How Birds Form Eggs

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What a pleasure it is when a breeder discovers a pair's first egg. It signals the successful culmination of complex processes which have lasted months or years. The egg marks the end of what may have been a long period of development, and the beginning of a new bird, separated from its mother. The joy of finding an egg is especially great if it comes from a newly acquired pair, or one that has been boarding for years and has finally produced an egg, or from a species not previously bred in captivity.

It has been pointed out by Forshaw (1978) that surprisingly little information is available about the breeding biology of most psittacines, even those that have been bred in captivity for years. This was brought home to me recently when Lorraine Sellers, a student in our cage-bird class, searched the literature for data on the eggs and breeding biology of 139 species of psittacines. For many of these, not even sizes and descriptions of the eggs were reported.

One part of the research program on cage birds at Davis is concerned with reproduction and how it can be influenced by the breeder. In order to achieve better results, however, it is necessary to know something about normal egg and sperm formation, fertilization, laying, and incubation. This article deals with the egg and how it is formed. A diagram showing the internal structure of a cockatiel egg is shown in Figure 1.

It takes months or even years for the whole cycle of the egg to occur. Special egg cells that can first be identified in a young embryo are carried through the blood and come to rest in the part of the body that will eventually become the ovary. Even at this early age, the larger egg cells can be distinguished from the smaller, ordinary body cells by their distinctive microscopic appearance. After incubation, the embryo hatches into a chick, and eventually reaches sexual maturity, in as short a time as 6 weeks for Japanese Quail to as long as 9 years or more for the Wandering Albatross. Generally speaking, small species mature more rapidly than large ones. Zebra Finches may reach sexual maturity at 3 months; Budgerigars at 4-5 months; Cockatiel females at 10 months, males at 7 months; Amazon parrots at 3 years; and large macaws at 5 or more years. The egg cells of the ovary grow slowly to an intermediate stage, then wait for months or years for the hormone signals that cause the envelope of follicle cells around each egg to begin depositing the yolk. Most cage birds require courtship activity to initiate yolk formation, but some domestic species have been selected to lay eggs without that stimulus.

It is believed that all birds form eggs similarly, but differ in rates of formation, relative amounts of yolk, albumen and shell, size, shape, shell color, and shell texture. The information we have about egg formation comes largely from studies of domestic chickens, turkeys, and quail. At the time of maturity, female hormones (estrogens) stimulate the liver to form proteins that are rich in fat and these are circulated in the blood stream.

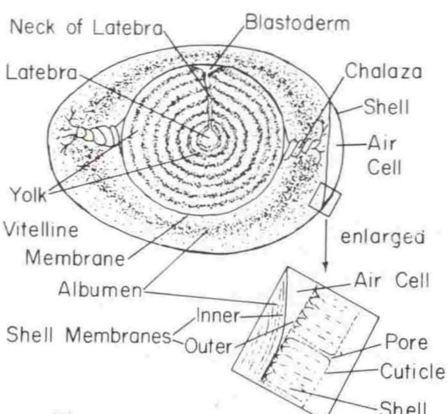

Figure 1.

The internal structure of a cockatiel egg. The yolk and its vitelline membrane are made by the ovary; the albumen, shell membranes and shell are added in the oviduct.

In one or more of the follicles of the ovary these proteins are concentrated and deposited as yolk. Deposition occurred within the egg cell or oocyte, which grows rapidly over a period of days, becoming the mature egg cell which we recognize as the yolk of an egg. This growth may be compared to that of a tree; in both the yolk and the tree new material is added on in successive layers. There are rings in yolks, just as in trees, except that yolk rings represent daily rather than yearly additions (Grau, 1976). We have studied this process by feeding dyes that are deposited in the yolk and then using new techniques of preparing yolks by freezing, fixing with formalin, and staining with dichromate. In this way we can now learn how long the yolk grows, and how much yolk is deposited each day and night. We can also determine the time that elapses between completion of yolk formation and laying of the egg, and for the first time, we can obtain the history of an egg by examining its internal structure.

An example of the way that this is done is shown in Figure 2, showing slices through the yolks of two eggs of the Ring Dove (*Streptopelia risoria*). These particular yolks are unique in that the bird that laid them had been fed capsules containing red or blue dye during the times that the yolks were being formed. My daughter Ellen noted the times of feeding the dyes to her bird and the times of laying, as follows:

Jan. 12, 7:30 AM, blue dye fed
Jan. 13, 7:30 PM, red dye fed
Jan. 16, 6:00 PM, blue dye fed
Jan. 17, between 1 PM and 10 PM egg #1 laid
Jan. 18, 8:30 AM, red dye fed
Jan. 19, between 8 AM and 7 PM egg #2 laid

From these time markers and a study of the daily rings laid down by the dove, we conclude that yolk formation of egg #1 was completed January 15, and the egg laid two days later. In egg #2, yolk was completed January 18, before the dye was fed, and laid January 19, one day later. The interval between eggs was slightly less than 2 days. By counting the total daily rings, it was concluded that it required 7 days to form the yolks of this dove, and a total of 11 days from the beginning of the first yolk to the laying of the second egg. Other doves may be different, hence 5 to 10 eggs are usually studied in order to obtain a valid result. The timing of egg formation in this dove is consistent with the patterns described by Lehrman (1965), in which the first egg is laid about 5:00 P.M., 8 or 9 days after a pair is put into a cage, and the second egg is laid about 9:00 A.M. on the second day following.

By using methods similar to those used with this dove, egg formation times in cockatiels are being studied by Lisa McDaniel, a graduate student at Davis. Other psittacines could also be studied in this way.

After the yolk is completed in the ovarian follicle, the wall of the follicle splits, releasing the ovum (egg cell) into the body cavity, where it is engulfed by the open, funnel-like end of the oviduct. Fertilization occurs by sperm that have been stored in the folds of the upper oviduct. Thousands of them are available to enter the ovum, but only one finally fertilizes the egg cell which then is moved slowly down the oviduct. The

Photos courtesy of C.R. Grau

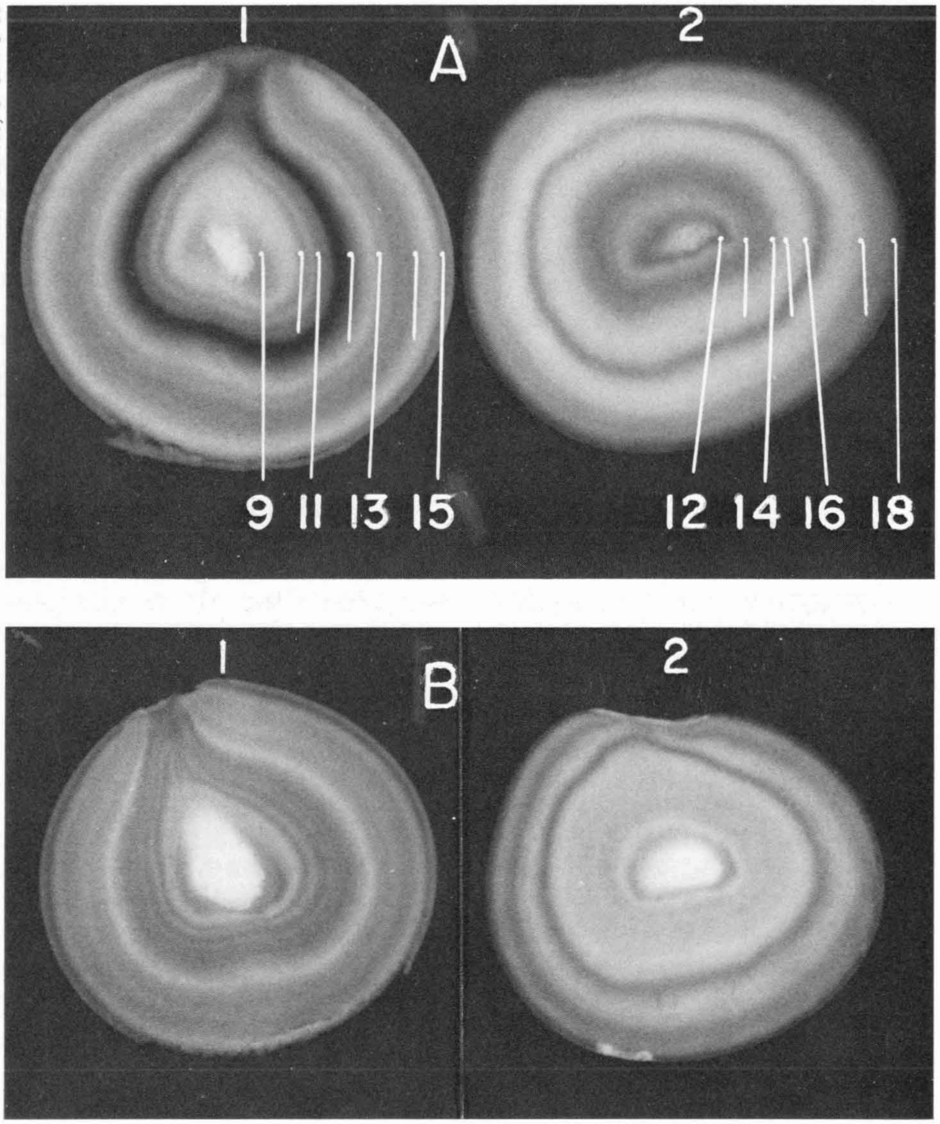

Figure 2. (A) Slices of yolks from a Ring-necked Dove that was fed blue dye 12 January and red dye 13 January, as noted in the text. The numbers are dates in January. Egg 1 was laid January 17; egg 2 was laid January 19. (B) Dichromate-stained slices of eggs 1 and 2. The actual diameters of the yolks are 14 mm.

albumen-secreting portion (magnum) delivers its thick albumen as a cover around the yolk, and the whole mass travels into the isthmus region, where the two loose-fitting shell membranes are secreted. In the shell gland (uterus), water and salts are added until the egg membranes are tightly stretched around the contents, and within a period of hours (20 hours in the chicken) the shell is completed and the egg is laid. As the egg has moved down the oviduct, the fertilized egg cell (zygote) has divided again and again, and the embryo has begun to grow. The tiny embryo stops growing after the egg is laid and cools on contact with air. When incubation begins, the embryo starts growing again. The details of these processes have not been described in psittacines, finches, or other cage birds: chickens and Japanese quail remain the best known species. Timing may be different for cage birds, but the general course of events is probably the same.

Studies of cage-bird eggs have barely begun, and it is too early to predict how useful results from such research will be. We hope, however, that better understanding of the biology of bird reproduction will be a step toward improving efficiency of producing birds now bred in captivity, and will lead to eventual success in breeding birds that have not yet produced their first eggs and chicks under the watchful eyes of experienced aviculturalists. ●

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