The Early Development of the Planorbid Snail, *Australorbis glabratus* (Say)

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*Australorbis glabratus* has received considerable attention because of its role as an important intermediate host of the human blood fluke, *Schistosoma mansoni*. Although the biology of this snail has been studied in detail, no published account of its embryology has been found. In the present study the development of *A. glabratus* has been followed from oviposition to hatching of the eggs.

**Materials and Methods**

Mature snails were obtained from the colony at Walter Reed Army Institute of Research. This colony had been established from material obtained in Puerto Rico.

Two snails were kept in a small aquarium (4 x 4 x 8 inches) containing approximately 750 ml dechlorinated tap water. The water was never changed. Excess food (lettuce) was removed, but fecal matter was allowed to accumulate. The snails suffered no ill effects. Occasionally, water was added to replace that lost by evaporation.

Oviposition was irregular. Sometimes the snails deposited egg clutches daily, but occasionally they would not lay any for a week or more. The addition of fresh water seemed to stimulate oviposition.

Egg clutches were carefully removed from the sides of the aquarium and transferred to watch glasses for examination. Each clutch was incubated in a glass vial containing dechlorinated tap water. The eggs were examined daily and changes in development and growth were noted. All studies were made on unstained, living material. The entire embryology has been traced in more than 100 eggs.

**Observed Embryology**

Eggs of *A. glabratus* have a mean diameter of 0.90 mm. In the earliest observed stage, the embryos measure 0.1 mm in diameter. Embryonic growth is gradual through the fifth day when the embryos have doubled in size. In the next three days they again double in size. By the ninth day, embryos average 0.54 mm in length. Growth continues rather uniformly so that just prior to hatching (14-16 days), the young snails occupy most of the space within the egg membrane.

The earliest embryonic stage observed was late morula. Since early segmentation is rapid, primary cleavages may have occurred prior to or immediately after oviposition. This problem was not studied.

During the first day after oviposition, a multi-cellular blastula develops. The cells which form the wall of the blastula are of uniform size and arrangement. The embryo measures approximately 0.12 mm in diameter (Figure 1).

In the late blastula stage numerous intercellular cavities appear. The contents of these cavities seem to be extruded from the embryo into the egg. With further cleavages, the intracellular cavities disappear as gastrulation begins.

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By the second day, embryonic development has advanced to the gastrula stage (Figure 2). The spherical shape of the blastula is distorted by the invagination of cells of the vegetal pole. Rotation of the embryo within the egg membranes begins.

Twenty-four hours later, cellular differentiation is underway. A mass of large entodermal cells fills about two-thirds of the coelom and mesodermal cells begin to form between the entodermal cell mass and the outer wall (Figure 3). In the transition from gastrula to trochophore the stomodal (mouth) invagination enlarges and a shallow invagination appears on the opposite (posterior) side of the embryo.

The post-trochophore stage (Figure 4) represents a marked advance towards the form of an adult snail. The shell gland has formed and has begun to secrete shell material over the posterior end of the embryo. The foot is a bulge ventral and posterior to the mouth. Ciliated cells form the external surface of the foot. A short tube extends from the mouth to the spherical mass of entodermal cells. A pouch on the ventral side of the tube is believed to be the radular sac.

In the transition from post-trochophore stage to veliger stage, tentacle buds form. Shell material, secreted by the shell gland, extends further over the back of the embryo. The mouth and the radular sac become more prominent. Macromeres aggregate in the foot region. The ectodermal wall is one cell thick.

By the sixth day of development, the embryo is well formed. Tentacles and eyes are discernible. The shell covers most of the snail’s back and the mantle is easily recognized. Entodermal cells may have assumed the functions, but not the appearance, of internal organs. Multiplying mesodermal cells fill the coelom and are especially noticeable in the foot where they will form muscles. This is the veliger stage (Figure 5).

Following the veliger stage, the transition into a typical snail is gradual. The foot, mouth, tentacles and eyes are easily distinguished. The shell covers the entire dorsal surface of the embryo and is rimmed by a thick mantle. The digestive system rapidly forms and becomes functional. The heart starts to function on the seventh day. The snail begins to crawl by means of the muscular foot rather than by cilia. The mouth area has a bilateral cleft. Radulae have developed and appear functional. The anus can be located on a projection posterior to the foot. All of these changes are apparent by the eighth day of development (Figure 6).

Until hatching on the fourteenth to sixteenth day, further changes in the embryo are principally in growth and shell development. Most changes in internal structure are subtle and almost indetectible in living material. However, the further development of the digestive system is prominent.

The shell continues to expand over the dorsal surfaces of the embryo (Figures 7 and 8). At hatching it is shaped like a helmet with only the foot and anal projection protruding.

**DISCUSSION**

Studies on the embryological development of planorbid snails are not new. In 1900, Holmes (1900) described and illustrated the early development of *Helisoma trivolis*. Later, Baker (1945) presented similar information on *Helisoma scalare*.

A sketchy outline of the embryonic development of *Bulinus truncatus*, an-
other intermediate host of human schistosomiasis, was published by Saliternik and Witenberg (1959). Similar, but more extensive studies of this snail were contributed by Najarian (1961).

One of the more detailed studies was by Lowrance (1934) on the development of *Stagnicola kingi*. Lowrance commented on the similarities in the observed development of *S. kingi* and the reported development of *Lymnaea, Physa*, and *Planorbis*.

Selected observations on the development of *A. glabratus* can be compared with the findings of other investigators. For example, the time from oviposition of hatching for *A. glabratus* was 14-16 days at room temperature (70-
Bulinus, Stagnicola and Helisoma required the same interval of time for this development. However, Lowrance observed that less time (9 to 11 days) was needed when the eggs were incubated at a higher temperature (80°F).

Early cleavage stages of *A. glabratus* were not observed. However, in *Bulinus*, Najarian found it took about five hours for newly laid eggs to reach the 16-cell stage.

Rotation of the embryo begins in the gastrula stage in *Australorbis, Bulinus* and *Stagnicola*. However, in *Australorbis* rotation began on the second day while in *Bulinus* it did not occur until the third day.

Observation of a pulsating heart was one day earlier in *Australorbis* than in *Bulinus*, occurring on the sixth day in the former and on the seventh day in the latter (Najarian, 1961).

The rate of embryonic growth appears to be similar for *Australorbis* and *Bulinus*. Najarian found that *Bulinus* doubled its size by the fourth day of development and again before the eleventh day.

Thus, except for minor details, the embryology of *A. glabratus* does not appear to be unlike that of *Bulinus, Helisoma*, or *Stagnicola* described in the reports cited above.

**LITERATURE CITED**


