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MORPHOLOGICAL CHANGES IN TERRESTRIAL MOLLUSKS UNDER ENVIRONMENTAL FACTORS

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ABSTRACT
The article analyzes the morphological changes that occur in terrestrial mollusks under the influence of environmental factors.
KEY WORDS: *abiotic, biotic, xerophile, reduction, cephalopodium, conhiolin, epiphragm.*

DISCUSSION

Abiotic and biotic factors of the external environment have a complex effect on mollusks. This is manifested primarily in the morphological features of existing terrestrial mollusks. At this point, the shell of the mollusk holds a great deal of information. The morphological structure of the shell can provide information not only about which taxonomic group the mollusk belongs to, but also about the environment in which it lived. Typically, the shell of terrestrial mollusks is divided into the following 6 types according to their morphological structure: helicoid, microhelicoid, buliminoid, pupilloid, zonitoid and succinoid (Uvalieva, 1990). The zonitoid type was described by A.A. Shileyko (1986).

In mollusks with helicoid and buliminoid type shells, the color of the shell can range from brown to white depending on the environmental conditions. In particular, in the representatives of Helicoidea, according to A.A. Shileyko (1978), the shell is brown, with a light-colored stripe at the edge, which is of a primary nature. A secondary feature is the fact that the shell color fades to a general background and has dark spiral bands as it passes into the xerophilic environment and survives. An example of this is the representatives of Hygromiidae. Representatives of Buliminidae also live mainly in xerophilic, open environments, with a common background white shell. Of course, the fact that mollusks living in xerophilic environments have a white shell is one of the means of protection from strong solar radiation.

Terrestrial mollusks with succinoid, pupilloid, and zonitoid shells live mainly in moist biotopes with thick grass cover. Such biotopes often form a topsoil composed of plant debris. Such topsoil consists not only of plant remains (leaves, branches), but also of fine soil and rock fragments (Gilyarov, 1970). Topsoil has the property of reducing sudden changes in humidity and temperature, and has a constant food supply consisting of detritus and fungi. Of course, such an ecological environment is extremely favorable for terrestrial mollusks, especially for slugs. Since shellfish are slightly more difficult to move in such an environment, A.N.Suvorov (1999d) suggests the following adaptation options, which are related to the movement in soil bed: 1. reduction of the shell; 2. development of a snail-shaped shell; 3. Development of mechanisms of placement of the shell relative to the cephalopodium; 4. formation of conchiolin tumors that reduce the contact of shell surface with wet substrate; 5. The development of a smooth conchiolin layer that pushes water on the surface of shell.

According to the first adaptation variant, it may have originated from small soil-dwelling slugs (Agriolimacidae, Boettgerillidae), as well as representatives of Arionidae, Milacidae and Parmacellidae (Suvorov, 2003).

The development of the snail-shaped shell is related to the apical angle of shell. With the transition of terrestrial mollusks from water to land, the shell shape changed from conical to oval (oval, axial, obtuse, cylindrical, towering). That is, in the evolutionary stage of development, mollusks with a constant apical angle, while adapting to live in the topsoil, in the next stage acquired a curved shape by successively reducing the apical angle in each package of shell. Such an adaptive shape reduces the resistance that occurs between the topsoil and the shell wall.

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In mollusks moving in topsoil arises the problem of keeping the shell in a stable position relative to the cephalopodium. This problem is often solved by teeth developing in the mouth of shell (Suvorov, 1993, 1999a, 1999b, 1999d, 2003).

There are various hypotheses about the importance of developing teeth in the mouth of shell. In particular, P.V. Matyokin (1959) believes that the teeth absorb mucous fluid from the foot of mollusk, which is pulled into the shell, and use it to form the epiphragmatic membrane. However, according to A.N.Suvorov (2003), teeth are not involved in the formation of epiphragmatic membrane at all. In addition, the developed epiphragmatic membrane can also be formed by terrestrial mollusks that do not have teeth (Suvorov, 2003; Block, 1971).

The first functional analysis of shell teeth was given by A.A.Shileyko (1984). He divides the teeth that make up the oral apparatus into 2 groups: the surface layer teeth formed by the enlargement of the lip and the internal teeth located in the last roll.

Internal teeth are involved in keeping shell in a stable position on the foot and facilitating the movement of high shell (Shileyko, 1984).

Importance and developmental laws of shell teeth After A.A.Shileyko, were completely analyzed by A.N.Suvorov (1993, 1999a, 1999b, 1999c, 1999d).

The epiphragmatic membrane plays a special role in the adaptation of terrestrial mollusks to live in different biotopes, especially in arid environments. Block (1971) distinguishes 2 types of epiphragmatic membrane: a thick consisting of a limestone plate and a thin type consisting of a semi-transparent membrane.

The epiphragmatic membrane is as important as the shell of terrestrial mollusks. Before going to daytime or seasonal sleep, any mollusk will cover its shell mouth with an epiphragmatic membrane. This membrane protects mollusk from the effects of different air temperatures, some insects and most importantly from drying out its body. According to some data, the epiphragmatic membrane was able to keep mollusks under temperature of -110, -120^{o}C for several days (Pasternak, 1988).

In long-lasting arid environments, multi-layered epiphragmatic membranes may be formed. For example, in Block experiments, Cryptomphalus aspersa produced up to 6 epiphragms when caught together with other mollusks and up to 16 epiphragms when caught separately (Block, 1971).

As a result of our observations in the Turkestan mountain range, it was found out that in the conditions of Central Asia, all terrestrial mollusks can form 1-3 epiphragmatic membranes. In hygrobiont mollusks, which usually live along the water, the epiphragm consists of a single layer. Some species form a two-layered epiphragmatic membrane. The first of these membranes is located on the surface of shell mouth and serves to attach the mollusk to various substrates. There is a solid second membrane enriched with $CaCO_3$ inside this membrane. Its main function is to protect the body of the mollusk from drying out during dry season.

This means that mollusks can control the composition of mucous membranes according to environmental conditions. In particular, they increase or decrease the amount of $CaCO_3$ when needed. In generaly, It was noted 8 types of mucus release from terrestrial mollusks (Campion, 1961). The mucous substance consists of mucopolysaccharide, protein, small particles of $CaCO_3$, fat droplets and pigments (Shileyko, 1978). Of these substances, $CaCO_3$ is of particular importance. $CaCO_3$ is found not only in the mucus, but also in the shell, making up the bulk of it. There is a great need for $CaCO_3$ during the growth of the shell, in the process of recovery of broken parts and the formation of epiphragmatic membrane. $CaCO_3$ is obtained by mollusks mainly at the expense of plant nutrients and from the soil. A.A.Shileyko (1978) emphasizes the importance of the degree of calcium enrichment of the substrate in the spread of mollusks and divides them into 2 groups: obligate and non-obligate calcifil.

In addition to A. Shileyko's information about mollusks in relation to calcium, it can be said that all terrestrial mollusks, even slugs, are calcifil. This is because calcium not only consists in the shell, but also provides the viscosity of the mucous substance secreted from the body of mollusk (Runham, Hunter, 1970). Mucous membranes of slugs have a higher viscosity level of mucous material than of shellfish, allowing them to move faster and consuming more of it. In addition, many slugs cover their bodies with a mucous membrane produced by themselves in sheltered places (under rocks, in cracks of soil) during the summer drought season (Likharev, Victor, 1980). In the view of all above, we have every right to call the caterpillars calciphyl, along with the shell mollusks. Of course, the degree of calcification is manifested differently in different mollusks. We can see this in the mollusks whose shell wall is developed at different levels. The shell wall of mollusks living in open and xerophilous biotopes is usually more developed than that of mollusks living in humid, hygrophilous biotopes. Some (Phenacolimax annularis) have undergone a reduction process. But in any case, the fact that the shell has a thin wall or is wrapped in a reduced mantle does not drastically reduce their demand for calcium.

In conclusion, it can be said that as a result of the influence of various factors of the external

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environment, first of all, there are adaptive changes in the morphological characteristics of existing mollusks. This is reflected in the color, shape, and size of shell and body of mollusk, as well as in the different levels of development of the shell mouth teeth.

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