

Turning Eggs and Embryonic Development



Dr Nick French

Expert in incubation and hatcheries

All species of birds, with one notable exception, turn their eggs during incubation. **In nests this is normally achieved by the incubating bird standing up and using its beak to move the eggs intermittently.**

The one exception is a small group of birds from the Australasian region called the Megapodes which bury their eggs in the ground much like their reptilian ancestors, the heat being supplied either by rotting vegetation, geothermal activity or the sun.



Why do we need to turn eggs?

So why do birds need to turn their eggs?
For many years it has been known that **unturned eggs do not hatch as well as turned eggs.**

More recent studies have also shown that **embryos in unturned eggs grow more slowly, and the extra-embryonic membranes** (the system of membranes outside of the developing embryo's body) **do not develop correctly.**

TURNING FREQUENCY PER DAY

	0	2x	5x
Hatch %	15	45	58

Eycleshymer (1907)

- ▶ **In the first five days of incubation unturned eggs have a smaller area vasculosa** (important for transferring nutrients to the embryo at the start of incubation) **and sub-embryonic fluid** (important for embryo growth).
- ▶ **After 5 days the main sub-embryonic membrane affected by turning is the chorio-allantois (CAM).**
- ▶ The CAM is a *highly vascularised membrane that start to grow after day 5 in the chicken embryo* and develops next to the inner shell membrane, by day 12 completely covering the whole of the inner surface of the eggshell. **Its primary function is to pick up oxygen and transport it to the embryo, and also remove carbon-dioxide.**

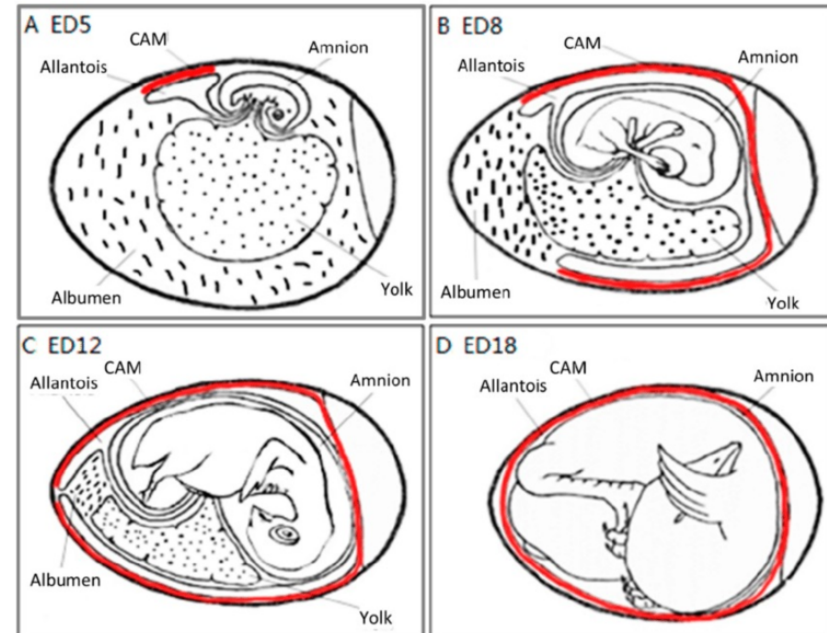
- ▶ In the later stages of incubation it also transports calcium from the eggshell to the embryo for bone formation.



When eggs are not turned, the CAM does not develop fully to the bottom (pointed end) of the egg, resulting in a plug of albumen being isolated there which cannot then be used by the embryo for development.

- ▶ The consequence of this is that the embryo has a more restricted oxygen supply and the protein and water in the isolated albumen is not available.

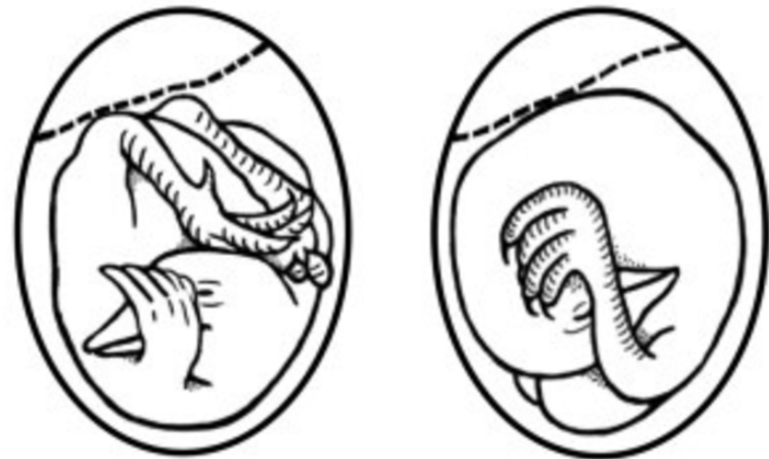
It has also been suggested that turning before day 5 moves the albumen between the embryo and the shell membranes, preventing adhesion of the embryo and extra-embryonic membranes to the shell membranes and increases the rate of diffusion of oxygen from the shell to the embryo.



Studies have also shown that eggs that are not turned correctly have a higher incidence of embryos that are incorrectly positioned prior to hatching (malpositions).

In unturned eggs there is a higher incidence of embryos that have their head in the small end of the eggshell and their feet pointing to the blunt, aircell end. *This is not the same as the malposition* where the embryo has its head between its legs, both head and legs in the small end of the egg.

It should be noted that head in small end is not diagnostic of turning problems as other problems such as setting the egg upside down can also cause the same malposition.

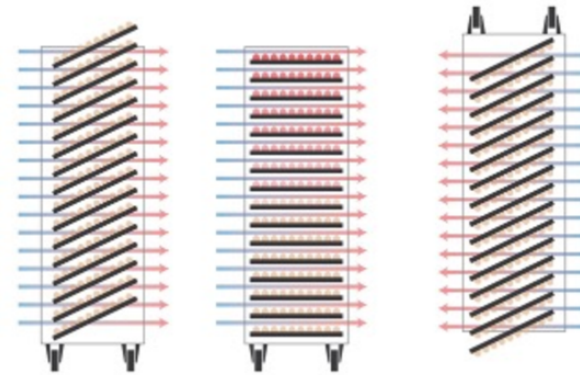


How do we turn eggs?

Wild birds turn their eggs by rolling them around their long axis. When ancient Egyptians first developed artificial incubation around 400BC, they laid the eggs on the floors of their ovens and rolled them in the same way as birds by hand.

Although the traditional hatcheries are still operating in Egypt, **for today's poultry industry rolling eggs by hand is not practical.**

In poultry hatcheries eggs are placed in setter trays blunt end pointing up so the long axis of the egg is vertical.



The eggs are then turned by tilting the tray either side of the vertical by approximately 45°, so that the eggs turn through an angle of 90° when moving from the left turn to the right turn.



The angle of turn must be sufficient so that the eggs are properly turned but not too much so the eggs fall out of the tray.

Studies investigating **the optimum turning for maximum hatchability** have shown:

- 1. The critical period for egg turning is in the first third of incubation** (chickens = 7 days).
- 2. Turning eggs less than 24 times per day (hourly) has been shown to reduce hatchability.** Increasing to 96 times per day has been shown to give a small, but significant increase in hatch, but there is a risk that more frequent turning does result in more mechanical wear on the turning mechanism.
- 3. The angle of turn from the vertical should be at least 35°, normally 38 - 45° is recommended.**

Turning Frequency (times per day)	Hatch of fertile (%)
24	91.8 ^a
12	85.8 ^b
6	77.6 ^c
3	73.7 ^c

a, b, c, d hatch result with same superscript are not significantly different ($p < 0.05$)

Oliveira et al. (2020)

Identification of turning problems

When hatch is lower than expected, *how can we determine whether it was caused by inadequate egg turning?* The first step would be a **breakout of unhatched eggs to look at the age of mortality and for any abnormalities and malpositions and an inspection of the hatched chicks.**

The following pattern of mortality would be indicative of a turning problem:

- 1. Increased early and late embryo mortality.**
- 2. High incidence of malposition head in small end.**
- 3. Plug of unused albumen in the small end of the egg:** this is probably diagnostic but its absence does not necessarily mean that it is not a turning problem.
- 4. Small embryos for a given developmental stage.**
- 5. Hatched chicks with dried albumen stuck onto the down.**

If a turning problem is suspected, then check the following in the setters:

1. Check the turning angles on all trolleys when turned in both directions, including those at the back of the machine.



2. Check all trolleys are turned the same direction in the setter.



3. Watch the trolleys turn:

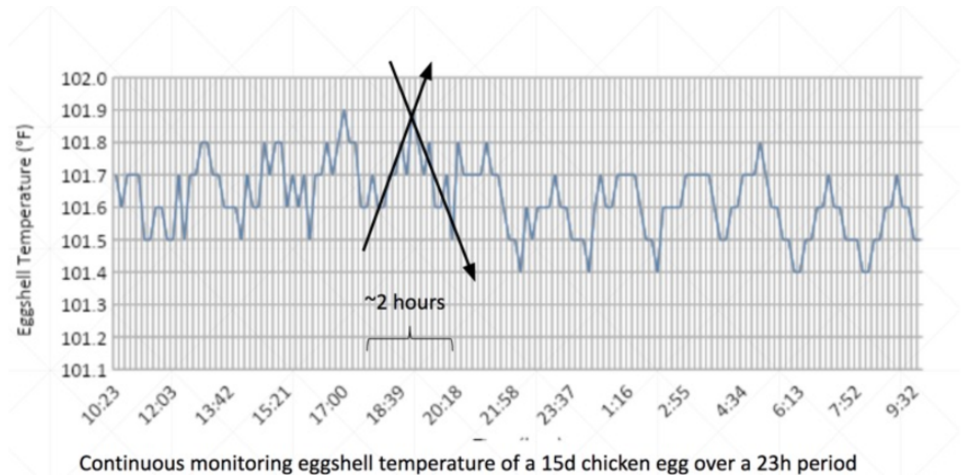
- a.** Are all trolleys turning together?
- b.** Is the turn smooth with no jolting or jarring?



- 4.** Check the machines at least 3 times per day and record the direction of turn. If turn direction has not changed investigate further.

Other consequences of egg turning

If we continuously monitor eggshell temperature (this is the temperature we are trying to control) in the last week of incubation, **what is normally observed is that it rises by a few tenths of a degree for an hour and then drops approximately the same amount for the next hour and so on.**



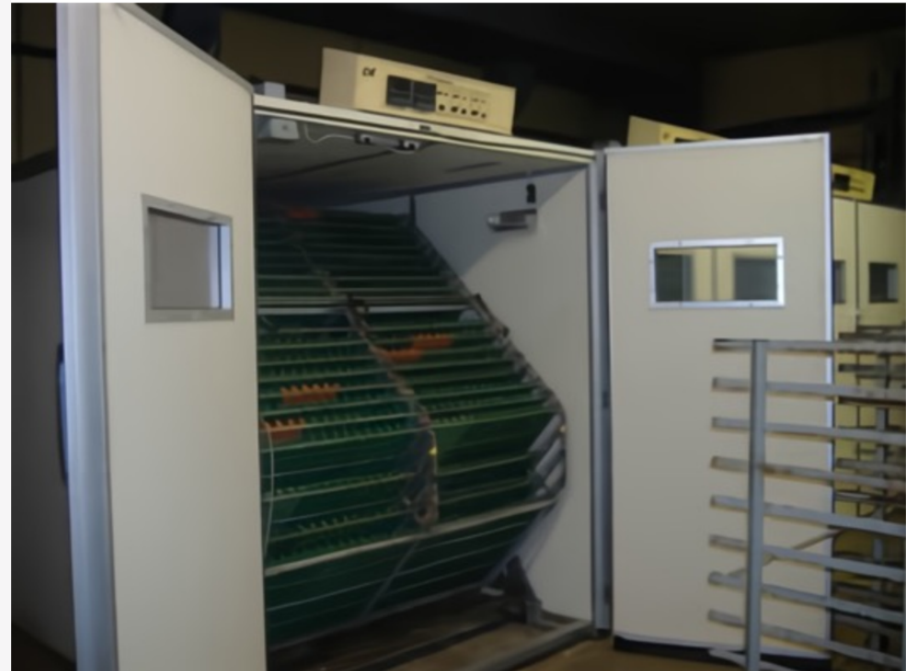
What is happening is the egg turning is changing the airflow over the eggs resulting in a **change the efficiency of heat transfer from the egg to the incubator air.**

In the second half of incubation embryos generate a lot of metabolic heat that must be lost from the egg to the surrounding air and the rate of transfer is greater the greater the volume of air moving over the egg.




Air flowing around the inside of the setter will change direction it is flowing through the eggs depending on whether the eggs are turned to the left or the right.

Some areas of the machine the airflow will be faster and other areas slower, and this will change when the direction of turn changes. **Turning may give a benefit to the embryos from moving them from hotter to cooler areas and vice versa every hour:** the eggs are not too hot or cold for too long and the average temperature is on target.



The other effect of turning seen in most machine types is the **space between the trays is reduced when the eggs are turned compared to when the trays are horizontal.**

 The reduced space between the trays results in less air flowing between the trays and the eggs get hotter, particularly in the middle of the tray.

One **possible solution to this problem is to level the trays to the horizontal position for the last third of incubation to maximise the space between trays and improve airflow.**

This can be successful in improving temperature control and uniformity in some machines, but it needs to be tested before implementing as it does not always improve results.



Thank you!

Grupo de Comunicación Agrinews S.L.

*Avinguda de Jaume Recoder, 17, 08301 Mataró,
Barcelona (España)*

info@grupoagrinews.com

Tel: +34 93 115 44 15