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THE ROLE OF WATER IN THE EVOLUTION OF THE WORLD
РОЛЬ ВОДЫ В ЭВОЛЮЦИИ ОКРУЖАЮЩЕГО МИРА

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Abstract. The article reveals the mechanism of evolution of the "inert" and living world that surrounds us, which is due to the creative function of water. The creative function of water is that it continuously dissolves some minerals with which it is not in equilibrium by the hydrolysis mechanism, but immediately creates others with which there is equilibrium, including those that were not on our planet before. System V.I. Vernadsky (water - rock - gas - organic matter) not only became more complicated many times, but also got the opportunity to create more complex organic compounds from simple carbohydrates, including proteins, lipids, carbohydrates, hemoglobin, etc. Subsequently, living organisms arose. Despite the multiple complications of the system, the basic mechanisms of its evolution essentially remained the same, and water retained and increased its creative function by dissolving simple compounds and creating more complex ones.

Key words: surrounding world, global evolution, thermodynamic equilibrium, equilibrium-nonequilibrium system, complication mechanism, creative function of water, system V.I. Vernadsky.

Introduction. Why is the world around us changing? How is its complication going? What forces drive its evolution? How did life come about? These and many other questions haunt scientists for several thousand years. Even the ancient thinkers of Hellas, who laid the foundations of dialectical thinking, tried to find answers to these questions. Even then, fundamental ideas were formulated about the unity of the world. By unity was meant the presence of one (main) substance, which creates this world. But what kind of substance does this - the views diverged: Thales from Miletus believed that water is the beginning of all things, their material essence, which turn into water; Heraclitus of Ephesus assigned the same function to fire. Since then, these two points of view continue to exist, finding no reconciliation.

Among the Neptunists, French zoologist stood out with his innovative ideas. Lamarck (1744–1829), who in 1802 published the book *Hydrogéologie*. In this book, he tried to uncover the role of water in the development and formation of Nature (in those days they wrote with a capital letter). In fact, in this edition of J.-B. Lamarck most fully laid out the foundations of his ideas about Neptunism as a scientific worldview [1]. Later he more fully developed his views in the *Philosophy of Zoology* (1809).

One of the most important tasks posed by J.-B. Lamarck, consisted in the search for a force that provides a change in Nature, its complication, evolution. Solving this grandiose problem, he, to his surprise, did not find any creative processes in the surrounding "inert" objects, only destructive ones. Then he suggested that such a life force (*pouvoir de la vie*) takes place only in living organisms, but it is unknown to science.

In the XX century physicists represented by E. Schrödinger (1887–1961) supported the idea of the presence of evolution only in living matter. In 1944, he



published a book, which already in 1947 was translated into Russian and repeatedly reprinted [2]. In this book, he developed the concept of the dependence of the complexity of any system on the ratio of the entropy fluxes from the system to the medium and vice versa. Living systems, in his opinion, are always nonequilibrium and never, except death, go into an inert (equilibrium) state. They maintain their disequilibrium due to the medium from which they continuously draw the necessary disorder or non-entropy. To live, Schrödinger writes, an organism must constantly extract negative entropy from its environment, “which is something very positive... Negative entropy is what the body eats”[2]. Unlike living matter, non-living, according to E. Schrödinger, very quickly comes into equilibrium with the environment, because it is unable to accumulate entropy from the latter.

The concept of E. Schrödinger that the complication of evolution is determined by the external environment has been recognized by virtually all science. And although complete unity in science was not achieved: various modifications of the evolutionary course [2] developed, the basic approach to evolution as a function of only living matter, the predominant role of natural selection and its random nature, has been preserved to this day. Since water is part of the inanimate world, it is not among the evolving elements. So the great J.-B. Lamarck, being an ardent supporter of Neptunism, the founder of the doctrine of evolution, actually excluded water from the evolutionary process taking place on our planet.

Lamarck’s position on the absence of evolution in inanimate matter seemed so convincing that even the brilliant scientist V.I. Vernadsky was of the same opinion. And although he attached great importance to the interaction of water with rocks, gases and organic matter, in fact showing that it is in the nature of evolution, nevertheless he never talked about evolution in inanimate matter. Among the main elements of the surrounding world V.I. Vernadsky [3] assigned a very special role to water with its many unusual properties, pointed to many mechanisms of transformation of the surrounding world by it, showed its “everywhereness” and diversity. But even today this unique combination remains at the margins of evolutionary theories.

The purpose of the work is to establish the role of water in the geological and biological evolution of the world.

Main part. By V.I. Vernadsky [3], evolution is a random phenomenon, the beginning and mechanism of which are unknown. But is it possible? Billions of organic compounds, cells, bacteria, plants, animals, people, the beauty of the world, the human mind, the self-organization of matter, life itself - random “passers-by”, ready at any moment to leave this world? Is it possible to believe this in the era of the noosphere, in the century of an unprecedented development of science and common sense?

It is especially striking that so far science considers evolution, and therefore life, to be a random phenomenon that occurs without the influence of any internal force that continuously complicates the world. Some scholars consider randomness a strictly logical phenomenon. For example, E.V. Kunin in his acclaimed book [4] substantiates the hypothesis that randomness has its own patterns at different stages of evolution, determined by different factors. Regarding the origin of life in



accordance with the hypothesis of MMM (model of the world of many worlds) E.V. Kunin believes that “in an infinite multiverse with a finite number of different macroscopic stories (so that each is repeated an infinite number of times). The author substantiates this position by mathematical methods, but they do not add to her conviction.

Geologists have also actively joined the idea of evolution in various geological processes, but have not found the internal mechanisms of this phenomenon. It is generally accepted that the evolution of the latter proceeds under the influence of external factors, among which are called a decrease in time of the intensity of the mantle heat flow, an increase in the mass of the continental crust, a decrease in areas with a mobile tectonic regime, an increase in the intensity of oxidative processes, a change in the composition of the atmosphere over time, and an increase in the role of living matter, etc. [5].

The above brief review shows that modern science basically considers evolution as the prerogative of only living matter, which appeared by chance, but captured the entire surrounding world, including “inert” systems. Water does not play any special role in the evolutionary processes of the surrounding world, but is one among many random factors that determine the course of evolution. But the main problem is forgotten: evolution (the formation of complexities) is impossible without the participation of water [1].

Other approaches to evolution are developed by synergetics, which is trying to expand the concept of global evolution by searching for common foundations for the complication of living and non-living systems.

Thus, synergetics, as an interdisciplinary science, undoubtedly forms a new way of thinking about the connection between the living and the nonliving, establishes bridges leading to the understanding of a single beginning of the evolutionary transformations of the world around us, tries to find some universal laws of evolution and self-organization of matter, but it also cannot do without accidents. This is because synergetics, like many other sciences, does not take into account the very special role of water in the creation and transformation of the Earth, the essence and mechanisms of the processes of interaction of water with rocks, gases, living and dead organics. In other words, the hydrogeochemical direction developed by the great V.I. Vernadsky, still remains to the end unconscious. Water is a very special matter of the planet, which permeates all its substance and, continuously rebuilding it, creates a new world. The interaction of water with matter, starting with rock, is of a special nature and develops without accident [1].

We can judge the change in the environment in the organs of living organisms, for example, by the content of H₂O and its dielectric constant (ϵ_s) in various human organs. Human organs located next to each other differ sharply in these parameters. Moreover, with a change in the amount of water, its permeability changes, which means other properties, i.e. biochemical environment as a whole.

Therefore, some general principles of the evolution of the water - organic system in living organisms are the same as the water - rock system. All this speaks of the inheritance of the mechanisms of evolution of living matter from "inert". The connecting link between living and “inert” is water, which, thanks to its unique



properties, ensured a continuous transition of evolution from dead matter to living. But such a transition is not a mechanical transfer of functions from the mother system to the daughter system, but a deep complication of the composition and structure of water. At each new stage of evolution, other water actually appeared. If we take into account the ideas of V.I. Vernadsky [3] that water is not one mineral, but many, then each stage of evolution forms its own aquatic mineral, which differs from others in composition and structure. And each new mineral of water is more difficult than its predecessor.

A completely different direction in the evolution of the composition of natural waters is characteristic of the system water - organic matter - gases. Warm-blooded animals and humans drink mainly river, lake, or underground water with salinity $<1\text{g/l}$ (animals — sometimes up to 5 g/l) with a low content of simple organic compounds. But over the long history of evolution (>2.0 billion years), the complication of the composition of water turned out to be so strong that such water was called blood, which is distinguished, first of all, by its large number of complex and diverse organic compounds.

The basis of the blood is water (77–82%) and organomineral solids (18–23%), in which the proportion of minerals is only 1.2–1.6%, and organic matter is 16.8–23.4%, i.e. blood is water in which not mineral, but organic compounds sharply dominate. Blood is a heterogeneous liquid: it consists of plasma (54–59%) and red blood cells (41–46%). The former comprises 90–91%, and the latter, 57–68% of water. Plasma and red blood cells also differ in density: $1.02\text{--}1.03$ and 1.09 g/cm^3 , respectively. Blood viscosity is 5–6 times higher than water viscosity; pH fluctuates in very narrow limits - from 7.35 to 7.42.

Blood is rich in various trace elements that play an important biochemical role [1].

Thus, with the advent of photosynthesis, the orientation of the creative function of water has changed dramatically. If, prior to photosynthesis, water formed secondary mineral products (sedimentary, hydrothermally altered and metamorphic rocks and ores up to granite gneisses and granites [1]), then with the advent of photosynthesis the formation of vegetation began, which means peat, coal, oil, methane gas, and also proteins, carbohydrates and lipids, and then living organisms (animals and humans).

All of the above shows that water in biological systems does not just transport nutrients, regulates body temperature, removes waste from the body, flushes toxins, lubricates joint joints, as is commonly believed, but creates the body as a whole, determines its properties, shape, structure, functions, mechanisms of action, direction of evolution. Water is an integral part of all organs of a living organism and, depending on the size of the vessels, changes its properties. This circumstance determines the course of all metabolic processes in a living organism.

So, in all the main systems (kingdoms) of our planet - mineral, plant and animal, including humans - the same principles of evolution operate due to the same reasons and mechanisms. The main creative and connecting component of these systems is water, which literally permeates all their components. Under conditions of an internally contradictory equilibrium-nonequilibrium state, water continuously



dissolves by any hydrolysis mechanism any formations (mineral, organic, organomineral, etc.) with which it is non-equilibrium, but at the same time it creates fundamentally new formations, including previously unknown on Earth. Moreover, if the environment in a particular system remains geologically stable for a long time, the same secondary products will form over time.

But water has another important property - it always participates in certain cycles, so the resulting secondary products after some time end up in the water of a different composition with which they are not in equilibrium. This new water partially dissolves secondary products and changes its composition. If this chemically altered water further enters the maternal formations with which it is not in equilibrium, then it will form other secondary formations that differ from previous ones.

This moment in the evolution of the interaction of water with “inert” or living matter is fundamentally important because it reveals yet another complication mechanism as a result of the evolution of the water-rock-gas-organic matter system (V.I. Vernadsky's system). In general, this mechanism consists in the fact that, after some time after the appearance of water on the planet and the beginning of its interaction with basalts, weathering products formed on the day surface. Later portions of water entering the Earth's surface primarily interact with these secondary formations, dissolving them and changing their composition. Such altered water, reaching the basalt surface at a certain depth, forms secondary minerals not of the first, but of later stages [1]. After the appearance of photosynthesis, organic and organomineral ones were added to the secondary mineral formations, which ensured a further continuous complication of the system.

So, modern rainwater, before entering the human body, passes through the crown of trees, different soil horizons, various weathering crusts, interacts with various sedimentary, less often igneous or metamorphic rocks. Then it ends up in a river or lake, where various life forms flourish, various chemical and biological processes take place, and numerous bacteria develop. Such, as well as fresh underground water, which is enriched with almost all chemical elements and their mineral-organic compounds, feed on plants, animals, people, i.e. all living things on the planet. In addition, animals and humans eat many secondary products (meat, plants, vegetables, fruits, berries, milk, etc.), which always contain at least 60% water, even more diverse in composition and structure, rich in various complex organic compounds. With this food, a person receives complex organic and organomineral compounds, including a variety of proteins, carbohydrates, lipids, etc. As a result of the process of dissolution and deposition throughout the geological history during multi-stage transformations in an aqueous solution of mineral and, later, organic compounds, a modern, extremely complex, surrounding world arose.

In its most general form, we can distinguish three main stages of the complication of this secondary world in the process of global evolution on our planet. At the first stage, the complication occurs due to the conversion by water of the initial rocks on Earth - basalts. The second one adds interaction with organic matter - the product of photosynthesis, which begins in geochemical media formed in the first stage, but gradually changing from geochemical to biogeochemical. At the third



stage, the complication is mainly associated with the transformation (digestion) of secondary mineral and organic formations that enter the body of an animal and a person, i.e. food. Each stage of evolution proceeds in a different, more complex, aqueous solution, which is continuously complicated by the dissolution of new, more complex secondary formations. It is fundamentally important that the complication occurs simultaneously in an aqueous solution and all secondary formations [1].

All these transformations became possible due to the presence in the system of water - endogenous rocks of internal evolution, which was later inherited by the system of water - organic matter, and even later - water - living organisms. The internal evolution in the water - rock - gas - organic matter system, which began even before the appearance of living organisms, is direct evidence of the absence of any connection with the idea of "power of life." This function - the function of creative power - is performed by water.

Conclusions. Since the appearance of water on the Earth, a stationary nonequilibrium-equilibrium water-rock system has arisen, which has an internally contradictory nature, which ensures its spontaneous, continuous, geologically long-term development with the formation of fundamentally new mineral phases and geochemical types of water. This system within the earth's crust (at $T < 400^\circ \text{C}$) is constantly evolving in the nonlinear region of the thermodynamic branch under conditions far from equilibrium, and belongs to the type of abiogenic dissipative, which play a special role in the progressive development of "inert" matter.

The ability of this system to continuously dissolve certain minerals and practically simultaneously form new ones that differ in composition and structure from the original soluble ones ensured the formation of successively alternating hydrogen-mineral complexes consisting of different paragenetically associated geochemical types of water and secondary mineral formations represented by various weathering products, sedimentary sedimentation of rocks of varying degrees of diagenesis and catagenesis, low-temperature metamorphism, halmirolysis. It is important that all these secondary complexes are continuously complicated in composition and structure, which ensured evolution in inanimate matter.

The appearance of photosynthesis, which ensured the formation of organic compounds, not only greatly complicated the system under consideration and many mechanisms of interaction of its components, but also directed the evolution of this system in a new direction. As a result, more complex compounds, including proteins, carbohydrates, lipids, etc., emerged from simple organic compounds. Due to the dissolved organic compounds, the composition of water radically changed, and the medium from a purely chemical one was transformed into a biogeochemical one, which ultimately led to the appearance of living organisms.

Due to the constant water cycle, secondary mineral and organic formations are continuously subjected to partial dissolution by new portions. As a result, the composition of the aqueous solution changes even before it enters the original (parent) rock. This circumstance led to at least two additional mechanisms of complicating the system: 1) the composition of the water changes even before interacting with primary rocks and basic organic compounds, which provides additional complication of the system as a whole; 2) the mixing of different types of



aqueous solutions, changed due to the dissolution of secondary and primary minerals, as well as various organic substances, led to an even greater effect of complicating the system.

The emergence of life ensured the emergence of a new grandiose stage in the complication of V.I. Vernadsky water - rock - gas - organic matter (dead and living). The gradual but continuous complication of the aqueous solution with organic compounds led to the emergence of a fundamentally new type of water - blood, which ensured the formation of the most complex living organisms, including humans.

Despite a thousandfold complication of the mechanisms of interaction between the leading components of the system, V.I. Vernadsky, the basic principles of evolution, laid down in the water-rock system in the early stages of planet development, are basically preserved. The system remained open, equilibrium-nonequilibrium, internally contradictory, nonlinear, irreversible, developing in a region far from equilibrium, and water retained the ability to create more complex ones by dissolving some compounds.

The evolution of the system under consideration is the result of the presence of internal mechanisms of continuous interaction of all its components, due to the incompatibility of the composition and structure of water at the first stages of evolution with basalts, and later with other formations that it dissolves. The transformation of one solid compound as a result of dissolution and precipitation into another is the main mechanism of evolution, which continuously destroys one existing world and creates a new, previously unknown. This is the main creative function of water in the world around us.

Water, bound in the process of hydrolysis by secondary "inert" products and living organisms, accumulates solar energy and thereby transfers to a higher energy level, which ensures a decrease in entropy, and therefore, is the basis for the formation of ordering, the reason for the complexity of the system as a whole. Such evolution serves as the basis for the transition from chaos to order, a new structural genesis, a driving force that provides a change in irreversible energy flows, leading to a new rationality of the world around us.

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Аннотация. В статье раскрывается механизм эволюции окружающего нас «косного» и живого мира, который обусловлен созидательной функцией воды. Созидательная функция воды заключается в том, что она непрерывно по механизму гидролиза растворяет одни минералы, с которыми неравновесна, но тут же создает другие, с которыми имеется равновесие, включая и такие, которых на нашей планете раньше не было. Система В.И. Вернадского (вода – порода – газ – органическое вещество) не только многократно усложнилась, но и получила возможность создавать из простых углеводов более сложные органические соединения, включая белки, липиды, углеводы, гемоглобин и т.д. В последующем из этих компонентов возникли живые организмы. Несмотря на многократное усложнение системы, основные механизмы ее эволюции принципиально остались такими же, а вода сохранила и приумножила свою созидательную функцию путем растворения простых соединений и создания более сложных.

Ключевые слова: окружающий мир, глобальная эволюция, термодинамическое равновесие, равновесно-неравновесная система, механизм усложнения, созидательная функция воды, система В.И. Вернадского.

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