a sign of the stain as compared with normal shelled eggs that were usually pink or bluish in colour. Such eggs were frequently thin shelled eggs, and one had to be careful even when handling them in case they cracked. Many of these were rough and lustreless shells as compared with the usual smooth and glossy shell of the normal egg. That they were definite "watery white" eggs was shown by measuring the albumin. To give only two examples:—

Egg No. 128 showed 19·5 c.cs. thin albumin and 8 c.cs. thick albumin.

Egg No. 126 showed 19 c.cs. thin albumin and 3 c.cs. thick albumin.

Photographs showing the interior of the shell stained were taken.

Porosity.

It is claimed by many big poultrymen that porous shelled eggs have a low degree of hatchability. When asked to describe what they mean by a porous shelled egg they describe the condition shown in Fig. 1. When such eggs are taken and stained this suggested porosity is more often than not absent. Writers refer to visibly porous eggs but refrain from saying how they know these eggs are porous. The group of eggs that should be classed as porous are those shown in photographs 3 to 8, and yet, over the "candle" before immersion in stain, they did not approach the eggs seen in photograph 1 as far as so-called porosity was concerned. One can understand thin fragile shelled eggs being classed as porous, but the majority of so-called porous eggs are usually firm and strong. One would say that there was an irregular deposition of lime in the shell rather than that the shells were porous. The impression that these eggs are porous is probably due to the fact that people think the light areas in the shell over the candle are actual pores. It is certain, however, that the greater amount of porosity in eggs as judged by the stained shells is to be found in definite cases of watery white eggs.

Membrane.

As is well known, when an egg is laid no air space is seen if the egg is "candled" immediately. Examined a day later, there is a distinct small air space. Every day after being laid the air space gets greater as the contents of the egg become less due to evaporation through the shell. This takes the form of a shrinking of the membrane.

The larger the air space the greater the surface area of albumin lining membrane which is detached from the shell membrane. The surface area being increased and the support from the shell being removed the membrane has to bear the whole of the shell contents. Weston, W. A. R. D., and Halnan, E. T. (1927), quoting Lillie,

state " The shell membrane consists of two layers, a thick outer layer next to the shell and a thinner one next the albumin. Both are composed of matted organic fibres (more delicate in the inner than in the outer layer) crossing one another in all directions ". It will thus be seen that the membrane enclosing the albumin will probably rupture easier than the membrane lining the shell. Hays, F. A., and

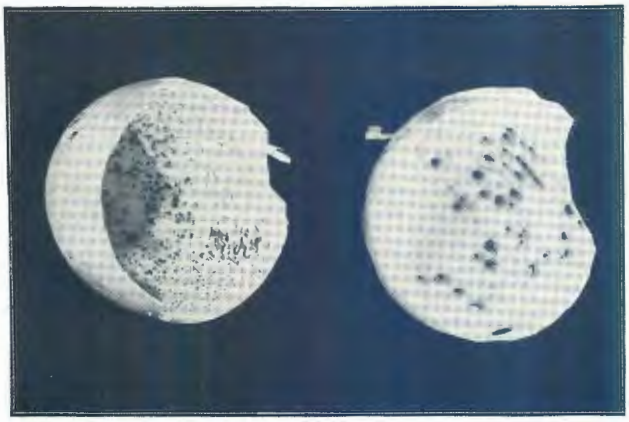


Fig. 8. Internal surface of same egg shell showing stained areas, outer surface showed nothing.

Fig. 9. Empty test tube.

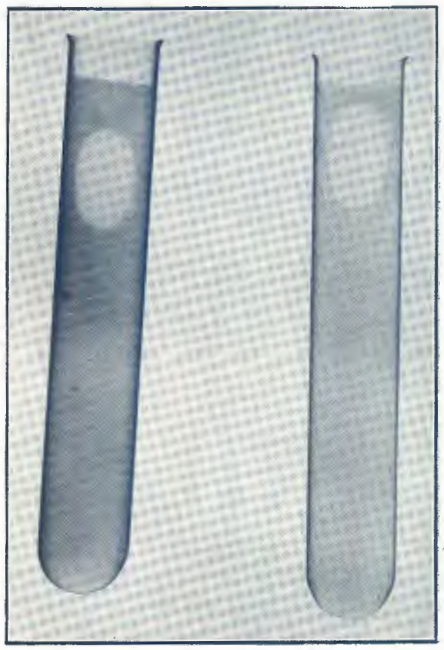


Fig. 10. Thin albumin (before shaking).

Fig. 9. Empty test tube.
Fig. 10. Thin albumin (before shaking).

Sumbardo, A. H. (1927), state that the numbers of pores per sq. mm. was greater in the inner shell membrane than in the outer shell membrane in all cases. Again this bears out the views of the first two workers. This air space is used as a guide by graders to tell the age of the egg.

In the case of " watery white " eggs as determined by candling one observed that no air space was present. This was due to the inner membrane having been ruptured.

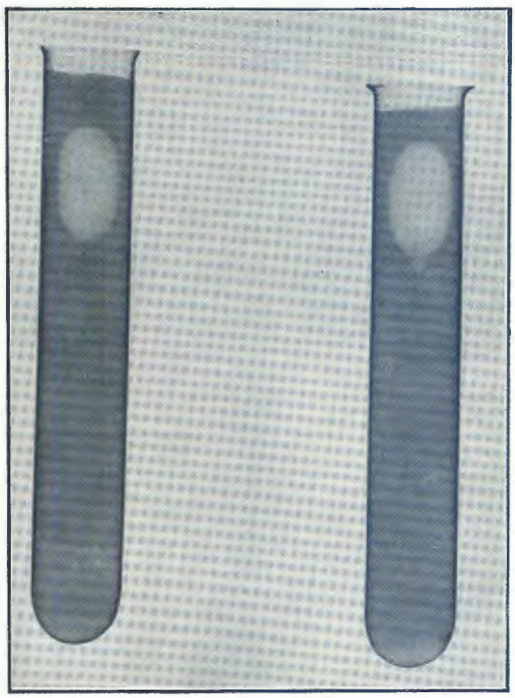


Fig. 11. Thick albumin (before shaking).

Weight.

There was no more variation in the weight of candle-determined watery white eggs than in normal eggs. Graphs made of normal eggs laid daily and weighed within 2 hours of being laid showed marked variations day by day in their weights. As has been noted previously by other workers the heavy egg, in almost every case, is followed by a lighter egg. One even lighter may be laid, and then once more the rise to another heavy egg.

It was impossible to obtain a continuous supply of eggs from any one fowl whose eggs showed a candled watery white, as these eggs come from all over Natal and are not marked as from any individual fowl. However, in the light of the whole egg weight of watery white egg resembling closely normal eggs one would surmise that here also the shell weights of watery white eggs were also fairly constant.

When one comes to the precentage comparison of weight of shell to weight of egg the following results are seen:—

Hen No.	Number of Eggs Laid.	Percentage of Shell to Egg Weight.		Percentage of Shell Weight to Egg Weight (Average).
		Maximum.	Minimum.	
		%	%	%
324.....	27	10·8	7·4	8·9
399.....	32	12·6	10·3	11·3
342.....	21	13·3	8·9	10·5
947.....	33	12·6	8·1	9·9
362.....	31	13·6	9·7	11·6
294.....	31	11·6	8·6	9·9
397.....	31	13	9	10
354.....	27	12·4	9·2	10·6
	233	Av. 12·4	Av. 8·9	Av. 10·3

These figures for normal eggs show that for 233 eggs the average percentage of shell weight to whole egg is 10·3 per cent. The figures for 92 candled watery white eggs showed an average percentage of shell weight to whole egg weight of 9·9 per cent. with a maximum percentage weight of 12·1 per cent. and a minimum percentage weight of 9·7 per cent.

It would appear as if there is a slight difference between percentage weight of shell to whole egg between normal eggs and candled watery white eggs.

(*c*) The Albumin.

(*a*) *Technique of Measuring the Amount of Albumin.*

A funnel, a 50 c.cs. measuring cylinder, and a sieve with meshes 9 to 1 inch were all that was needed for measuring the thin and the thick albumin. The egg was cracked and the albumin allowed to run into the sieve, the thin portion ran through until no more would pass the meshes. This amount was then read off in c.cs., the thick albumin was then poured into the cylinder and again the reading taken. In this way the amounts of thin and thick albumin could be estimated.

(*b*) *Quantities of Thin and Thick Albumin in Candled Normal Eggs taken shortly after being Laid.*

It is well known that the albumin in the normal egg is made up of both thin and thick albumin, the thick being usually in excess of the thin albumin. It has been stated that thin albumin may be present in normal eggs varying from 18 per cent. to 53 per cent. and the egg is still classed as normal. From this work after examining a large number of eggs one did not meet with so high a percentage as 53 per cent., our highest figure was 51·8 per cent. and our lowest 25·4 per cent. The percentages of thick albumin were from 48·2 per cent. to 74·6 per cent. (See tables.)

Holst, W. F., and Almquist, H. J. (1931), give a table showing the percentage of thick white from eggs of different fowls. The variations in the percentages are small for each individual hen and the greatest difference is 8 per cent. From our figures taken over long periods for the eggs of various hens much greater variations are shown.

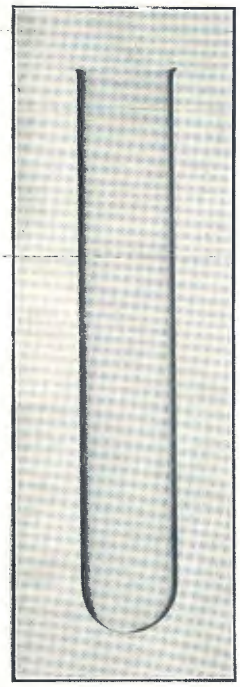


Fig. 9a. Empty test tube.

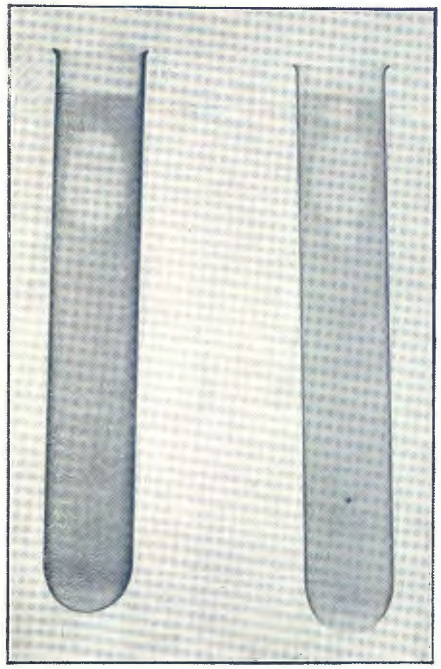


Fig. 10a. Thin albumin (after shaking).

Fig. 9a. Empty test tube.

Fig. 10a. Thin albumin (after shaking). Note bubbles as compared with before shaking.

Hen 294: Maximum difference between lowest and highest percentage, 17·9 per cent.

Hen 397: Maximum difference between lowest and highest percentage, 15·4 per cent.

Hen 362: Maximum difference between lowest and highest percentage, 20·4 per cent.

Hen 342: Maximum difference between lowest and highest percentage, 18·9 per cent.

Hen 947: Maximum difference between lowest and highest percentage, 12·2 per cent.

Hen 324: Maximum difference between lowest and highest percentage, 13·5 per cent.

Hen 399: Maximum difference between lowest and highest percentage, 21·5 per cent.

Hen 354: Maximum difference between lowest and highest percentage, 13·6 per cent.

(c) Quantities of Thin and Thick Albumin in Candled Watery White Eggs.

When the albumin of these eggs is measured remarkable differences are seen. Many of these eggs give measurements which correspond with the measurements of albumin of normal eggs. The smallest percentage of thin white was 18·1 per cent., while the smallest thick white was 6·3 per cent. The largest percentage of thin white was 93·7 per cent., while that of thick white was 81·9 per cent.

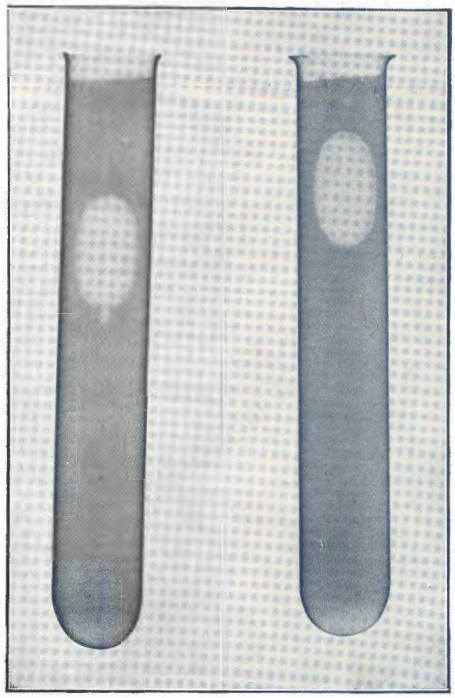


Fig. 11a. Thick albumin (after shaking).

(d) Quantities of Thin and Thick Albumin in Candled Normal Eggs at Varying Intervals after being Laid.

The eggs used in this experiment were those taken from the groups of fowls whose eggs had been tested and examined within 24 hours of being laid. They were kept at room temperature in a single layer in a cardboard egg container for varying periods of days. The temperature was usually between 70° and 75°. Before measuring the albumin, all were tested over the candle and were definitely not watery white eggs. Several were shaken and then examined and we found the typical watery white appearance over the candle. The figures from these birds are interesting. The maximum and minimum percentages of both thin and thick albumin from these eggs will be given. In the tables will be found the details of the eggs examined of each fowl. The maximum percentage of thin albumin was 87·3 per cent., while that of thick albumin was 68·1 per cent. The minimum percentage of thin white was 31·9 per cent., while that of thick white was 12·7 per cent.

From the graphs it will be seen that as a result of being kept the total amount of albumin in these eggs was diminished.

(*e*) *Reaction of Albumin of Normal and Defective Eggs.*

Sharp & Powell (1927) state that the pH of the whites of freshly laid eggs is about 7·6 and that after a few days in a well-ventilated room it will reach 9·5, provided they are not oil-dipped, or placed in water or water-glass solution. They further state that untreated eggs kept in a badly ventilated room (full of eggs) may have a pH considerably lower than 9.5. They further quote Sharp and Whitaker and Stark and Sharp, who claim it is possible for organisms to grow in media with a pH of 7·6 or slightly higher, but never if the pH be 9·5.

We found here that the pH of normal eggs, some tested just after being laid, other a day or more old, varied from 6·8 to 8·5. We then proceeded to test the albumin of naturally and artificially caused watery white eggs. Very little difference was found, the pH varying from 7·2 to 8.

(*d*) Discussion.

Armed with the figures obtained about thin and thick albumin from normal eggs recently laid and from normal eggs stored we are now in a position to give a better and more exact definition of a watery white egg. The candle appearance of the moving air space is not necessarily an indication of a watery white egg. Again, the absence of the movable air space is no indication that the egg is a normal egg or a watery white egg. Thus we are forced to the conclusion that candling is not a reliable test for seeing whether an egg is a watery white one or not; however, in the circumstances it is the only one available, and although many eggs are rightly condemned many others as far as their albumin is concerned are normal.

The appearance of the shell as seen over the candle is no indication as to its porosity except in the case of a shell that shows the light clearly and brightly through it. This indicates a thin shelled egg. A watery white egg may have a good shell or the poultry-man's so-called porous shell or a thin shell, conditions which may also be found in normal eggs. Many true watery white eggs show on being stained this excessive porosity from the outside to the inside, this condition has not as yet been seen in a normal egg. Such egg shells prior to being stained, when examined over the candle show nothing abnormal.

The shells of true watery white eggs are in at least 90 per cent. of cases whitish in colour; only rarely are brown eggs subject to this condition.

The membrane of candled watery white eggs was invariably ruptured; this is borne out by the X-ray plates. In one of the plates a partial detachment of the membrane is shown. This is the tremulous condition mentioned by Halnan.

There does not seem to be much difference between the percentage weight of shell as compared with total weight of eggs of normal and watery white eggs.

Fig. 12.

Fig. 13.

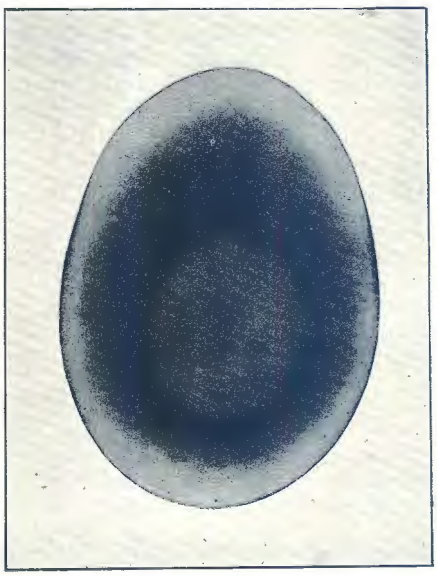


Fig. 14.

Figs. 12, 13, 14. X-ray of candled watery white egg showing air bubbles but no air spaces.

From observations made it appears that the keeping qualities, so far as thick and thin albumin goes, of normal eggs vary considerably. There is a decided tendency towards an excess of thin albumin over thick albumin. This commencing change started from about the 7th day and became marked from the 10th to 14th days. Over the candle one was able to see a large air space indicating an old egg. By giving such eggs a slight shake a flop would be heard, and on recandling one would obtain the typical candled watery white egg appearance. This would rather point to the fact that many eggs sent overseas, the trip lasting at least 16 to 21 days, from the time of being laid, are likely to be watery white eggs on their arrival at their destination without in many cases showing it over the candle.

EXPERIMENTAL PRODUCTION OF WATERY WHITE EGGS.

We found that fresh eggs kept at room temperature for fourteen days and shaken gave the typical watery white appearance on being candled; when their albumin was measured this was confirmed. Prior to being shaken, these were candled and conformed to the graders' opinion that they were normal, although not new laid.

We next collected eggs immediately on being laid and placed them in a bacterial incubator running at 37° C., which corresponded to a temperature of 98·6° F. Such a temperature would be considered a fair one in comparison with what prevails in Natal during the time this condition of defective eggs is most common. At definite intervals these eggs were taken out and examined over the candle, and apart from showing a larger air space than would eggs which had been kept at room temperature for the same period, they were normal. On giving these a shake we were again able to set up the candled watery white egg appearance. The shortest time in which we were able to produce this appearance was in two cases, 24 hours. Unfortunately at that time we did not measure the albumin, so we are unable to state whether or not these were true watery white eggs. (See Table 1.)

SUGGESTED CAUSES.

One would first consider those eggs whose appearance over the candle suggests a watery white condition and yet on measuring the albumin they appear quite normal.

(*a*) Warmth.

The points in favour of warmth are:—

1. The fact that the largest number of affected eggs is found during the warmest months of the year, and the egg export season is usually from mid-September to about the end of January.

2. The frequent placing of nests for laying in such a position that the sun heats them.

3. The fact of having too few nest boxes and eggs being collected not frequently enough, with the result that the earliest laid eggs have almost 10 hours' incubation.

4. Eggs are frequently not cooled after being laid, but are placed straight into egg boxes or stored in warm houses without any moisture in them. That this is a most important point is borne out by the advice given to poultry-men overseas, viz.: " Get a layer of fresh grass; upon this place a layer of hay and lay the eggs on their sides on it. A temperature of 50° F. is the best one for storing eggs ".

5. The fact that eggs that are kept at 37° C. for 24 hours and then shaken show changes indistinguishable from watery white egg changes.

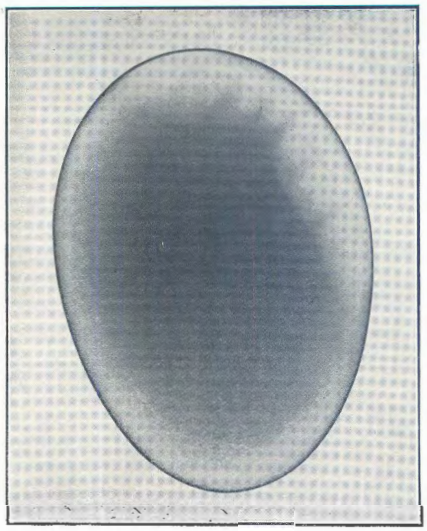


Fig. 15. X-ray of candled watery white egg showing detachment of inner shell membrane. No air bubbles present.

6. In all cases of these incubated eggs, one observes a fairly large air space, which is an indication of drying out. In eggs kept at room temperatures, especially in cool rooms, this air space increases day by day, but not so rapidly as when eggs are subjected to outside temperatures. The larger the air space, the more room for the albumin and yolk to move, with a consequent detachment of the albumin membrane from that lining the egg shell and its subsequent rupture.

(*b*) Vibration or Movement.

The points in favour of vibration are:—

1. Eggs heated at 37° C. for 24 hours, when shaken, take on a similar appearance to the affected eggs under discussion.

2. The majority of naturally caused watery white eggs have come to the egg circle from a distance which has entailed travelling. In transit they have been subjected to much shaking and knocking about from the time they have been loaded on the farm to the time they have been unloaded at the receiving depot.

3. In the case of eggs being found affected on arrival overseas, in spite of being passed as normal when packed in South Africa, the same factors are present, viz., handling, repacking, cartage from depot to dock, loading, vibration, however slight, for 16 to 21 days continuously from the ship's engines, pitching and rolling of the ship, and finally unloading and dispatching to various egg distributing centres.

When one comes to consider the possible cases of true watery white eggs the following conclusions are reached. The age of the egg possibly plays an important part. In no candled affected egg is there any air space for the graders to say whether an egg is old or not, but one frequently meets with " stuck yolks ", which is an indication of age. On breaking affected eggs one frequently finds degenerative changes in the yolk, such changes also being present in known old eggs.

Many eggs which have been kept and are apparently normal over the candle are distinctly watery white eggs when measured; this indicates that the candle appearance is only secondary to the true cause. From the graphs it will be seen that these changes take place the longer the egg has been kept. This has been recognized by St. John, J. L., and Flor, I. H. (1931), who state " there were comparatively few number one eggs and none after the seventh day of storage ". The change from thick to thin white is probably due to some extent to the temperature at which they are stored and probably due to enzyme reaction converting the thick to thin white.

So far we have not observed an egg being laid as a watery white egg.

With such eggs shaking or vibration next plays a part. This was actually utilized by Platt, C. S. (1929), to identify watery white eggs. He states " the case was then shuffled back and forth across the floor moving it at arms' length each time. One hundred movements were used in each instance. This had been previously found necessary for the proper determination of the ' watery white ' eggs ".

We now come to the possibility of porous shells playing a part. One refers to those shells that take stain excessively as shown in the photographs and those shells which are definitely weak, brittle, and thinner than a normal shell. Excessive evaporation must take place. It was noted in our work that many such thin shelled eggs contained very small amounts of thick white, e.g., 3 c.cs. as compared with 25 c.cs. of thin white, 2·5 c.cs. as compared with 20 c.cs., and 1·5 c.cs. as compared with 22·5 c.cs. to quote three examples. The causation of such thin shelled eggs is referred to by Taylor, L. W., and Martin, J. H. (1928), whose summary states three main causes: (1) wrong feeding including vitamine and calcium deficiency, (2) the inherited inability to produce heavy shelled eggs, and (3) pathological conditions in the oviduct.

Finally one would suggest that towards the end of an egg-laying period among hens that lay over 200 eggs a season there is likely to be a big strain on her and it is possible that some portion of the

oviduct may in some way be temporarily affected. This would only occur among a limited number of birds and is not likely to be a very common cause.

We are unable to make any definite statement on the possibility of porous shells playing a part in the causation of watery white eggs.

SUMMARY.

(*a*) The method of testing eggs by means of the candle is not an exact method for showing whether an egg is a watery white egg or not.

(*b*) It is reliable for showing whether or not the albumin lining membrane is ruptured or not.

(*c*) Under the present conditions it is, however, the only method that can be used.

(*d*) All eggs showing air bubbles or a bubble are not watery white eggs.

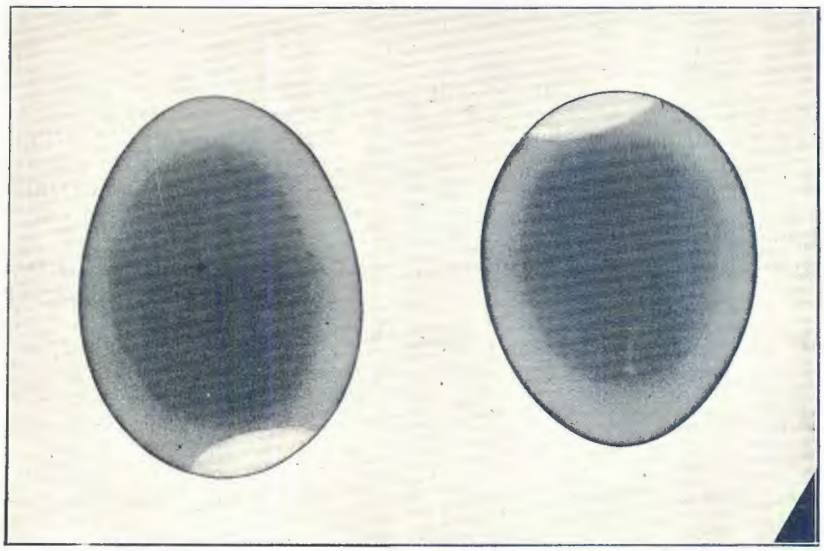


Fig. 16. X-ray of two normal eggs showing air spaces.

(*e*) Many eggs not showing air bubbles or a bubble are definitely watery white eggs.

(*f*) The poultryman's porous shelled egg as distinct from a thin brittle shelled egg is in the majority of cases decidedly not porous.

(*g*) Many shells which on being tested by stain are markedly porous, are, when placed over the candle prior to staining, apparently normal shells.

(*h*) The longer an egg is kept the more porous the shell becomes.

(*i*) Porosity does not seem to play an important part in the causation of watery white eggs.

(*j*) In all eggs showing air bubbles or a bubble the inner shell membrane covering the albumin is ruptured.

(*k*) There is not much variation in the percentage of shell weight to total egg weight between normal and watery white eggs.

(*l*) Definite watery white eggs showed a maximum percentage of thin albumin of 93·7 per cent.

(*m*) Normal eggs kept for varying intervals became in many cases definite watery white eggs although this could not be shown over the " candle ".

(*n*) The reaction of the albumin of normal and watery white eggs was practically similar.

(*o*) There are probably a number of causes all acting together or at times separately to set up watery white eggs.

(*p*) These are probably warmth, vibration or movement, storage or age of eggs, excessive porosity in a few cases, and probably the result of strain in hens towards the close of a heavy egg-laying period in a further number of cases.

ACKNOWLEDGMENTS.

I would like to thank Mr. L. F. Forsyth, of Maritzburg, for very kindly supplying me daily with large numbers of eggs from definite trap-nested hens. To Mr. Slatter, Secretary of the Durban depot of the Natal Co-operative Egg Circle, my thanks are due for kindly sending me all the watery white eggs I worked on. I must also acknowledge advice and suggestions so readily given me by many practical poultrymen of Natal. To Dr. Grieve, of Maritzburg, my thanks are due for taking the X-ray plates of affected eggs, and to Mr. Hill, my assistant, for the photographs and willing help.

APPENDIX 1.

Normal Eggs.

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg. Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
22.10.32	294	57·78	6·6	11·4	9	17·5	26·5	33·9–66·1
24.10.32	,,	64·33	7·1	11	13	17	30	43·3–56·7
25.10.32	,,	58·21	6·3	10·9	9	16·5	25·5	35·2–64·8
27.10.32	,,	58·03	6·2	10·7	9	19	28	32·1–67·9
28.10.32	,,	56·21	5·68	10·1	8	17·5	25·5	31·6–68·4
29.70.32	,,	56·59	6·55	11·5	10·5	18·5	29	36·2–63·8
31.10.32	,,	61·36	6·97	11·3	11	19·5	30·5	36 –64
1.11.32	,,	58·65	5·57	9·5	8·5	19	27·5	30·9–69·1
2.11.32	,,	57·75	5·72	9·9	11·5	16·5	28	41 –59
4.11.32	,,	61·80	5·69	9·2	10·5	19·5	30	35 –65
5.11.32	,,	56·95	5·66	9·9	10	16	26	38·4–61·6
7.11.32	,,	63·11	6·31	10	9·5	21·5	31	30·6–69·4
8.11.32	,,	56·72	5·58	9·8	8·5	18	26·5	32 –68
9.11.32	,,	55·60	6·46	11·6	9	16·5	25·5	35·2–64·8
11.11.32	,,	60·25	5·88	9·7	11	19	30	36·6–63·4
13.11.32	,,	57·13	5·92	10·3	11	16	27	40·7–59·3
14.11.32	,,	63·62	5·66	8·9	10·5	21·5	32	32·8–67·2
15.11.32	,,	57·02	6·20	10·8	6·5	19	25·5	25·4–74·6
17.11.32	,,	63·77	6·08	9·5	10·5	21	31·5	33·3–66·7
18.11.32	,,	57·43	5·51	9·6	8·5	18·5	27	31·4–68·6
19.11.32	,,	59·58	6·18	10·3	12	16·5	28·5	42·1–57·9
21.11.32	,,	62·50	5·93	9·4	12	18	30	40 –60
23.11.32	,,	59·88	5·61	9·3	8	20	28	28·5–71·5
25.11.32	,,	65·84	5·70	8·6	11·5	20·5	32	35·9–64·1
27.11.32	,,	61·11	5·86	9·5	10·5	18·5	29	36·2–63·8
28.11.32	,,	67·54	6·40	9·4	11	21·5	32·5	33·8–66·2
29.11.32	,,	55·39	5·54	10	10	16	26	38·4–61·6
1.12.32	,,	61·52	5·66	9·2	11·5	19	30·5	37·7–62·3
2.12.32	,,	57·61	5·79	10	10·5	18·5	29	36·2–63·8
4.12.32	,,	64·33	5·59	8·6	9·5	23·5	33	28·7–71·3
5.12.32	,,	57·98	5·40	9·3	11	16	27	40·7–59·3
22.10.32	399	62·79	7·76	12·2	12·2	12·8	25	48·8–51·2
23.10.32	,,	61·75	7·65	12·3	12	15·5	27·5	44·1–55·9
25.10.32	,,	64·10	7·32	11·4	10	20	30	33·3–66·7
26.10.32	,,	61·97	7·33	11·8	12	17	29	41·3–58·7
27.10.32	,,	61·27	7·48	12·2	11	17	28	39·2–60·8
29.10.32	,,	64·01	7·63	11·9	13	12·8	25·8	50·3–49·7
30.10.32	,,	61·73	7·71	12·4	11·5	17·5	29	39·6–60·4
31·10·32	,,	60·62	7·41	12·2	11	17	28·5	38·5–61·5
2.11.32	,,	65·22	7·26	11·1	13	18	31	41·9–58·1
3.11.32	,,	61·79	6·69	10·8	12·5	17·5	30	41·6–58·4
4.11.32	,,	60·48	6·66	11	10·8	16·7	27·5	39·2–60·8
6.11.32	,,	63·76	6·83	10·7	13	16·5	29·5	44 –56
7.11.32	,,	62·18	7·11	11·4	11	17	28	39·2–60·8
9.11.32	,,	64·88	7·24	11·1	11	19·5	30·5	36 –64
10.11.32	,,	62·14	7·16	11·5	11	17·5	28·5	38·5–61·5
11.11.32	,,	61·65	7·14	11·5	10	18·5	28·5	35 –65
13.11.32	,,	63·31	7·00	11	9·5	20	29·5	32·3–67·7
14.11.32	,,	63·45	7·00	11	12	18	30	40 –60
15.11.32	,,	61·62	7·50	10·5	11·5	17·5	29	39·6–60·4
17.11.32	,,	63·51	7·26	11·4	11·5	17·5	29	39·6–60·4

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg. Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
18.11.32	399	60·67	6·50	10·7	11·5	16	27·5	41·8–58·2
19.11.32	,,	61·60	7·22	11·7	12·5	15·5	28	44·6–55·4
21.11.32	,,	63·40	7·25	11·4	13	17	30	43·3–56·7
22.11.32	,,	62·56	6·71	10·7	13	16·5	29·5	44 –56
24.11.32	,,	59·35	6·68	11·2	12	15	27	44·4–55·6
25.11.32	,,	61·92	6·39	10·3	13	16	29	44·8 55·2
28.11.32	,,	61·57	6·31	12·6	10	19	29	34·4–65·6
29.11.32	,,	60·35	6·82	11·3	12	16	28	42·8–57·2
1.12.32	,,	61·19	6·54	10·7	8·5	21	29·5	28·8–71·2
2.12.32	,,	61·10	6·76	11	10	18·5	28·5	35 –65
4.12.32	,,	60·41	6·69	11	12	16	28	42·8–57·2
5.12.32	,,	63·19	7·09	11·2	12·5	16·5	29	43·1–56·9
22.10.32	362	56·60	6·9	10·4	10	15	25	40 –60
23.10.32	,,	54·29	7·3	13·5	7	15	22	31·8–68·2
25.10.32	,,	58·55	7·5	12·9	9·5	15·5	25	38 –62
26.10.32	,,	57·68	7·8	13·6	11	15	26	42·3–57·7
28.10.32	,,	60·91	6·55	10·7	12	14	25	48 –52
29.10.32	,,	58·10	7·39	12·7	10·5	15·5	26	40·3–59·7
31.10.32	,,	60·64	7·71	12·7	9	19·5	28·5	31·5–68·5
1.11.32	,,	56·85	6·38	11·2	11·5	14	25·5	45 –55
2.11.32	,,	55·52	6·67	12	11	14	25	44 –56
4.11.32	,,	59·47	6·27	10·5	13	14·5	27·5	47·2–52·8
5.11.32	,,	57·45	6·81	11·8	11	14	25	44 –56
7.11.32	,,	59·18	6·22	10·5	10	16·5	26·5	37·7–62·3
8.11.32	,,	57·32	6·54	11·4	10·5	14·5	25	42 –58
10.11.32	,,	59·45	7·00	11·7	8·5	18·5	27	31·4–68·6
11.11.32	,,	57·45	6·39	11·1	11·5	14·5	26	44·2–55·8
13.11.32	,,	57·86	7·08	12·2	11	15·5	26·5	41·5–58·5
14.11.32	,,	57·39	7·31	12·7	11·5	14	25·5	45 –55
15.11.32	,,	55·94	7·48	13·3	10·5	14·5	25	42 –58
17.11.32	,,	57·93	6·92	11·9	11·5	14	25·5	41·5–58·5
18.11.32	,,	55·56	6·62	11·9	11	15	26	42·3–57·7
19.11.32	,,	59·35	6·6	11·1	12·5	15	27·5	45·4–54·6
21.11.32	,,	56·05	6·44	11·5	11·5	13·5	25	46 –54
23.11.32	,,	58·87	5·73	9·7	13·5	15·5	29	46·5–53·5
26.11.32	,,	58·28	6·92	11·8	14	13	27	51·8–48·2
27.11.32	,,	57·57	6·06	10·5	12	14	26	46·1–53·9
28.11.32	,,	53·82	6·01	11·1	11·5	13·5	25	46 –54
30.11.32	,,	57·08	6·25	10·9	11·5	15	26·5	43·3–56·7
1.12.32	,,	55·20	5·67	10·2	10·5	14.5	25	42 –58
2.12.32	,,	55·12	6·24	11·3	12	13	25	48 –52
4.12.32	,,	56·25	6·22	11	11	16	27	40·7–59·3
5.12.32	,,	52·58	6·23	11·8	11	14	25	44 –56
22.10.32	342	55·05	7·3	13·3	10	15	25	40 –60
26.10.32	,,	55·97	6·5	11·6	8	18	26	30·7–69·3
28.10.32	,,	54·55	6·64	12·1	7	15	22	31·8–68·2
30.10.32	,,	57·41	7·63	13·2	9·5	16·5	26	36·5–63·5
1.11.32	,,	55·75	5·65	10·1	8	17·5	25·5	31·3–68·7
2.11.32	,,	57·93	6	10·3	11	16·5	27·5	40 –60

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg. Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
4.11.32	342	57·94	5·67	9·8	9·5	17·5	27	35·1–64·9
7.11.32	,,	58·9	7·23	12·2	8	19·5	27·5	29 –71
10.11.32	,,	56·82	6·55	11·5	9·5	17	26·5	35·4–64·6
11.11.32	,,	56·76	5·89	10·3	8	17·5	25·5	31·3–68·7
13.11.32	,,	57·02	5·95	10·4	10	17	27	37 –63
14.11.32	,,	60·39	5·9	9·7	12	17	29	41·3–58·7
16.11.32	,,	60·04	6·06	10·1	10·5	18	28·5	36·8–63·2
17.11.32	,,	60·58	5·82	9·6	12	18	30	40 –60
19.11.32	,,	55·72	5·32	9·5	9·5	16	25·5	37·2–62·8
21.11.32	,,	57·41	5·74	10	11	17	28	39·2–60·8
24.11.32	,,	57·37	5·5	9·5	12	15	27	44·4–55·6
27.11.32	,,	58·15	5·13	8·9	9·5	18·5	28	33·9–66·1
1.12.32	,,	52·34	5·43	10·3	6	17·5	23·5	25·5–74·5
4.12.32	,,	59·23	5·60	9·4	10	19	29	34·4–65·6
5.12.32	,,	56·06	5·93	10·5	10·5	15·5	26	40·3–59·7
22.10.32	354	65·525	8·1	12·3	9	18	27	33·3–66·7
25.10.32	,,	63·271	7·9	12·4	7	19	26	26·9–73·1
26.10.32	,,	62·986	7·6	12	—	—	—	—
27.10.32	,,	64·866	7·2	11·1	9	19	28	32·1–67·9
29.10.32	,,	67·26	8·1	12·1	9·5	17·5	27	35·1–64·9
31.10.32	,,	66·29	8·1	12·2	10	19·5	29·5	33·8–66·2
1.11.32	,,	67·06	7·3	10·9	9·5	19·5	29	32·7–67·3
3.11.32	,,	66·24	6·1	9·2	9·5	20	29·5	32·2–67·8
4.11.32	,,	66·12	6·18	9·3	9·5	18	27·5	30·9–69·1
6.11.32	,,	62·71	6·55	10·4	8	17	25	32 –68
5.11.32	,,	66·39	6·32	9·5	10	19	29	34·4–65·6
8.11.32	,,	66·45	7·44	11·2	8·5	20·5	29	29·3–70·7
9.11.32	,,	66·27	7·34	11	9·5	19	28·5	33·3–66·7
10.11.32	,,	66·61	7·37	11	9·5	20	29·5	32·2–67·8
12.11.32	,,	62·69	6·59	10·5	8	18·5	26·5	30·1–69·9
13.11.32	,,	61·78	6·66	10·7	11	16·5	27·5	40 –60
19.11.32	,,	60·18	6·49	10·8	9	18	27	33·3–66·7
21.11.32	,,	63·67	6·7	10·5	8	22	30	26·6–73·4
23.11.32	,,	61·63	6·57	10·6	7	19·5	26·5	26·4–73·6
25.11.32	,,	65·77	6·29	9·5	8·5	20	28·5	29·8–70·2
27.11.32	,,	62·02	6·25	10	9	18·5	27·5	32·7–67·3
28.11.32	,,	63·56	6·04	9·5	8	21	29	27·5–72·5
29.11.32	,,	64·37	6·6	10·2	7·5	19·5	27	27·7–72·3
1·12·32	,,	64·688	6·18	9·5	10·5	17·5	28	37·5–62·5
2.12.32	,,	62·20	6·49	10·4	9·5	18	27·5	30·9–69·1
4.12.32	,,	65·26	6·82	10·4	8·5	21·5	30	28·3–71·7
5.12.32	,,	61·79	6·22	10	9	18	27	33·3–66·7
22.10.32	397	69·05	8·1	11·7	13	21	34	38·2–61·8
24.10.32	,,	66·56	7·3	11	14	18	32	43·7–56·3
25.10.32	,,	60·82	6·7	11	10	19	29	34·4–65·6
27.10.32	,,	63·62	6·9	10·9	11	19	30	36·6–63·4
28.10.32	,,	62·54	6·07	9·7	11	20	31	35·4–64·6
30.10.32	,,	65·05	7·57	11·6	11·5	21·5	33	34·8–65·2
31.10.32	,,	62·46	7·16	13	8·5	21·5	30	28·3–71·7

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
2.11.32	397	66·70	6·61	9·9	15·5	19·5	35	44·2–55·8
3.11.32	,,	66·10	6·21	9·3	14	18·5	32·5	43 –57
6.11.32	,,	67·99	6·25	9·2	14	20	34	41·1–58·9
7.11.32	,,	66·30	7·30	11	12·5	18·5	31	40·3–59·7
8.11.32	,,	64·02	6·61	10·3	12·5	19	31·5	39·6–60·4
10.11.32	,,	68·35	7·07	10·3	13	21·5	34·5	37·6–62·4
12.11.32	,,	66·38	6·64	10	15	18·5	33·5	44·7–55·3
13.11.32	,,	73·35	7·34	10	14	20·5	34·5	40·5–59·5
15.11.32	,,	64·85	6·54	10	12	21	33	36·3–63·7
16.11.32	,,	63·61	5·94	9·3	9	22	31	29 –71
17.11.32	,,	66·55	6·15	9·2	14	20	34	41·1–58·9
19.11.32	,,	64·72	6·07	9·3	13·5	18·5	32	42·1–57·9
20.11.32	,,	61·86	5·58	9	12·5	18·5	31	40·3–59·7
21.11.32	,,	59·98	5·64	9·4	12	18	30	40–60
23.11.32	,,	64·81	6·11	9·4	13	20·5	33·5	38·8–61·2
24.11.32	,,	62·86	5·75	9·1	11·5	19·5	31	37 –63
25.11.32	,,	62·15	5·83	9·3	10	21	31	32·2–67·8
27.11.32	,,	66·08	6·51	9·8	14	19	33	42·4–57·6
28.11.32	,,	62·50	5·88	9·4	14·5	16	30·5	47·5–52·5
29.11.32	,,	60·72	6·37	10·4	13	17	30	43·3–56·7
1.12.32	,,	68·70	7·23	10·5	17	18	35	48·5–51·5
2.12.32	,,	63·72	6·03	9·4	14	18	32	43·7–56·3
4.12.32	,,	60·52	6·07	10	14	16·5	30·5	45·9–54·1
5.12.32	,,	66·31	6·64	10	14.5	18.5	33	43·9–56·1
22·10·32	324	55·161	5·48	9·9	10·5	15·5	26	40·3–59·7
24.10.32	,,	60·11	6·14	10·2	11·5	18·5	30	38·3–61·7
26.10.32	,,	64·46	5·76	8·9	12	20	32	37·5–62·5
28.10.32	,,	59·80	4·59	7·6	10	20	32	31·2–68·8
29.10.32	,,	57·10	4·71	8·2	10	19	29	34·4–65·6
30.10.32	,,	57·35	5·52	9·6	8·5	20·5	29	29·3–70·7
2.11.32	,,	58·95	4·92	8·3	11·5	18·5	30	38·3–61·7
3.11.32	,,	57·38	4·29	7·4	11	18	29	37·9–62·1
4.11.32	,,	56·80	4·64	8·1	10	15·5	26·5	37·7–62·3
6.11.32	,,	60·23	5·17	8·5	10	19·5	29·5	33·9–66·1
7.11.32	,,	56·35	4·71	7·4	12	16	28	42·8–57·2
9.11.32	,,	59·01	5·80	9·8	9·5	18	27·5	34·5–65·5
11.11.32	,,	57·09	5·45	9·5	8·5	20	28·5	29·8–70·2
15.11.32	,,	58·44	5·24	8·9	9	19·5	28·5	31·5–68·5
16.11.32	,,	55·99	4·85	8·6	10	16·5	26·5	37·7–62·3
18.11.32	,,	60·32	6·08	10·8	11	19·5	30·5	36 –64
19.11.32	,,	59·53	5·52	9·2	11	17	28	39·2–60·8
21.11.32	,,	59·30	5·22	8·8	10·5	18·5	29	36·2–63·8
22.11.32	,,	57·61	4·78	8·2	11·5	16·5	28	41 –59
23.11.32	,,	54·33	5·41	8·9	9	16·5	25·5	35·2–64·8
25.11.32	,,	60·29	5·15	8·5	10·5	19	29·5	35·5–64·5
27.11.32	,,	57·56	4·97	8·6	10	18·5	28·5	35 –65
28.11.32	,,	60·51	6·53	10·7	11	17·5	28·5	38·5–61·5
29.11.32	,,	55·72	4·91	8·8	9	17·5	26·5	33·9–66·1
30.11.32	,,	56·56	5·36	9·2	10	16	26	38·4–61·6
2.12.32	,,	59·41	5·52	9·2	10·5	17	27·5	34·5–65·5
4.12.32	,,	56·60	4·86	8·5	10·5	17	27·5	34·5–65·5

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
22.10.32	947	52·77	6·66	12·6	9·8	13·2	23	42·6–57·4
24.10.32	,,	52·74	6·41	12·1	9·5	12	21·5	44·1–55·9
25.10.32	,,	54·14	5·74	10·6	9	15·5	24·5	36·7–63·3
26.10.32	,,	53·22	5·46	10·2	8·5	13·5	22	38·6–61·4
28.10.32	,,	56·44	5·68	10	10	15	25	40 –60
29.10.32	,,	54·90	6·18	11·2	10	17	27	37 –63
30.10.32	,,	55·40	6·44	11·6	9	14·5	23·5	38·2–61·8
31.10.32	,,	53·28	5·81	10·9	9	14	23	39·1–60·9
2.11.32	,,	55·63	5·48	9·8	11	13	24	45·8–54·2
3.11.32	,,	54·93	5·07	9·3	10	14·9	24·9	40·1–59·9
4.11.32	,,	54·11	5·36	9·9	11	13	24	45·8–54·2
7.11.32	,,	56·39	6·26	11·1	11·5	13·5	25	46 –54
8.11.32	,,	56·44	5·35	9·4	10	15	25	40–60
9.11.32	,,	54·94	5·45	9·9	10	13·5	23·5	42·5–57·5
10.11.32	,,	54·17	5·45	10	10	13·5	23·5	42·5–57·5
13.11.32	,,	55·67	5·43	9·7	11	14	25	44 –56
14.11.32	,,	58·19	6·28	10·8	10	15·5	25·5	39·2–60·8
15.11.32	,,	51·86	4·96	9·5	9·5	14	23·5	40·4–59·6
17.11.32	,,	55·93	5·38	9·6	10·5	14	24·5	42·8–57·2
18.11.32	,,	55·06	5·31	9·6	10	15	25	40 –60
19.11.32	,,	55·18	4·95	9	11	14	25	44 –56
20.11.32	,,	53·97	5·46	10·1	10	14·5	24·5	40·8–59·2
21.11.32	,,	52·93	4·92	9·3	11	14	25	44 –56
24.11.32	,,	56·40	5·04	8·9	11	14·5	25·5	43·1–56·9
25.11.32	,,	56·93	4·62	8·1	11	14·5	25·5	43·1–56·9
26.11.32	,,	55·43	4·76	8·5	11·5	12	23·5	48·9–51·1
27.11.32	,,	53·98	5·11	9·6	10	14	24	41·6–58·4
29.11.32	,,	56·09	5·45	9·5	11	14·5	25·5	43·1–56·9
30.11.32	,,	54·49	4·66	8·5	10·5	15·5	26	40·3–59·7
1.12.32	,,	53·22	4·92	9·2	11·5	13	24·5	46·9–53·1
2.12.32	,,	54·55	5·87	10·7	11·5	14·5	26	44·2–55·8
4.12.32	,,	55·42	5·35	9·6	10·5	14·5	25	42 –58
5.12.32	,,	55·54	5·67	10·2	10·5	15	25·5	41·1–58·9

APPENDIX 2.

Normal Eggs Stored and Tested.

Temperature and Humidity not Constant.

Date.	No.	Date of Test.	Interval.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage of Thin to Thick Albumin.
			Days.	c.cs.	c.cs.	c.cs.	% %
6.12.32	947	20.12.32	14	14	6	20	70 –30
8.12.32	,,	22.12.32	14	13	8	21	61·9–38·1
9.12.32	,,	22.12.32	13	11	10·5	21·5	51·1 –48·9
10.12.32	,,	22.12.32	12	12·5	8·5	21	59·5–40·5
11.12.32	,,	24.12.32	13	11·5	8·5	20	57·5–42·5
12.12.32	,,	29.12.32	17	13	6	19	68·4–31·6
14.12.32	,,	6.1.33	23	14	7	21	66·6–33·4
16.12.32	,,	6.1.33	21	11.5	9·5	21	54·7–45·3
17.12.32	,,	6.1.33	20	10·5	7·5	18	58·3–41·7
20.12.32	,,	6.1.33	17	12·5	9	21·5	58·1–41·9
21.12.32	,,	6.1.33	16	15	8·5	23·5	63·8–36·2
22.12.32	,,	6.1.33	15	11·5	9·5	21	54·7–45·3
23.12.32	,,	6.1.33	14	13	8	21	61·9–38·1
25.12.32	,,	6.1.33	12	12·5	9	21·5	58·1–41·9
26.12.32	,,	6.1.33	11	10·5	12·5	23	45·6–54·4
28.12.32	,,	6.1.33	9	11·5	9	20·5	56 –44
1.1.33	,,	6.1.33	5	7·5	16	23·5	31·9–68·1
8.12.32	294	21.12.32	14	11	13·5	24·5	44·8–55·2
9.12.32	,,	22.12.32	13	15	9·5	24·5	61·2–38·8
14.12.32	,,	7.1.33	24	16·5	8	24·5	67·3–32·7
16.12.32	,,	7.1.33	22	14	12·5	26·5	52·8–47·2
25.12.32	,,	7.1.33	13	13·5	11·5	25	54 –46
30.12.32	,,	7.1.33	8	11	13	24	45·8–54·2
6.12.32	324	20.12.32	14	12·5	13·5	26	48·7–51·3
9.12.32	,,	23.12.32	14	9·5	17·5	26·5	35·9–64·1
11.12.32	,,	24.12.32	13	10	16·5	26·5	37·7–62·3
12.12.32	,,	29.12.32	17	13·5	11·5	25	54 –46
16.12.32	,,	9.1.33	24	10·5	11·5	22	47·7–52·3
17.12.32	,,	9.1.33	23	11·5	10·5	22	52·2–47·8
21.12.32	,,	9.1.33	19	15	12	27	55·5–44·5
23.12.32	,,	9.1.33	17	12·5	14	26·5	47·1–52·9
25.12.32	,,	9.1.33	15	9	13	22	40·9–59·1
26.12.32	,,	9.1.33	14	10·5	16	26·5	39·6–60·4
29.12.32	,,	9.1.33	11	11	14	25	44 –56
30.12.32	,,	9.1.33	10	11·5	14	25·5	45 –55
6.12.32	397	20.12.32	14	19·5	8	27·5	70·9–29·1
7.12.32	,,	21.12.32	14	19	8·5	27·5	72·7–27·3
9.12.32	,,	23.12.32	14	23·5	8·5	32	73·4–26·6
11.12.32	,,	23.12.32	12	19	10·5	29·5	64·4–35·6
13.12.32	,,	23.12.32	10	18	13	31	58 –42
14.12.32	,,	23.12.32	9	14	15	29	48·2–51·8
15.12.32	,,	23.12.32	8	17	14·5	31·5	53·9–46·1
16.12.32	,,	23.12.32	7	16·5	15	31·5	52·6–47·4
18.12.32	,,	23.12.32	5	16	15	31	51·6–48·4
19.12.32	,,	23·12·32	4	14	17	31	45·1–54·9
21.12.32	,,	23·12·32	2	16·5	16·5	33	50—50
10.12.32	,,	23.12.32	13	19·5	9·5	29	67·2–32·8

Date.	No.	Date of Test.	Interval.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage of Thin to Thick Albumin.
			Days.	c.cs.	c.cs.	c.cs.	% %
22.12.32	397	9.1.33	18	23·5	5	28·5	82·4–17·6
23.12.32	„	9.1.33	17	27·5	4	31·5	87·3–12·7
25.12.32	„	9.1.33	15	17·5	11	28·5	61·4–38·6
29.12.32	„	9.1.33	11	22·5	9	31·5	71·4–28·6
30.12.32	„	9.1.33	10	20	10	30	66·6–33·4
1.1.33	„	9.1.33	8	17·5	12·5	30	58·3–41·7
7.12.32	354	21.12.32	14	10	17·5	27·5	36·3–63·7
8.12.32	„	22.12.32	14	9·5	15	24·5	38·7–61·3
10.12.32	„	23.12.32	13	9·5	17·5	27	35·1–64·9
12.12.32	„	29.12.32	17	10	17·5	27·5	36·3–63·7
15.12.32	„	5.1.33	21	12·5	12·5	25	50 –50
17.12.32	„	5.1.33	19	9·5	12·5	22	43·1–56·9
18.12.32	„	5.1.33	18	10	16	26	38·4–61·6
19.12.32	„	10.1.33	21	13·5	9·5	23	58·7–41·3
21.12.32	„	10.1.33	19	12·5	13·5	26	48 –52
22.12.32	„	10.1.33	18	11	13	24	45·8–54·2
25.12.32	„	10.1.33	15	10·5	15·5	26	40·3–59·7
26.12.32	„	10.1.33	14	9·5	16	25·5	37·2–62·8
27.12.32	„	10.1.33	13	11·5	16	27·5	41·8–58·2
28.12.32	„	10.1.33	12	9·5	12·5	22	43·1–56·9
30.12.32	„	10.1.33	10	9·5	16	25·5	37·2–62·8
1.1.33	„	10.1.33	9	10	18	28	35·7–64·3
6.12.32	342	20.12.32	14	9·5	15	24·5	38·7–61·3
7.12.32	„	21.12.32	14	10·5	13·5	24	43·7–56·3
9.12.32	„	22.12.32	13	11	14·5	25·5	43·1–56·9
13.12.32	„	5.1.33	23	11·5	12·5	24	47·9–52·1
14.12.32	„	5.1.33	22	9	13	22	40·9–59·1
20.12.32	„	11.1.33	22	13·5	10	23·5	57·4–42·6
23.12.32	„	11.1.33	19	10	14	24	41·6–58·4
25.12.32	„	11.1.33	17	13	11·5	24·5	53 –47
16.12.32	„	11.1.33	26	9	13·5	22·5	40 –60
19.12.32	„	11.1.33	25	12·5	10·5	23	54·3–45·7
26.12.32	„	11.1.33	16	11	14·5	25·5	43·1–56·9
29.12.32	„	1.11.33	13	12	12·5	24·5	48·9–51·1
30.12.32	„	11.1.33	12	11	13	24	45·8–54·2
7.12.32	362	21.12.32	14	15	9	24	62·5–37·5
8.12.32	„	22.12.32	14	12	9·5	21·5	55·8–44·2
10.12.32	„	22.12.32	12	16·5	7·5	24	68·7–31·3
11.12.32	„	24·12·32	13	13·5	9·5	23	58·7–41·3
13.12.32	„	3.1.33	21	17	8	25	68 –32
14.12.32	„	9.1.33	26	18	5	23	78·2–21·8
16.12.32	„	9.1.33	24	15	6·5	21·5	69·7–30·3
17.12.32	„	9.1.33	23	15·5	6	21·5	72 –28
19.12.32	„	9.1.33	21	16·5	5·5	22	75 –25
21.12.32	„	9.1.33	19	18·5	6·5	25	74 –26
22.12.32	„	9.1.33	18	14	8·5	22·5	62·2–37·8
23.12.32	„	9.1.33	17	15	7·5	22·5	66·6–33·4

Date.	No.	Date of Test.	Interval.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage of Thin to Thick Albumin.
			Days.	c.cs.	c.cs.	c.cs.	% %
25.12.32	362	9.1.33	15	14	9	23	60·8–39·2
27.12.32	„	9.1.33	13	13	9·5	22·5	57·7–42·3
28.12.32	„	9.1.33	12	13·5	9·5	23	58·7–41·3
30.12.32	„	9.1.33	10	12	11	23	52·1–47·9
6.12.32	399	20.12.32	14	14	12	26	53·8–46·2
8.12.32	„	22.12.32	14	15·5	9	24·5	63·2–36·8
9.12.32	„	22.12.32	14	14	10·5	24·5	57·1–42·9
12.12.32	„	29.12.32	17	17·5	7·5	25	70–30
13.12.32	„	3.1.33	21	21	4	25	84 –16
15.12.32	„	3.1.33	19	15·5	9	24·5	63·2–36·8
17.12.32	„	3.1.33	17	17	8	25	68 –32
18.12.32	„	3.1.33	16	18	9	27	66·6–33·4
19.12.32	„	3.1.33	15	17	9	26	65·3–34·7
21.12.32	„	3.1.33	13	14	11	25	56 –44
22.12.32	„	3.1.33	12	12	13·5	25·5	47 –53
25.12.32	„	3.1.33	9	12·5	11	23·5	53·1–46·9
26.12.32	„	3.1.33	8	12·5	13	25·5	49 –51
28.12.32	„	3.1.33	6	11·5	14·5	26	44·2–55·8
27.12.32	„	10.1.33	17	16	7·5	23·5	68 –32
30.12.32	„	10.1.33	14	12	14	26	46·1–53·9
1.1.33	„	10.1.33	9	11·5	12·5	24	47·9–52·1

APPENDIX 3.

CANDLED "WATERY WHITE" EGGS, *Ex* DURBAN.

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
20.10.32	1	59·671	6·5	10·8	9	15·5	24·5	36·7–63·3
,,	2	58·036	5·7	9·9	10·5	13	23·5	44·2–55·8
,,	3	57·016	5·2	9·2	12	11	23·3	51·5–48·5
,,	4	59·109	6·1	10·4	13	12	25	52 –48
,,	5	62·709	5·7	9·1	12	18	30	40 –60
,,	6	53·891	5·1	9·5	12	11	23	52·1–47·9
,,	7	54·362	5·6	10·3	10	15	25	40 –60
,,	8	56·623	5·4	9·5	7	15	22	31·8–68·2
,,	9	56·730	5·6	9·9	8	17	25	32 –68
,,	10	64·429	6·9	10·7	15	12	27	54·8–45·2
,,	11	58·399	5·7	9·8	11	15	26	42·3–57·7
,,	12	56·951	5·5	9·8	12	12·5	24·5	48·9–51·1
,,	13	60·540	6·3	10·4	16	10	26	61·5–38·5
,,	14	68·197	6·7	9·8	16	13	29	55·1–44·9
,,	15	52·419	5·9	11·1	11	12	23	47·9–52·1
,,	16	50·296	5·5	10·9	10	11	21	47·6–52·4
29.10.32	17	60·641	6·535	10·7	12	15	27	44·4–55·6
,,	18	53·041	5·615	10·5	16	7	23	69·5–30·5
,,	19	57·036	6·585	11·5	8·5	17·5	26	32·6–67·4
,,	20	58·826	5·248	8·9	13·5	14·5	28	48·2–51·8
,,	21	66·351	6·555	9·8	16	18	34	47 –53
,,	22	58·651	5·495	9·3	11	13·5	24·5	44·9–55·1
,,	23	62·751	6·338	10	16	11	27	59·2–40·8
,,	24	61·671	7·090	11	13	17	30	43·3–56·7
,,	25	51·746	5·348	10·3	9·5	13	22·5	42·2–57·8
,,	26	58·461	5·665	9·6	11·5	17·5	29	39·6–60·4
,,	27	51·941	5·561	10·7	15	13	28	53·5–46·5
,,	28	49·696	4·745	9·5	10·5	12·5	23	41·2–58·8
,,	29	54·406	5·233	9·6	11	17	28	39·2–60·8
,,	30	50·126	5·338	10·6	10	12	22	45·4–54·6
,,	31	49·501	5·655	11·4	6·5	14·5	21	30·9–69·1
9.11.32	32	54·811	5·870	10·7	9	14·5	23·5	38·2–61·8
,,	33	61·226	6·755	11	9·5	17	26·5	35·8–64·2
,,	34	54·501	5·785	10·6	13·5	9·5	23	58·7–41·3
,,	35	50·956	4·955	9·7	13·5	10	23·5	57·4–42·6
,,	36	46·651	4·605	9·8	8·5	12	20·5	41·4–58·6
,,	37	54·481	5·055	9·2	9	16·5	25·5	35·2–64·8
,,	38	58·176	6·770	11·6	11·5	14	25·5	45 –55
,,	39	59·906	5·945	9·9	10	17·5	27·5	36·3–63·7
,,	40	54·316	4·910	9	6·5	19	25·5	25·4–74·6
,,	41	67·701	6·273	9·2	14	18·5	32·5	43 – 57
,,	42	54·901	5·751	10·4	14·5	8·5	23	63 –37
,,	43	56·656	6·007	10·6	12	13	25	48 –52
,,	44	60·106	6·578	10·9	11	17·5	28·5	38·5–61·5
,,	45	55·806	5·390	9·6	15·5	9·5	25	62 –38
,,	46	64·111	6·672	10·4	16·5	13·5	30	55 –45
,,	47	58·541	5·672	9·6	14	14·5	28·5	49·1–50·1
,,	48	54·656	6·450	11·8	8·5	12·5	21	40·4–59·6
,,	49	54·201	5·762	10·6	9·5	16	25·5	37·2–62·8
14.11.32	50	63·021	7·155	11·3	12	16	28	42·8–57·2
,,	51	56·791	5·358	9·4	10	15	25	40 –60
,,	52	55·956	5·470	9·7	18	7	25	72 –28
,,	53	59·526	6·428	10·7	12	16·5	28·5	42·1–57·9
,,	54	50·499	5·770	11·4	13	10·5	23·5	55·3–44·7
,,	55	50·281	4·675	9·3	8	14·5	22·5	35·5–64·5
,,	56	59·476	6·200	10·4	16·5	11	27·5	60– 40

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg Weight.	Thin Albumin.	Thick Albumin.	Total Albumin	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
„	57	54·381	5·095	9·3	14·5	13·5	28	51·7–48·3
„	58	65·046	5·735	8·8	15·5	18·5	34	45·5–54·5
„	59	60·593	7·285	12	10·5	14·5	25	42 –58
„	60	52·161	5·263	10	10·5	12	22·5	46·6–53·4
„	61	55·503	6·776	12·1	8	14·5	22·5	35·5–64·5
„	62	55·221	5·095	9·2	7·5	14·5	22	34 –66
„	63	59·631	5·977	10	10	16	28	35·7–64·3
„	64	56·341	6·420	11·4	10	15·5	25·5	39·2–60·8
14.11.32	65	51·846	4·220	8·1	8	15·5	23·5	34 –66
„	66	58·101	6·785	11·6	13	13·5	26·5	49 –51
„	67	55·601	5·170	9·3	9·5	16·5	26	36·5–63·5
„	68	61·951	6·140	9·9	16·5	12	28·5	57·8–42·2
„	69	56·621	5·870	10·3	11·5	15·5	27	42·5–57·5
„	70	56·401	—	—	—	—	—	—
„	71	47·907	5·740	11·9	10	9	19	52·6–47·4
„	72	52·761	5·980	11·3	10	13·5	23·5	42·5–57·5
„	73	56·955	—	—	15	11·5	26·5	56·6–43·4
„	74	52·66	—	—	13	10	23	56·5–43·5
„	75	59·35	—	—	18	7	25	72 –28
„	76	66·325	—	—	20·5	11	31·5	65 –35
„	77	59·05	—	—	—	—	—	—
„	78	54·47	—	—	6	19	25·5	23·5–76·5
„	79	61·155	—	—	18·5	9	27·5	67·2–32·8
„	80	58·455	—	—	13·5	19	32·5	41·5–58·5
„	81	62·15	—	—	14·5	17	31·5	46 –54
„	82	59·895	—	—	12	16	28	42·8–57·2
„	83	66·155	—	—	13	14	27	48·1–51·9
„	84	55·06	—	—	13	11·5	24·5	53 –47
„	85	56·865	—	—	11	17·5	28·5	38·5–61·5
„	86	57·675	—	—	11	17	28	39·2–60·8
„	87	54·425	—	—	9	14	23	39·1–60·9
„	88	53·34	—	—	15	9	24	62·5–37·5
„	89	58·625	—	—	9·5	14	23·5	40·4–59·6
„	90	53·55	—	—	4	18	22	18·1–81·9
„	91	52·015	—	—	12·5	12·5	25	50 –50
„	92	42·755	—	—	9	10	19	47·3–52·7
„	93	49·505	—	—	13·5	7·5	21	64·2–35·8
„	94	49·92	—	—	16·5	6·5	23	71·7–28·3
„	95	41·145	—	—	6	12	18	33·3–66·7
29.11.32	96	61·901	—	—	25	3	28	89·2–10·8
„	97	56·061	—	—	14	11	25	56 –44
„	98	61·931	—	—	14	15	29	48·2–51·8
„	99	65·601	—	—	17	14	31	54·9–45·1
„	100	61·971	—	—	17·5	11·5	29	60·3–39·7
„	101	56·271	—	—	11	14·5	25·5	43·1–56·9
„	102	59·666	—	—	13	14·5	27·5	47·2–52·8
„	103	66·271	—	—	—	—	—	—
„	104	59·781	—	—	11·5	15	26·5	43·3–56·7
„	105	66·386	—	—	12	24	36	33·3–66·7
„	106	56·411	—	—	9·5	14	23·5	40·4–59·6
„	107	58·671	—	—	9·5	20	29·5	32·2–67·8
„	108	63·161	—	—	12·5	18·5	31	40·3–59·7
„	109	58·061	—	—	11·5	14	25·5	45 –55
„	110	63·321	—	—	16·5	16·5	33	50 –50
„	111	56·821	—	—	17·5	9	26·5	66 –34
„	112	58·731	—	—	13	16	29	44·8–55·2

Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
„	113	54·941	—	—	15·5	10·5	26	59·6–40·4
„	114	57·911	—	—	15	10	25	60 –40
„	115	60·291	—	—	14	15	29	48·2–51·8
„	116	51·111	—	—	11	11·5	22·5	48·8–51·2
„	117	49·671	—	—	8	14	22	36·3–63·7
„	118	49·321	—	—	11·5	11	22·5	51·1–48·9
7.12.32	119	68·386	6·435	9·4	20	12	32	62·5–37·5
„	120	64·981	6·807	10·4	12	20	32	37·5–62·5
„	121	62·706	6·06	9·5	15·5	14·5	30	51·6–48·4
„	122	58·801	5·907	10	11·5	11	22·5	51·1–48·9
„	123	51·426	4·202	8·1	20	2·5	22·5	88·8–11·2
„	124	52·656	5·175	9·8	11	13·5	24·5	44·8–55·2
„	125	57·961	6·095	10·5	8·5	19·5	28	30·3–69·7
„	126	58·746	5·680	9·6	10	16·5	26·5	37·7–62·3
„	127	60·481	6·2	10·2	16·5	12·5	29	56·9–43·1
„	128	60·476	5·9	9·7	16·5	14·5	31	53·2–46·8
„	129	58·981	5·495	9·3	15·5	14	29·5	52·5–47·5
„	130	54·561	5·220	9·5	8·5	17	25·5	33·3–66·7
„	131	56·686	4·807	8·4	15·5	12	27·5	56·3–43·7
„	132	60·321	6·395	10·5	11·5	17·5	29	39·6–60·4
„	133	52·666	4·303	8·1	7·5	13·5	21	35·7–64·3
„	134	59·756	5·745	9·6	14·5	13	27·5	52·7–47·3
„	135	52·191	6·170	11·8	14·5	8·5	23	63 –37
„	136	53·716	5·610	10·4	15	11	26	57·6–42·4
„	137	50·116	4·675	9·3	7	12·5	19·5	35·8–64·2
„	138	48·036	5·270	10·9	9·5	11	20·5	46·3–53·7
„	139	45·926	3·250	7	7·5	15	22·5	33·3–66·7
„	140	68·018	—	—	14·5	19·5	33	43·9–56·1
„	141	64·250	—	—	8	16·5	24·5	32·6–67·4
„	142	54·790	—	—	19	3	22	86·3–13·7
„	143	61·598	—	—	27	3	30	90 –10
„	144	59·705	—	—	19·5	8	27·5	70·9–29·1
„	145	55·038	—	—	14·5	10	24·5	59·1–40·9
„	146	51·085	—	—	11	8	19	57·9–42·1
„	147	56·149	—	—	16	11	27	59·2–40·8
„	148	60·905	—	—	13·5	15	28·5	47·3–52·7
„	149	59·2	—	—	18	12	30	60 –40
„	150	58·075	—	—	9	16	25	36 –64
„	151	55·075	—	—	9·5	13	22·5	42·2–57·8
„	152	63·518	—	—	15·5	16	31·5	49·2–50·8
„	153	59·555	—	—	18	9	27·5	65·4–34·6
„	154	53·58	—	—	9	15	24	37·5–62·5
„	155	68·268	—	—	24·5	7·5	32	76·5–23·5
„	156	57·388	—	—	12·5	13·5	26	48 –52
„	157	57·701	—	—	11	13·5	24·5	44·8–55·2
„	158	52·189	—	—	9·5	14	23·5	40·4–59·6
„	159	47·74	—	—	5·5	11·5	17	32·3–67·7
28.12.32	160	—	—	—	10	15	25	40 –60
„	161	—	—	—	13	16	29	44·8–55·2
„	162	—	—	—	5	14	19	26·3–73·7
„	163	—	—	—	15	9	24	62·5–37·5
„	164	—	—	—	19	6·5	25·5	74·5–29·5
„	165	—	—	—	15·5	10	25·5	60·7–39·3
„	166	—	—	—	10·5	11·5	22	47·7–52·3
„	167	—	—	—	17·5	10	27·5	63·6–36·4
„	168	—	—	—	7	8	15	46·6–53·4

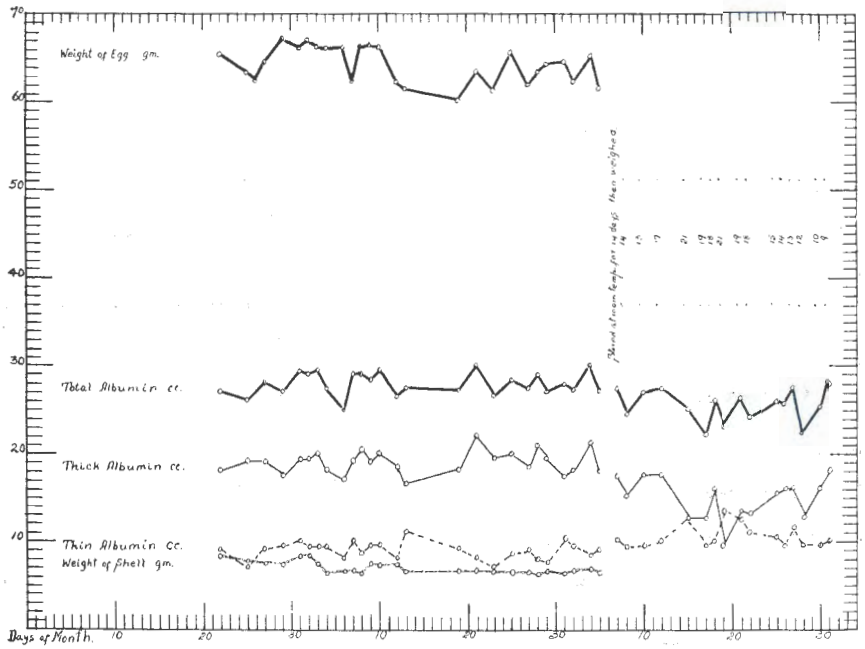
Date.	No.	Weight of Egg.	Weight of Shell.	Percentage of Shell to Egg Weight.	Thin Albumin.	Thick Albumin.	Total Albumin.	Percentage Thin to Thick Albumin.
		gms.	gms.	%	c.cs.	c.cs.	c.cs.	% %
„	169	—	—	—	10·5	7·5	18	58·3–41·7
„	170	—	—	—	18	8	26	69·2–30·8
„	171	—	—	—	7·5	9·5	17	44·1–55·9
„	172	—	—	—	9·5	11	20·5	46·3–53·7
„	173	—	—	—	19·5	7·5	27	72·2–27·8
„	174	—	—	—	8·5	19	27·5	30·9–69·1
„	175	—	—	—	16·5	9	25·5	64·7–35·3
„	176	—	—	—	11	8	19	57·9–42·1
„	177	—	—	—	16	13	29	55·1–44·9
„	178	—	—	—	7·5	14	21·5	34·8–65·2
„	179	—	—	—	14·5	11	25·5	56·8–43·2
„	180	—	—	—	23·5	4·5	28	83·9–16·1
„	181	—	—	—	12·5	12	24·5	51 –49
11.1.33	182	—	—	—	12·5	13	25·5	49 –51
„	183	—	—	—	8·5	15·5	24	35·4–64·6
„	184	—	—	—	15	8	23	65·2–34·8
„	185	—	—	—	23	2·5	25·5	90·1– 9·9
„	186	—	—	—	13·5	14·5	28	48·2–51·8
„	187	—	—	—	15·5	6·5	22	70·4–29·6
„	188	—	—	—	14·5	13	27·5	52·7–47·3
„	189	—	—	—	15·5	7·5	23	67·3–32·7
„	190	—	—	—	15	8	23	65·2–34·8
„	191	—	—	—	14	12	26	53·8–46·2
„	192	—	—	—	13·5	8·5	22	61·3–38·7
11.1.33	193	—	—	—	12	9·5	21·5	55·8–44·2
18.1.33	194	—	—	—	19	14·5	33·5	56·3–43·7
„	195	—	—	—	12	14	26	46·1–53·9
„	196	—	—	—	17·5	8·5	26	67·3–32·7
„	197	—	—	—	10	16·5	26·5	37·7–62·3
„	198	—	—	—	12·5	13·5	26	48 –52
„	199	—	—	—	14·5	14·5	29	50 –50
„	200	—	—	—	14·5	8·5	23	63 –37
„	201	—	—	—	14·5	7	21·5	67·3–32·7
„	202	—	—	—	15	9	24	62·5–37·5
„	203	—	—	—	14·5	12	26·5	54·7–45·3
„	204	—	—	—	13	15	28	46·4–53·6
„	205	—	—	—	14	12·5	26·5	52·8–47·2
„	206	—	—	—	8	12·5	20·5	39 –61
„	207	—	—	—	11·5	14	25·5	45 –55
„	208	—	—	—	12·5	5	17·5	71·4–28·6
„	209	—	—	—	15	9·5	24·5	61·2–38·8
„	210	—	—	—	15·5	12	27·5	56·3–43·7
„	211	—	—	—	19·5	2	21·5	90·7– 9·3
„	212	—	—	—	22·5	1·5	24	93·7– 6·3
„	213	—	—	—	17·5	2	19·5	89·7–10·3
„	214	—	—	—	12·5	10·5	23	54·3–45·7
„	215	—	—	—	12·5	15	27·5	45·4–54·6
28.1.33	216	—	—	—	11	15·5	26·5	41·5–58·5
„	217	—	—	—	8	21·5	29·5	27·1–72·9
„	218	—	—	—	17	16	33	51·4–48·6
„	219	—	—	—	9·5	15·5	25	38 –62
„	220	—	—	—	14·5	11	25·5	56·8–43·2
„	221	—	—	—	14·5	15	29·5	49·1–50·9
„	222	—	—	—	13	12·5	25·5	50·9–49·1
„	223	—	—	—	13	17	30	43·3–56·7
„	224	—	—	—	15	19	34	44·1–55·9
„	225	—	—	—	11	9·5	20·5	56·6–43·4

TABLE 1.

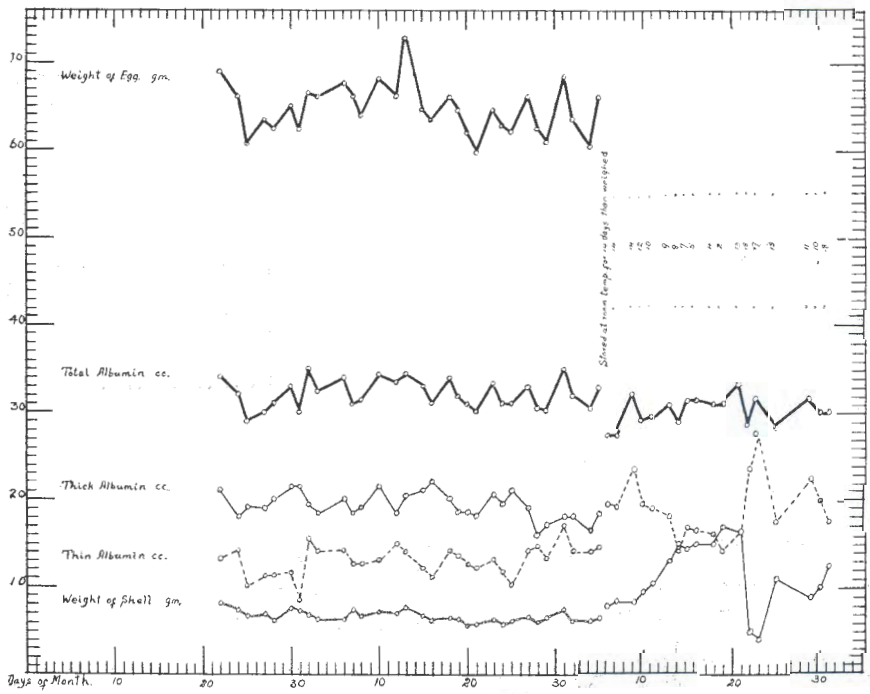
No. of Egg.	Date. Laid.	Temperature of Incubator.	Date of Testing.	No. of Days in Incubator.	Size of Air Sac at Testing. inches.	Description of Shake.	Description of Shell.	Description of Yolk after Test.	Description of Albumin, after Test.	pH on Testing.
9	22.4.32	37° C.	3.5.32	11	$1\frac{3}{8}$	Moderate..	Good quality	Flattened...	Apparently normal; watery white	8
10	„	„	„	11	$1\frac{5}{16}$	„	„	„ ..	Slightly thick, clear; watery white	7·8
11	23.4.32	37° C.	3.5.32	10	$1\frac{7}{16}$	Moderate..	Good quality	Flattened...	Slightly thick, clear; watery white	7·8
12	„	„	„	10	$1\frac{3}{8}$	Slight.....	Not too thick	„	Apparently normal; watery white	7·8
3	19.4.32	37° C.	27.4.32	8	$1\frac{7}{16}$	Slight.....	Good quality	Flattened...	Slightly turbid: watery white....	8
4	„	„	„	8	$1\frac{1}{8}$	„	„	„	Apparently normal; watery white	8
5	20.4.32	37° C.	28.4.32	8	$1\frac{3}{16}$	Moderate..	Good quality	Small round	Watery and clear; watery white	8
6	„	„	„	8	$1\frac{1}{4}$	Slight.....	„	„	„ „ „	8
7	21.4.32	37° C.	29.4.32	8	$1\frac{3}{16}$	Strong....	Thick, good	Flattened...	Watery and clear; watery white	8
8	„	„	„	8	$1\frac{1}{16}$	Moderate..	Good quality	„ ..	Watery and slightly turbid; watery white	8
13	25.4.32	„	3.5.32	8	$1\frac{1}{8}$	Slight.....	Not too thick	Rounded...	Apparently normal; watery white	8
14	„	„	„	8	$1\frac{1}{4}$	„	„	„ ...	„ „ „	8
1	18.4.32	37° C.	25.4.32	7	$1\frac{3}{16}$	Slight.....	Not too thick	Flattened...	Slightly turbid and watery white	7·5
2	„	„	„	7	$1\frac{1}{4}$	„	„	Rounded...	Apparently normal; watery white	7·5
28	10.5.32	37° C.	16.5.32	6	$1\frac{1}{4}$	Slight.....	Not too thick	Flattened...	Apparently normal; watery white	8
29	„	„	„	6	$1\frac{1}{16}$	„	„	„	Watery and clear; watery white	8
26	9.5.32	37° C.	14.5.32	5	$1\frac{1}{8}$	Slight.....	Not too thick	Flattened...	Slightly turbid; watery white	7·8
27	„	„	„	5	$1\frac{1}{16}$	„	Good quality	„ ..	Apparently normal; watery white	8

No. of Egg.	Date. Laid.	Temperature of Incubator.	Date of Testing.	No. of Days in Incubator.	Size of Air Sac at Testing. inches.	Description of Shake.	Description of Shell.	Description of Yolk after Test.	Description of Albumin, after Test.	pH on Testing.
30	11.5.32	37° C.	16.5.32	5	1	Slight.....	Not too thick	Flattened...	Thin and clear; watery white	7·9
31	„	„	„	5	1 1/16	Vigorous...	Thick shell..	—	—	—
31	„	„	17.5.32	6	1 1/8	„ ..	„ ..	—	Broken, because unable to set up Watery white. Albumin membrane only detached	7·2
32	12.5.32	37° C.	16.5.32	4	1	Slight.....	Not too thick	Rounded...	Clear and thin; watery white	8
33	„	„	„	4	1	„	„	„ ...	„ „ „	8
21	5.5.32	37° C.	9.5.32	4	7/8	Slight.....	Fair.....	Flattened...	Thick and clear; watery white	8
22	„	„	„	4	7/8	Vigorous...	Thick.....	„ ..	Clear and thin; watery white	7·8
25	7.5.32	37° C.	11.5.32	4	7/8	Slight.....	Not too thick	Flattened...	Thick and clear; watery white	7·8
34	13.5.32	37° C.	16.5.32	3	1 5/16	Slight.....	Not too thick	Flattened...	Fairly thick; watery white.....	8
35	„	„	„	3	1 3/16	Moderate..	Fairly thick	Flattened...	„ „	8
23	6.5.32	37° C.	9.5.32	3	1 1/16	Slight.....	Not too thick	Small, round	Thin and clear; watery white	8
24	„	„	„	3	3/4	„	„	„	„ „ „	8
20	4.5.32	37° C.	6.5.32	2	5/8	Slight.....	Not too thick	Small, round	Apparently normal; watery white	8
19	„	„	„	2	3/4	Moderate..	Fairly thick	„	„ „ „	8
15	2.5.32	37° C.	3.5.32	1	1/2	Vigorous...	Fair.....	Small, round	Apparently normal; watery white	7·8
16	„	„	„	1	1/2	„ ..	„	„	„ „ „	8
17	3.5.32	37° C.	4.5.32	1	1/2	Vigorous...	Fair.....	—	*No watery white.*	
17	„	„	5.5.32	2	5/8	Slight.....	„	Small, round	Apparently normal; watery white	7·8
18	3.5.32	„	4.5.32	1	1/2	Vigorous...	„	—	*No watery white.*	
18	„	„	5.5.32	2	5/8	Slight.....	„	Small, round	Apparently normal; watery white	7·8
36	21.5.32	53° C.	21.5.32	6 hrs.	—	*Cooked.*		—	—	—
37	„	„	„	1½ hrs.	—	*Partly Cooked.*		—	—	—

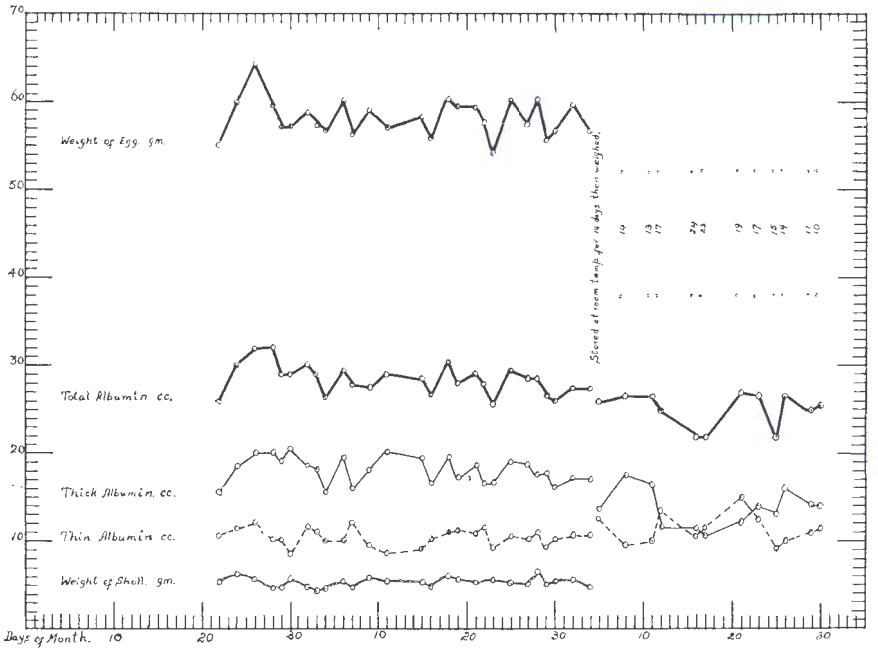
Watery white in last but one column refers to appearance over candle, albumin not measured.



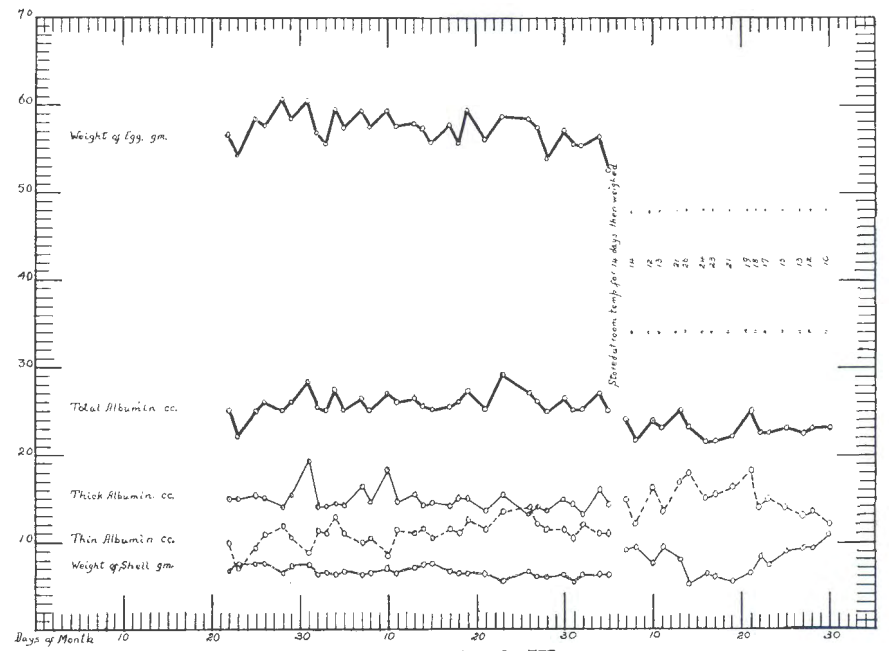
Hen 354, Graph I.



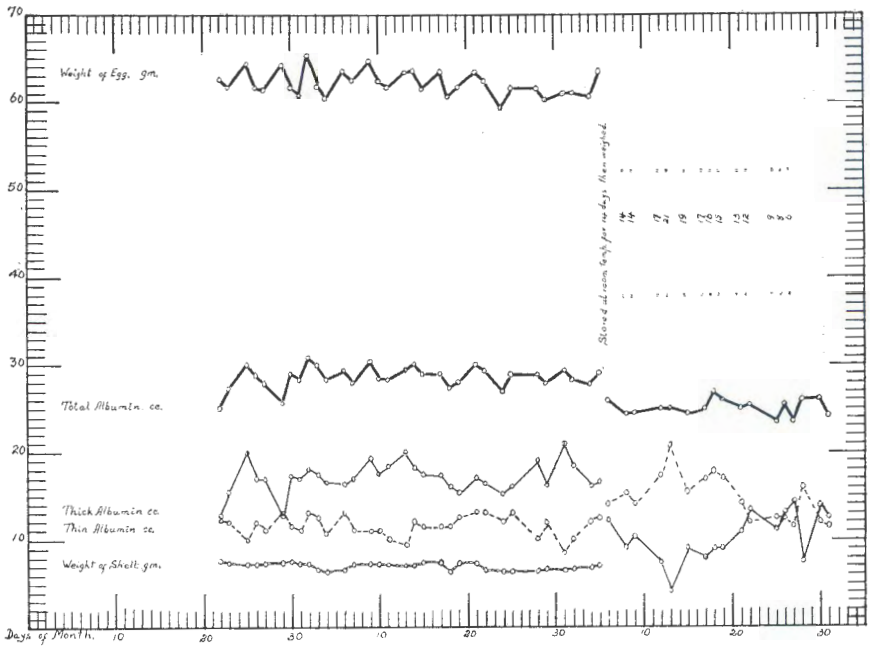
Hen 397, Graph II.



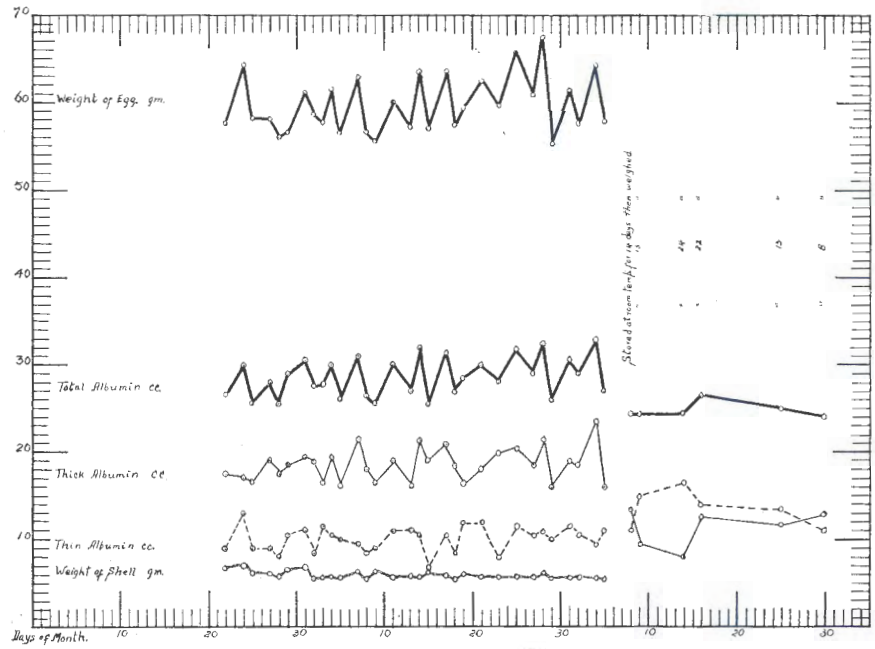
Hen 324, Graph III.



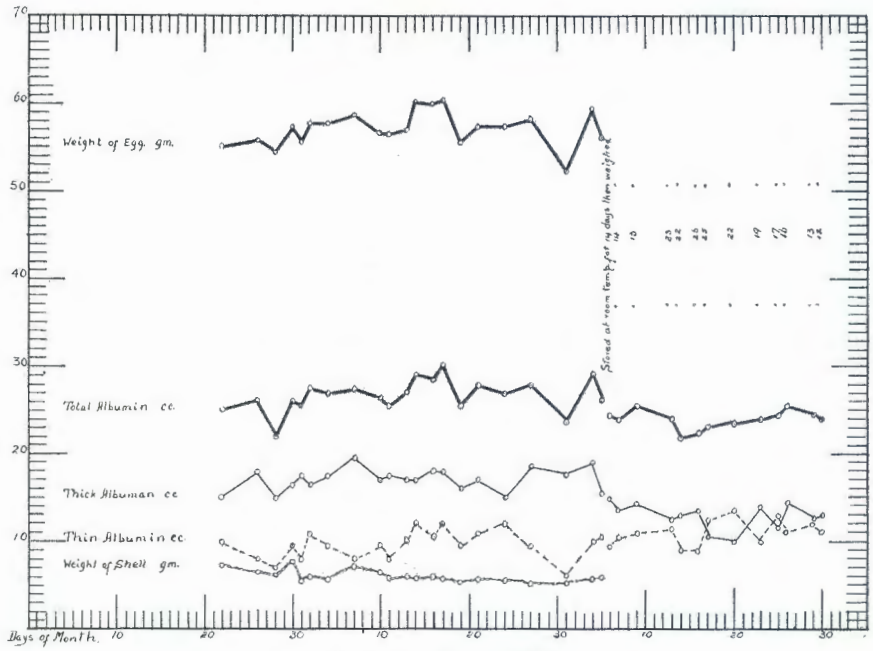
Hen 362, Graph IV.



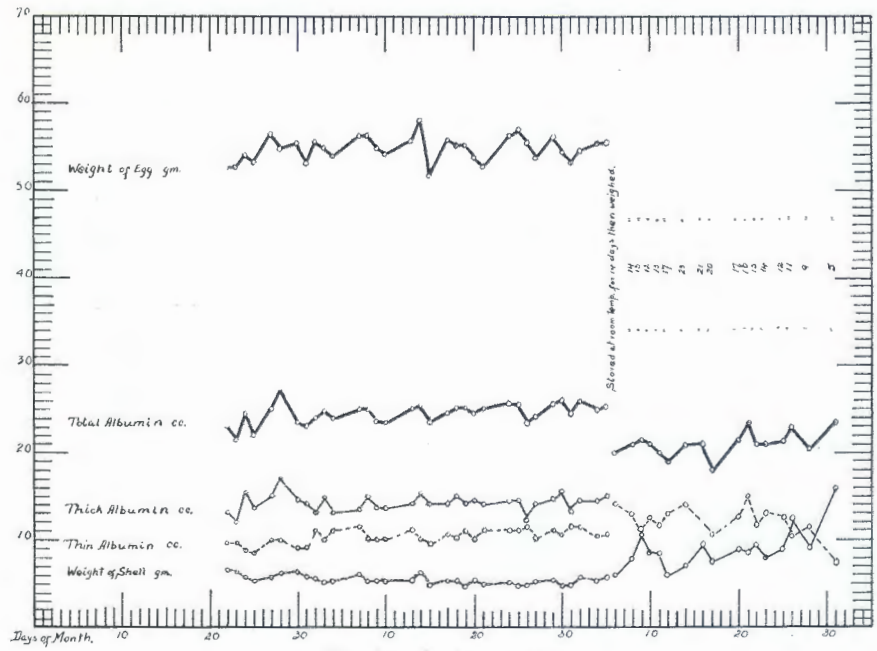
Hen 399, Graph V.



Hen 294, Graph VI.



Hen 342, Graph VII.



Hen 947, Graph VIII.