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REGULATIONS IN ADAPTATIONS OF ARTHROPODS TO TERRESTRIAL LIFE 1970 Pub House NAUKA Moscow

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This is my translation, with a little help from Google, of the original Russian text

INTRODUCTION

The idea of the origin of terrestrial forms of animals from aquatic subconsciously evolved in the minds of mankind from a long time, even during the period of creationist views, long before the triumph of ideas about the development of the organic world.

An illustration can be, for example, the remarkable painting “The Creation of the World” by Hieronymus Bosch, in which the artist depicted the emergence of land animals as the formation of aquatic landforms by passing through the amphibiotic state. See the left wing of the triptych - "Garden of earthly joys." as it is called in the Prado Museum..

For example, Anaximander suggested the emergence of animals from "sea sludge" and their acquisition of the skin with a transition to life on land.

The development of taxonomy around the XVI-XVII centuries and the concept of "ladder of beings" prepared the minds of the nineteenth-century zoologists to adopt those development of the organic world and phylogenetic schemes, the development of which has become one of the favourite problems of the evolutionists of the post-Darwinian period.

The schemes of phylogenetic relations between different groups of organisms were, until very recently, built only on practical materials, without taking into account the possible changes in environmental conditions in which the directions of evolution of certain groups could be realised. Therefore, evolutionary zoologists often come to diametrically opposed views on the relationships between different groups of animals.

In detail (if such questions as the ratio of different classes and even types can be considered as “details”!) the phylogenetic schemes of different authors are sharply different. But one position remains generally accepted - the secondary nature of the organisation of land groups of animals, their origin from aquatic ancestors.

The concept of the origin of terrestrial arthropods from aquatic ancestors is also generally accepted; However, the specific paths of evolution of individual groups of opinion are very contradictory.

Suffice it to recall that, for example, insects have been different researchers for the last 40 years, bred directly from trilobites (Handlirsch, 1925; Heegard, 1945), crustaceans (Crampton, 1928), from Symphyla (Tiegs a. Manton, 1947) and other centipedes (de Beer, 1930), from onychophora (cf. Du Porte, 1965)! To understand the evolution of a group, you need to ... real ways of its development, those environmental conditions, in which the evolution of this group of themes could take place, and not in any other way.

The conditions of existence in water and on land are so different that a direct transition from life in water to life in an open atmosphere is impossible for most groups of animals.

The main obstacle to the transition to life on land for aquatic organisms is the death from the loss of water, and there are no devices for preventing aquatic organisms.

In particular, the transition to life on land for aquatic arthropods and ancestors of terrestrial arthropod groups during phylogenesis was possible only through an environment in which air breathing is possible with minimal loss of moisture, through an environment in which the air is constantly saturated with water vapour or very slightly deviates from such a regime.

Such an intermediate environment in the phylogenesis of many groups of terrestrial invertebrates was the soil (including litter) initial substrates in water regime (rock cracks, cavities under stones, rotten wood, etc.), in which representatives of many aquatic groups animals (Ghilarov, 1949).

The transition from life in water to life in the soil and other environments in which the air is saturated with water vapour, makes it possible for animals to leave the aquatic environment who do not have special tools for protection against drying, are capable of skin breathing, etc.

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Rows of emerging transitions of release from constant communication with a wet environment can be traced in different classes of centipedes. Among helixes, such series are outlined in general in a complex of different orders of arachnids and even

within smaller taxa (for example, in ticks). Akhelitserovye (???) in general, allow us to analyze the whole range of transition from life in the water to the terrestrial existence.

If the currently distinguishing selection of scorpions from the arachnid class to the merostom class, then scorpions give another parallel branch of evolution from aquatic forms (fossil Palaeophonus) to terrestrial.

Finally, phylogenetically young and ecologically very complete series of transitions illustrate crustaceans such as isopods. The secondary transitions to life in the water of insect larvae (and the secondary transitions of secondary-water larvae to life on land!) Make it possible to isolate more plastic adaptation features when changing habitats.

At present, it is difficult to imagine that just 30 years ago, the naively fantastic representations of A. Handlirsh, who painted the path of evolution from trilobites directly to winged insects, such as Palaeodictyoptera, were widespread.

Refinement of the phylogenetic pathways of evolution of terrestrial arthropods, the allocation within the type of different levels of adaptation to life outside water (in the soil and other wet substrates and in the open atmosphere, volume of humidity) allows you to find out the patterns of evolution of organisms during habitat changes.

There is no doubt that phylogenetic development is a natural process that has a certain direction. The question of the focus of the phylogenetic process in our literature has bypassed the latter

I am silent Idealistic interpretations of evolutionary directional phenomena, which were given by supporters of the theory of orthogenesis (Eimer, 1927) and related concepts (Berg, 1922; Osborn, 1930, etc) led to the denial or neglect of the very facts of a particular evolutionary orientation of many groups.

Regarding the lower taxonomic categories, the patterns of possible variations of characters and their combinations are expressed in the ideas of N. I. Vavilov (1922), who formulated the "law of homologous series" of variation. Knowledge of the patterns of evolution of groups allows us to foresee the direction of their further evolution, as pointed out by V.V. Popov (1939) with respect to some bees.

The environmental studies of the post-Darwinian period were directed mainly along the path of genealogical research, along the way of identifying those organization features that make it possible to ascertain the phylogenetic relationship of different groups of organisms, i.e. those similarity features that are commonly combined under the general term "homology".

It was the establishment of homology that turned out to be the center of attention of comparative anatomy and embryology, which were rapidly developing at the end of the past - the beginning of our century. Based on the finding of homologous traits, evolutionists have restored and restored the historical development of different groups of organisms, phylogenetic relationships between them.

Until recently, features of similar similarity resulting from convergence and parallelisms were not recognized. They didn't pay enough attention to understanding the ways of phylogenesis, and therefore the study of the phenomena of similar similarities and patterns of its occurrence.

However, it is precisely those patterns that determine the features of a similar similarity, determine a parallel or convergent course of phylogenesis of various groups, determine the directions of phylogenetic development.

Therefore, the study of convergences and parallelisms makes it possible to identify patterns in the directions of phylogenesis, which are determined in the process of the historical development of the relationship of the organism with the environment (Ghilarov, 1960, 1964) and the historical development of different groups of organisms, and the phylogenetic relationships between them.

The direction of evolution of organisms of a group can be understood on the basis of the analysis of the characteristics of the original organization, which determines the possibilities of adaptation when environmental conditions change, taking into account the main environmental factors to which adaptation occurs and when opening possible principles of functioning of the main organ systems in these conditions of existence.

The studies carried out in such a triple plan allow Reestablishing possible real paths of evolution of organisms.

Elucidation of possible ways of adaptation to specific conditions of existence shows the limitations of the options for biologically viable pathways of phylogenetic changes of organisms in these conditions and, as a result of this, the pattern of trends in the evolutionary process.

Such an approach deprives the phenomenon of orthogenesis (undoubtedly stated in parallel phylogenetic series) of that idealistic was previously associated with this term, and to one. determines the need to study them to understand the evolutionary process.

Nowadays, the idea of analogy as an inferior concept that does not matter for comparative studies sounds like an anachronism, as Novikov (1935) argued, for example, since it is the study of convergent and parallel formations that makes it possible to identify those solutions that are crucially important for the life of the organism. and chemical tasks that can be implemented

animatic structures (ilars, 1960; Hubbs, 1944). However, in studies of convergences, it must be remembered that only correctly restored phylogenetic changes can serve as a

criterion in verifying conclusions about the laws of the evolutionary process, since historical patterns are learned in comparative phylogenetic series. Therefore, only

The second (and not arbitrary) arrangement of the individual forms in the comparative series is the key to solving the problem. To establish the general trends of the evolutionary process, the results of studies of specific phylogenesis, based on the identification of homology, serve as material and as a criterion for verification. For example, to confirm or overthrow the “theory of oligomerization”, V. A. Dogel (1954) is not indifferent to whether the multi-segment (like geophilides) forms of the hilopods are original, more primitive (Beklemishev, 1944; Gilyarov, 1948c; Kaufman, 1961; Manton, 1952), or they are derived from oligomeric forms (Snodgrass, 1952).

in the ranks of different groups of arthropods who have adapted to life on land, a large number of

These changes are associated with adaptation to moisture deficiency. Analysis of the characteristics of the organization of representatives of different groups of that the evolution of adaptation to life on land follows a general pattern, is proceeding as a directional process.

Since the basis of all life processes are biochemical reactions occurring in aqueous solutions and complex colloidal systems, obtaining water, its retention and preservation are the most difficult and responsible task for terrestrial organisms.

The conservation of water in the body of an animal requires the development of a set of devices.

Knnim refers primarily to the reduction of transpiration through integuments, in connection with which terrestrial arthropods passing to life on land develop more or less waterproof integument

However, in arthropods, especially in small ones that live in water or in soil, integuments also serve as the respiratory surface (in case of skin respiration), or some specialized areas of integuments assume the function of the gas exchange surface (gill outgrowths of water forms). with the transition to life on land in conditions of moisture deficiency, the differentiation of covers into areas impenetrable, protecting against loss of water (most of covers), and into areas permeable to gas exchange becoming specialized air breathing organs is inevitable.

With air breathing and a constant lack of moisture on land, the gas exchange process is inevitably associated with the loss of water through the surface of the respiratory organs. Therefore, in all terrestrial forms, the evolution of the respiratory organs proceeds towards adaptation to the reduction of water loss, and the study of the respiratory organs of arthropods during the transition

Life on land is of interest for understanding the laws of adaptation to life in the air. On

Loss of water also occurs during the elimination of nitrogen metabolism products. Intrinsic medium may excrete easily soluble products. mediocre in the external environment, which is impossible on land, since this requires a huge flow of water. In this regard, in the ground groups, we should expect the development of adaptations to the isolation of difficultly soluble catabolites and the creabsorption of water from excreta. The study of these devices also makes it possible to find certain regularities in the course of evolution of terrestrial arthropods, as will be shown below.

Living on land causes not only in adaptations to the conservation of water in the body, but also to its renewal, especially difficult for the inhabitants of arid areas and dry substrates. The degree of mastery of water sources on land and the path of moisture production largely characterizes the possibilities of conquering the open land surface by different groups of arthropods.

Transition to habitat on land is impossible without internal insemination. The study of its features in different groups of arthropods also provides extensive material for understanding the patterns of adaptation to life on land.

When assessing adaptations to life on land, one has to deal with the fact that they are not identical at different stages of ontogenesis, and adaptations associated with the passage of the embryonic period of development are of great importance.

Analysis of these adaptations in different groups of terrestrial articulations in comparison The following chapters are devoted to water and soil, and to identifying the general patterns of change associated with the transition to life on land.