THE UNBORN ONE

S. Sri Ram

Class XI, MEA Higher Secondary School

Lodhi Estate, New Delhi

I have seen hundreds of eggs, yet never have I been able to look through the shell and perceive the wonder within, never have I been able to appreciate the extraordinary genius of Nature hidden inside the wonderful egg. How does young chick, full of life, emerge from an egg, which to all appearance was a mere bit of sticky yolk? I could only find out by examining eggs of various ages.

The purpose of this project was to study the chick's development while still in the egg. I knew that that there was something that happened in the egg when a hen sat on it, and perhaps that is how a chick is formed from the egg.

Material and Methods

Not much of equipment was needed. A few shallow vessels, a pair of fine scissors, forceps, a needle mounted on a handle, a blunt tongue-depresser, a medicine dropper, a few jam jars, 4 per cent solution of formaldehyde, and normal solution of 0.75 per cent saline were all that I needed. A few rings of different sizes cut out from filter papers, and a hand lens were my additional requirements.

I had an old box camera which had ceased to be of service and which I did not throw away. I had always thought that if nothing else, the springs or the metal pieces could come in handy sometime or the other. When a microscope was needed for more detailed examinations of specimens, I took off all the lenses and reassembled them in a cardboard tube using candle wax to fix them properly. With my textbook knowledge of optical instruments, I managed to improvise a working microscope which could enlarge objects nearly 50 times.

For my project, at least a dozen eggs of known ages were needed. Artificial hatching was necessary. Knowing the requisites of an artificial hatching device, I proceeded to model an incubator.

An old wooden box was taken. To this was fixed a night bulb and a lid. Three holes of half-inch diameter were made on the top; one on the right hand corner, one on the left hand corner, and a third in the middle. I lined the inside of the box with cotton-wool (for insulation) and plugged the two corner holes with cotton. A centigrade thermometer fitted into the third hole revealed the inside temperature. This was not enough. The humidity had to be maintained at 50 to 70 per cent. A coffee-can filled with water and a small piece of mudpot kept partly dipping in the water helped to maintain the proper level of humidity. I refilled the water in the coffee-can whenever it dried up.

All that I had to do to set the incubator working was to close the door of the incubator and switch on the bulb and after every two hours or so, read the temperature from the thermometer. By judiciously opening the two corner holes on the top, I maintained the required temperature between 30°–40°C.

Experiment and Observation

I next bought a dozen hen's eggs from a dairy, marked on them with a pencil, the date of purchase, and placed them in the incubator. All set, I launched on my project. Here are my observations in brief.

On June 18, I opened a fresh egg and studied the internal structure. An oval ball of yellow yolk in the centre was separated from the surrounding colourless, jelly-like albumen. On either side of the yolk, reaching up to the end the egg was a twisted chord, the *chalaza* (Fig. 1).

The egg was protected by a thick shell. Between the shell and the contents of the egg were two thin membranes. At the broader end of the egg, the two membranes separated out to enclose a little air between them. On the dorsal side of the yolk was a white speck, the *blastodisc*, placed directly in the centre.

After waiting for a day, I opened another egg. I held the egg in my palm so that it rested on its larger side. I then poked carefully a needle on the side of the egg, about half an inch from the top. Then I inserted a pair of scissors into the hole and cut round the egg. Having done this I lifted, with forceps, the top, as if it were a lid.

To my disappointment I found that there was no development in the egg. I had misgivings about the effectiveness of my incubator. Then someone told me that when the cocks are not sufficient in number to mate all the hens in the poultry, there are chances of some eggs being unfertilised. This was news to me, for I had presumed that all eggs could produce chicks. Now I understand that the male unit of reproduction (*sperm*) that is required to fertilise the egg does not enter all the eggs and hence the existence of unfertilised ones. One thing I noticed was that the *blastodisc* was always on the dorsal side, no matter in which position I held the egg. I held one of the eggs in a certain position, and then turned it upside down and cut it open quickly, and found that the yolk was slowly turning sideways so that once again the *blastodisc* came up to the dorsal side of the yolk. So there must be some factor that makes the *blastodisc* always incline towards the dorsal side.

The next few days found me going from place to place in search of fertile eggs, until by chance I came across a poultry farm where fertile eggs were being sold. The man assured me that at least 80 per cent of the eggs would be fertile. I bought a dozen of these eggs and placed them in the incubator with fresh hopes.

My persistence did not go unrewarded, for after a day of incubation I opened an egg and found, to my joy something more than what I had seen in a fresh egg. In place of the *blastodisc*, a more or less discoid area clearly differentiated from the remaining yolk surface was seen. At the periphery of this area were a number of spots which perhaps had something to do with blood. Within this area was a membrane less opaque than the. outer area. This membrane bore a thin stick-like structure with a knob in front. On closer

examination I found that that was the embryo which later would develop into the chick. This had a minute hole at the tip of the head. Right down the middle of the embryo ran a thin groove.

Farther down, on either side of the groove were six paired blocks which made the groove look like the spinal cord, while the blocks themselves looked like vertebrae in section (Fig. 2).

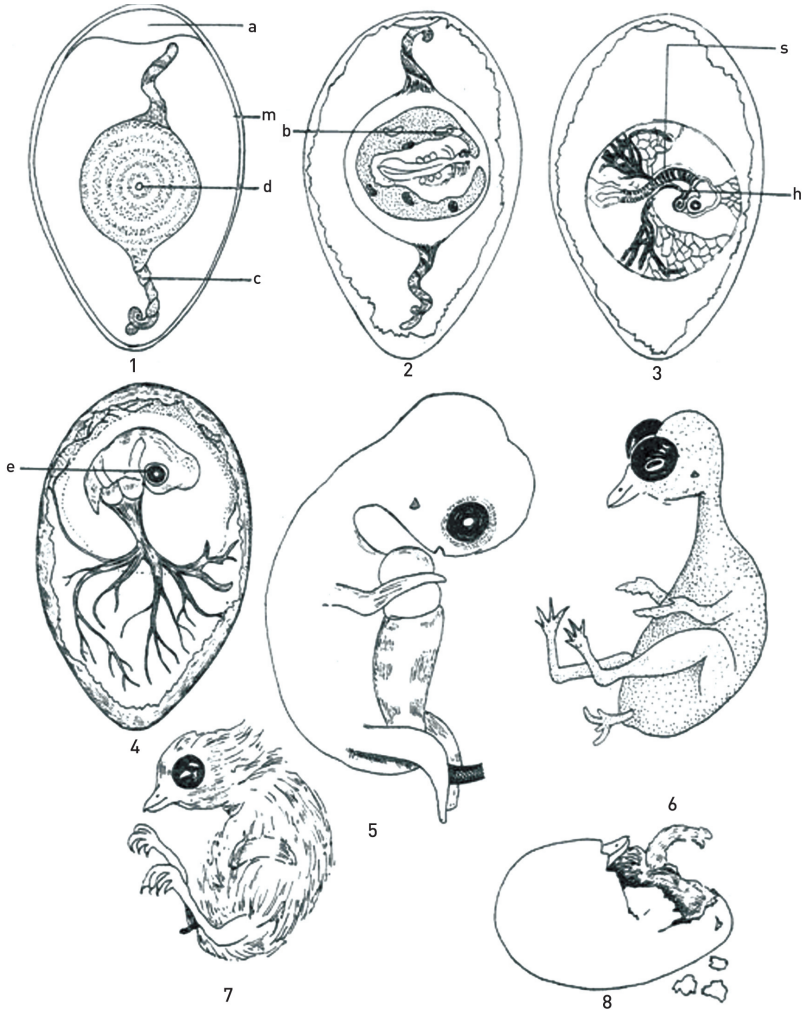

Fig. 1: The Structure of an egg: embryo a mere speck. **Fig. 2:** The 1-day embryo: a tiny rod. **Fig. 3:** The 2-day embryo: heart appears. **Fig. 4:** The 5-day embryo: Limbs are seen. a = air sac; b = blood island; c = chalaza; d = blastodisc; e = eye; h = heart; m = shell membranes; s = somite **Fig. 5:** The 8-day embryo: the ear is visible. **Fig. 6:** The 10-day embryo: the heart is pushed into the body. **Fig. 7:** The 12-day embryo: developed but pre-matured. **Fig. 8:** Hatching: birth at last.

The next day I examined an embryo that had been incubated for two days. The embryo that had during the first day of development been lying on its back, now lay on its side. The chalaza was absent. The embryo had the shape of a question mark. I realised the existence of a small bag which became red and pale-pink alternately. This was engulfed in the anterior area. I recognised this as the heart. I traced a number of blood vessels through which the blood, fresh and wine red in colour was flowing in spurts. This was not so readily visible to the naked eye, but my improvised microscope enabled me to see the spurting movement of blood.

Finally I understood; the embryo 'feeds' on the yolk particles. Since its mouth is undeveloped, the embryo 'eats' by another well contrived device. It pumps blood to the yolk membranes. The blood, while passing through the yolk, takes up a number of yolk particles and carries them back to the heart. This yolk-laden blood is then circulated within the embryo. The embryo thus has two types of circulation at this stage—the embryonic circulation and the extra-embryonic circulation.

This stage of the embryo had 23 of those paired blocks, or *somites*. A few drops of saline produced movement of the embryo. To preserve this embryo, I took a filter paper ring, a bit smaller than the *embryonic disc* (area where the embryo and blood vessels lie). Placing the ring on the embryonic disc, I cut around the filter paper. I then lifted the embryo along with the paper ring, using forceps, and placed the embryo in a petri-dish containing normal saline, solution.

After the adhering yolk particles had been washed off, I carefully transferred the embryo to a petri-dish containing a 4 per cent solution of formaldehyde.

I was surprised at the appearance of limbs in an embryo which had developed for five days. The embryo was enclosed in a sac containing some fluid (Fig. 4). The unborn chick had a pair of forelimbs, slightly bigger than the hind limbs which, unlike the forelimbs, ended in conical structures.

The heart was divided into two chambers. Each pumped blood alternately. The heart ended in a tapering structure which branched off as blood vessels.

A few drops of saline made the embryo shrug. The poor creature seemed to cling desperately to its heart, with its weak limbs.

After this, I turned the eggs upside down daily. (I do not know the purpose, but someone told me to do so).

I have never had nor will have the opportunity to experience what a mother feels when she sees her child play and grow everyday. But this project provided a near substitute, for everyday found me watching intently the growth of the 'chick' with increasing joy.

After eight days of development an embryo is a real thrill of joy to see. The big outsized brain, the disproportionately huge eyes protruding out of the head, the small opening between the two eyes that later becomes the mouth, the two small triangular openings for hearing, the huge heart which completely covers the front part of the body, the four big folded limbs; all this on a small curved body—this is the splendid sight that an 8-day embryo affords (Fig. 5).

A beak on an embryo that does not in any way resemble either a bird or a chick is very odd. All embryos younger than the 10-day embryo had

their eyeballs attached superficially, but in the 10-day embryo, the eyeballs were buried and covered by the surrounding skin. All along, the heart had been outside the body but in the 10-day embryo, all but the big blood vessels arising as a continuation of the tapering portion had been pushed into the body. The limbs were bigger and forked. The skin was covered with small dots which looked more or less like buds (Fig. 6). I stored all these embryos in bottles containing 4 per cent solution of formaldehyde and labelled them according to age.

A twelve-day embryo is in all respects similar to a fully grown chick; only, it is smaller. The whole body is covered with silky hairs, the hind limbs end in four well-developed toes and the forelimbs look like wings (Fig. 8). When I opened a 12-day old egg, I found the eyelids of the embryo slightly open.

Taking an incubated egg, 20 days old, I carefully peeled off the shell without injuring the interior. To my surprise, I found something poking out of the membranes covering the embryo. I felt it with my fingers and the thing moved: I could hear a squeaking sound. So that was the beak: it had pierced through the membranes for drawing air from the air sac. I tore away the membranes and found a chick, developed in all respects. It really was a wonder to find such a huge chick enclosed in a shell so small as that.

Two more eggs remained, and they were nearing their hatching hour? My calculations told me that the struggle for freedom would start sometime at midnight. Making a safe guess, I fixed my alarm clock to ring at 2 O'clock. The ringing of the bell at 2 O'clock next morning roused the whole family. I went to the incubator and to my disappointment, found no signs of birth. Then suddenly, I heard a low knocking sound quite distinct and regular. I picked up that egg from which the sound came. (Eventually I was to discover that the other one was unfertilised).

So at last my chick was striving to come out of the shell. I carefully lifted the egg and placed it on a cotton spread.

The struggle started. The chick pecked at the hard shell. After a few minutes' rest it attempted again, and again, until, finally it succeeded in making a crack on the shell, then a small hole. It pushed out its beak through the hole and started sawing with the hard sides of its beak. The hole grew larger and the energetic bird worked on unceasingly. It had lived nothing—but a small mass of yolk for past twenty—one days; yet the energy and unfailing determination that it possessed was remarkable. 'What gives such motive force?' I wondered.

Finally, the forelimb of the chick emerged. The beak moved behind the shell once again so that it became out of sight. The beak pecked from one side and the forelimb fluttered from the other until the shell gave way (Fig. 8). This went on until nearly half the shell was chipped off.

It was 07.09 hours. The chick was relieved of all bondage. *My chick was born.*

Like a hen, I had, for the past twenty-one days, meticulously incubated the eggs, and here was my reward—my sweet young one.