**De Formatione Ovi et Pulli (1621), by Girolamo Fabrici**

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The embryological treatise *De formatione ovi et pulli* (On the Formation of the Egg and of the Chick) was written by anatomist and embryologist Girolamo Fabrici and published in Padua posthumously in 1621. The book was edited by Joahannes Prevotius and is separated into two parts that describe Fabrici’s observations and assumptions on embryology and combine the traditional knowledge of his predecessors with his own first-hand anatomical observations. Each part is separated into three chapters: the first part concerns the formation of the egg while the second part of the treatise covers the generation of the chick within the egg.

The first chapter covers the formation of the egg and reiterates the three bases of animal generation described by Aristotle. Fabrici discusses Aristotle’s views of the egg, the seed, and spontaneous generation from decomposing matter. Fabrici interpreted the germinal disc of the hen’s egg as the scar left on the yolk from the detachment of the string that had attached it to the ovary during development. He is credited with revealing the cloacal bursa, which he mistakenly believed was found only in the hen, and which he determined would collect the semen of the rooster. The bursa is often referred to as the ?bursa of Fabricius? but the function was discovered in the 1950s to be the site of hematopoiesis, the organ that makes blood cell components and plays an integral part in the immune system of both male and female birds.

The second chapter attempts to show that the uterus carries out two functions?formation of the egg and the immediate and prolonged nutrition of the egg. Fabrici states that the yolk was formed in the upper part of the uterus and the rest of the egg forms in the lower part of the uterus. He details a process in which the egg leaves the ovary as a naked yolk and the shell develops afterwards in the oviduct, the organ in oviparous (egg laying) animals that the eggs eventually travel down to become fertilized. He writes that the yolk grows due to the nutrition brought to it by uterine blood vessels while it is attached to the ovary and that growth ceases once it separates from the ovary. The third chapter of part one encompasses Fabrici’s discussion on the usefulness of the uterus, concluding that it is for the protection of the fetus.

The second part of this treatise covers the structure, action, and function of the egg. Fabrici spends some time discussing the differences in shape, size, color, and texture of eggs in different species. He characterizes a ?perfect? egg as having a shell, two shell membranes, the albumen (white or cytoplasm), a yolk membrane, the yolk, and two chalazae (strands holding the egg yolk in place). Fabrici also disagrees with Aristotle’s spontaneous generation theory of insects, asserting instead that they are also the result of eggs.

The first chapter of part two focuses on the formation, growth, and nourishment of the chick. Fabrici asserts that the yolk and albumen are used as food in the development of the chick.
[9], and he states that the chalaza of the blunt end of the egg [8] is the source of the form of the chick [9]. He then begins his discussion of the rooster's semen [14], which he declares never actually enters the egg [8]. Fabrici discusses his belief that the length of the uterus [16] makes it impossible for the semen [14] to reach the egg [8] and even when the egg [8] reaches the lower end of the oviduct [17], the shell has been formed and serves as a barrier to the semen [14]. Instead of the semen [14] penetrating the egg [8] for generation, Fabrici envisioned a spiritual faculty where the semen [14] from the rooster was collected in the bursa of the hen where it would miraculously fertilize the entire uterus [16] and egg [8] without any physical connection. This outlook was in line with the views of Aristotle [10], who believed that all the material for generation was contained within the female. However, in Fabrici's thoughts on the cause of generation within viviparous [21] animals, he diverges from Aristotle [10] and follows the theory of Galen [22], who claimed that the male seed was responsible for the material and efficient cause of generation. Nevertheless, Fabrici makes no further elucidation of his beliefs on viviparous [21] aspects of fertilization [23].

The second chapter considers the actions that occur in the developing egg [8] and Fabrici again follows a position in line with Galen [22]. Attributing the functions of generation, growth, and nutrition to the egg [8], he writes an account of the logical sequence in the development of the chick [9], stating that the head, spine, and ribs can be seen by the naked eye in a one- or two-day-old chick [9]. He then notes that the heart and viscera become apparent after the development of the head, spine, and ribs, and that the limbs develop thereafter. This observation surpasses those of both Aristotle [10], who believed the heart developed first, and Galen [22], who thought it was the liver. In the third and last chapter of part two, Fabrici returns to reiterating his naturalist philosophy, stating that the greatness of nature has adequately provided for every thing that a developing fetus [18] needs in order to be born into the world.

In the same fashion as Fabrici's other major treatise on embryology [7], De formato foetu (The Formed Fetus), engraved plates (done by an unknown artist) with illustrative anatomy are found within this book, seven in all. The first three of the seven plates have descriptive legends that were added by the editor, Johannes Prevotius, from his interpretation of Fabrici's notes. Most of the labels are affixed to the wrong structures, but it is impossible to say whether it was the author, editor, or engraver who is responsible for the mistake. The first plate represents figures of the anatomy of the ovary [13] and oviduct [17] of the hen, as well as the first ever published illustration of the cloaca of the fowl. The second plate depicts the structure of the egg [8]. The last five plates are considered to be the first published illustrations of the development of the chick [9], and are remarkably detailed despite the lack of a magnifying aid. Days one through three of the development show extremely vague depictions with no details, and the engraving of the fourth day depicts a dot in the middle of the egg [8] with a reference in the legend stating what the size of the developing embryo was relative to a very tiny flea. However, in the text Fabrici notes that by the third day the beating of the heart may be observed, so it is difficult to discern the accuracy of the correlation between the images and his theories. The fetal membranes are shown in plates depicting the seventh to twelfth days and the amnion [24] is shown as emerging by the sixth day of incubation. Fabrici then makes note that the chick [9] hatches from the egg [8] on the twenty-fourth day of incubation, although this measurement of time is considered to have been erroneous because the embryonic development had most likely been impeded due to his process of experimental incubation.

In addition to describing the fetus [18] of a chick [9] at various stages of development and including illustrations of his work, Fabrici helped to establish embryology [7] as an independent
study. He also introduced the term ovarium into embryological literature, although he used the term in application to both the ovaries and the oviducts. Fabrici's investigations into the development of the chick and the egg are important artifacts of the changing anatomical and embryological conceptions of his time and are also indicative of the lasting influences of Aristotle and Galen.

Sources


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