Understanding the World through Systems: History, Classification and Future Directions

Kochetov N. V.

ANNOTATION

The article is devoted to the understanding of the world as an object consisting of systems, as separate "bricks", despite their diversity.

Non-living systems develop according to the laws of natural sciences: physics, chemistry, astronomy. Their development is not targeted, while there is an increase in disorder (entropy).

Living systems strive to survive and expand, while they transform everything around them to improve their existence. Disorder (entropy), from the point of view of living systems (in relation to the achievement of a goal), decreases.

A general classification of the systems of the surrounding world is given. The evolution of living systems and the features of their development are explained.

Keywords: system, non-living systems, living systems, social systems, evolution, development.

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I. INTRODUCTION

In recent years, the concept of "system" has been increasingly used. As a result, the concept of a system is found in almost all fields of knowledge, which has given rise to many definitions. It is almost impossible to give an accurate comprehensive definition of the system. Any of them will be relative.

Therefore, it is better to consider the historical process of the formation of the concept of "system".

The system (from the Greek. Σύστημα – a combination, a whole made up of parts, a connection) is a set of elements that are in relations and connections with each other, which forms a certain integrity, unity. [1]

Having undergone a long historical evolution, the concept *of system* has become one of the key philosophical, methodological and special scientific concepts since the middle of the 20th century. In modern scientific and technical knowledge, the development of problems related to the study and design of systems of various kinds [2] is carried out within the framework of the systems approach [3], the general theory of systems [4], various special theories [5], in cybernetics [6], and systems engineering [7], system analysis, etc. [8]

II. HISTORY OF DEVELOPMENT

In ancient Greek philosophy and science (Euclid [9], Plato [10], Aristotle [11]) the idea of the systematic nature of knowledge (the axiomatic construction of logic and geometry) was developed. constructions of scientific systematics. 17th and 18th centuries, which strove for a natural interpretation of the systematic nature of the world (for example, the classification of Carl Linnaeus) [14]. In the philosophy and science of modern times, the concept of system was used in the study of scientific knowledge; at the same time, the range of proposed solutions was very wide, from the denial of the systemic nature of scientific and theoretical knowledge (Etienne Condillac) [15] to the first attempts at a philosophical substantiation of the logical-deductive nature of knowledge systems.

And to this day, in the absence of a precise definition of the concept of a system, researchers widely use it at an intuitive level. [16]: "Most researchers intuitively realize that there is still a real commonality in this variety of directions, which should follow from a common

understanding of the system. However, the reality is that there is still no common understanding of the system."

It was also widely used by the classics, although the term itself is not in their works [17, 18]. In the 19th and 20th centuries, there was no such detailed terminology as there is now, some concepts underwent changes and were clarified. But the concept of system was in the air in the works of scientists, penetrating the content of the works. The concept of complex systems appeared: "*An* electron is as inexhaustible as an atom" [18].

A great contribution to the theory of systems was made by the Russian philosopher A.A. Bogdanov, in his work "Tectonomics", republished in the 1880s [19]. The work concerned organizational structures.

Later, the "General Theory of Systems" was formulated [20], in which systems are divided into closed and open (developing). The division is relative, since all systems are under the influence of entropy in time. Inanimate systems tend to increase disorder. Living systems strive to create conditions for habitation, for which they develop surrounding systems for this purpose.
There are several modern definitions of the system.

Academic definition of the concept of a system by Academician P.K. Anokhin, who studied living systems.

A system is a complex of selectively involved elements that interact to achieve a given useful result, which is accepted by the main system-forming factor [21].

Disputes about the *classification of systems* continue [3, 22, 23]. We can propose another one based on the evolution of systems. First of all, it is advisable to divide systems into *non-living* and *living*.

III. NON-LIVING SYSTEMS

Non-living systems are characterized by the fact that they develop uncontrollably by anything Albert Einstein once expressed it as follows: "Nature hides its secrets due to its inherent height, and not by tricks" [24, 25]. Non-living systems change over time. In comparison with living systems, the time of change of non-living systems occurs either quickly (changes at the molecular level) or very slowly (at the planetary level). the change of day and night, seasonal changes (winter-summer), tides, movement of air masses, water as a result of sea flows.

That is, the time of changes in inanimate nature has the widest range. For now, we can say that this range is unlimited, as is space. It is supposedly described by the "big bang theory", and this area remains open for study.

Any system, as a group of interconnected elements, can remain intact under certain conditions. For example, an atom of a substance. There are stable states (in our usual conditions), and there are states that disintegrate and can exist in a short period of time (radioactive substances). Most of all in the universe is elemental hydrogen. Why is there so little of it on Earth in its free form? Where does so much oxygen come from on Earth, which, when combined with hydrogen, formed a lot of water? The force of gravity does not keep hydrogen on the Earth's surface. Other gases are simply squeezed out from the surface of the Earth. But some of it combined with oxygen and formed water. Oxygen is a very active element, so there are a lot of oxides on Earth, in addition to water.

What are the favorable conditions on Earth? First of all, high stability. There is a magnetic field, an atmosphere, which protect from the adverse effects of the external environment. The Earth's rotation makes it possible to maintain the temperature on its surface within 200-300 degrees Kelvin [26, 27]. The pressure of the atmosphere is such that many substances are in a gaseous state [28].

The presence of winds allows you to move large volumes of gases and liquids, which can be a building material during chemical reactions. For example, carbon dioxide, calcium and magnesium salts dissolved in water.

Water occupies an exceptional place for favorable conditions: on Earth it can be in several states of aggregation: gaseous, liquid, solid. Fluid mobility provided an environment for the development of life. The evaporation of water led to the formation of clouds that carried large masses of water in the form of rain over the Earth's surface. This created conditions for life on the surface as well. Clouds are an important stabilizer of temperature on the Earth's surface.

A characteristic feature of the development of non-living systems is that they are not targeted. They develop according to the laws of physics, chemistry, the laws of motion of celestial bodies, and the development of the Galaxy. The action of the laws of the development of inanimate nature is chaotic. Usually, the development of non-living systems leads to disorder (an increase in entropy).

These laws are objective, that is, they were before, are and will be after the development of living systems. But living systems depend on the behavior of non-living systems. Therefore, the study of non-living systems makes it possible to use these laws in the interests of humanity. By combining inanimate systems, mankind achieves important target results that cannot be achieved in inanimate nature (technical systems: engines, artificial materials).

Non-living systems are the "building material" on which living systems arise and develop. Conditions contribute to the origin or introduction of living systems from outside. And then evolution is possible (if the development of non-living systems does not interfere with this.

IV. LIVING SYSTEMS

Living systems are more studied systems from the point of view of science. There are several fields that study them (biology, botany, zoology, anthropology, etc.). The time intervals of changes in such systems are more definite, although this range is quite wide (the periods of division of bacteria and viruses are quite short). The change of generations of plants and animals (including humans) is slower. The evolution of life on Earth is a slower process (so far we do not know of other living systems). But they are also very short compared to the "big bang" process.

So far, we cannot explain the emergence of living systems (life). But scientists are concerned about the question of what will happen as a result of the development of living systems [29]. It is clear that evolution was impulsive. At some moments, there were stops and rollbacks due to the influence of the external environment (changes in non-living systems). For example, global catastrophes that led to the formation of chalk deposits, fossil fuels (gas, oil, coal). And later local catastrophes that led to the disappearance of entire living systems (the extinction of mammoths).

Closer examples of the development of living systems are the evolution of man. Darwin put forward the theory of evolution. Did man evolve from apes or are they species that evolved in parallel? Apparently, a common ancestor howled, but it disappeared as a result of one of the disasters. Neanderthals, Cro-Magnons, Australopithecus - what place do they occupy in the process of human evolution?

As we can see, living systems that are closer to us are also inexhaustible for study. Perhaps the simplest forms of living systems take place in the Universe, but their development and evolution are possible only under certain favorable conditions (very rare). So far, no other Civilizations have been discovered, but does this mean that the Earth is the only non-living system suitable for the development of living systems in the infinite Universe?

Non-living systems develop according to the objective laws of chemistry, physics, and the laws of the development of galactic systems. Living systems cannot influence these laws, but they can use them to produce useful results. This also applies to living systems that are in a state of symbiosis with other living systems (man and botanical, zoological, bacteriological systems, objects of genetic engineering).

V. ARTIFICIAL LIVING SYSTEMS

Artificial systems (systems related to life) are systems that have arisen as a result of the evolution of life for its development (symbiosis, the formation of the "food pyramid").

Such systems have goals because they serve the interests of living systems (humanity). Humans have not created artificial life, but they have been successful in the selection of living systems that are useful to them.

Centuries of work to improve these living systems led to the development of agriculture, primarily crop production and animal husbandry. The potential of the seas is being actively developed. The selection of many plants, the breeding of productive breeds of livestock, the development of the potential of the sea led to the fact that large volumes of useful plants and animals were grown.

The accumulated information is reflected in the form of arrays of knowledge about living useful systems [30, 31]. This allows you to expand the areas of animal breeding, increase sown areas, and develop the potential of the seas.

Thanks to the successful development of agriculture, the population is steadily growing [32, 33]. However, this process will come to a halt: in the developed countries of Europe, there is almost no natural population growth. The quality of life has changed: the period of starting a family is preceded by a period of training, education, career building, etc.

Next, let us consider the social systems that are closest to this issue.

VI. SOCIAL SYSTEMS

Social systems are one of the specific types of systems. On the one hand, they are not living systems in their pure form, like a single individual. On the other hand, these are artificial systems that form relationships between people.

In the animal form, we also observe the rudiments of such systems: flocks of birds, shoals of fish, herds of herbivores, flocks of wild animals. This allows you to get a greater competitiveness of a particular type of living world.

But to the greatest extent, such behavioral systems were received in the development of mankind. At first, these were separate tribes. Then separate state structures began to form: Ancient Egypt, Babylon, the civilizations of China and the original states of the American region. This led to the stratification of the population of the state (the ruling elite, ordinary members of society).

As they developed and grew, states began to interact with each other (trade, confront, compete). This led to the emergence of a monetary system, jurisdiction, law enforcement agencies, armies, etc. The economy began to develop: crafts, construction, manufacture of ships, weapons, household items. That is, the structure of the state developed, became more complex, and became multi-invested [34].

Different segments of the population specialized in certain types of activities. Such universal trends in the development of society as health care, sports, education, art, science, and culture have appeared. Each of which is a separate, independent system.

For example, the international trade system, presented in the form of the Observatory of Economic Complexity (EC) [35], which is designed to increase the efficiency of economic ties between businesses.

VII. ARTIFICIAL NON-LIVING SYSTEMS

Non-living systems are the "bricks" on which living and artificial systems develop. These "bricks" are inexhaustible. But you need to know how to make something out of them, that is, you need TECHNOLOGIES. Examples of the influence of technology on the development of artificial systems: people have learned to smelt iron, produce aluminum, make artificial diamonds from carbon material, polymerize artificial materials from natural gas.

The most studied are technical systems, which are non-living artificial systems. As a result of the

research, it was possible to obtain complex nested systems. Examples include steam engines and turbines, internal combustion engines, electric motors, and electrical power generators.

What is the manifestation of nesting of systems? Consider the internal combustion engine. The main elements of this system will be the crank mechanism, ignition system, fuel mixture preparation system, exhaust system, control system, and a certain type of fuel. Each element performs a specific function. But in order to perform this function, the element in question is itself a system of a lower level, and so on.

If we consider a higher level in relation to the internal combustion engine, then here we can give an example of systems in which internal combustion engines are used: vehicles (cars, diesel locomotives, motor ships), power machines (mobile power plants, construction and technological production equipment).

At the same time, the engine, as an element of the system, will be supplemented by other systems that will determine the purpose of the system of a higher level. For example, a car that turns on the engine will be supplemented with a propeller (wheels), steering mechanism, gearbox (gearbox), accommodation for the driver and passengers (body), etc. Such development of artificial systems reduces disorder (entropy).

As we can see, each element of the artificial system will have a pronounced target character. In this way, artificial systems differ from non-living systems, which develop according to the objective laws of physics, chemistry, celestial mechanics, and the theory of probability. The development of inanimate nature tends to increase entropy.

Examples of such systems are social and state institutions, distribution systems (money), and technical systems.

It is these systems that continue to develop rapidly. Since artificial systems are created for the interests of people, they should not develop in such a way as to harm the existence of humanity. This should be the basis for the development of artificial systems.

The development of living non-artificial systems also has a purposeful character: self-preservation and expansion. But humanity uses much more opportunities for this, thanks to the acquired knowledge, science, and built infrastructure. Although initially the external environment is the same for all living systems.

VIII. CONCLUSIONS AND PROSPECTS

1. The concept of "system" is widespread and has several definitions in various fields of knowledge. Almost none of them fully reveals this concept.
2. It is important to distinguish between three types of systems: inanimate, living, systems for achieving certain goals of living systems (artificial).
   Non-living systems are objective in nature, they develop according to objective laws (the laws of physics, chemistry, and the development of galactic systems). The result of their action is due to the laws of probability theory, which is why the result is chaotic (tandem). The development of such systems tends to reduce order (increase entropy).
3. In the last century, artificial systems begin to develop rapidly and tend to accelerate this development. Artificial systems can be non-living (technical), living (based on living systems: new varieties of plants, breeds of livestock, bacterial strains, vaccines), combined (in recent years, research in this area has been actively conducted).
4. Living systems adapt to existence in the conditions of non-living systems (either die or follow the path of evolution). For successful evolution, artificial systems can appear for the purposes of living systems (artificial). Such systems are created for their intended purpose. They are based on a combination of several non-living systems, on living systems, or a combination of them. Such systems lead to ordering (reducing entropy).
5. Living systems have goals: self-preservation and expansion. At the same time, their development is aimed at overcoming the

conditions created by the development of inanimate systems. On the other hand, in order to expand living systems, they begin to compete with each other. Here the process of destruction, squeezing out or subjugation is observed. These processes can be intertwined. As a result, symbiosis can occur.

Living and artificial systems function within the framework of non-living systems and depend on the development of the latter. Therefore, in order to preserve life, it is important to study the laws of development of non-living systems in order to prevent catastrophes that may arise as a result of the development of these non-living systems.

6. Humanity is at the top of the evolutionary pyramid. It is a living system based on non-living, living, and artificial systems. Naturally, mankind is characterized by progressive development, the desire to expand the environment of its existence. Just like all living things, competition based on knowledge and science is inherent.
7. The desire for self-survival is no less strong, like any other living system. Further development of mankind should follow the path of eliminating the dangers that may come from non-living systems (global catastrophes, galactic collisions, radiation, poisoning, etc.) and living systems (diseases, toxic strains of bacteria and viruses, Varangian bacteria from other terrestrial environments and space systems).

In the conditions of earthly competition, it is in this direction that it is necessary to evolve.

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