

THEORETICAL FRAMEWORK AND INITIATION OF SCIENTIFIC PROJECT “LIFE. MOTION OF ENERGY- ELEMENT INFORMATIONAL UNITY OF THE MATTER”

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Abstract

To provide a scientific answer to the questions “How did life originate?” and “How does life affect the Earth and the Earth affect life?” a concept of the function of energy-element-informational state of physical and biological systems $f(E, C, I)$ has been developed. The regularities have been established and simulation of Life as a natural phenomenon, which is organized by moving in space and time energy-element-informational trinity of the Universe, has been run.

Keywords: Life, motion, energy, element, information, system model

Introduction

The U.S. National Research Council has formulated 10 key questions to which geologists and planetary scientists seek answers in the early 21st century. Among others, there are questions * How did life originate? * How does life affect the Earth and the Earth affect life?

Life is one of the forms of existence of the matter that occurs naturally under certain circumstances in the course of its development.

Modern science looks at material systems as matters, energy fields, noting that reflection is the universal property of the matter. The role of reflection (information processes) is of special importance for biosystems that actively perceive information from the external environment, transform it, use it for its development, accumulate, store and communicate it to the external environment.

Motion is an essential attribute of the matter. When moving a material system changes its *state* which is manifested in the change of *properties* of the system.

To be able to describe changes of the system state (with a complex change in its substance, energy and information) a scientific study of some concept, feature, function of unity of elements, energy and information is required.

Objective:

- To develop the concept of the function of energy-element-informational state of systems;
- To develop an overall picture (model) of the organization of life of the Universe, from nanosystems to the mega-level systems;
- To develop a plan for further multidisciplinary system research within the project "Life".

Results and Discussion

1. Function of Energy-Element-Informational State of Systems

The common (for physical and biological objects) components which together define the structure and properties of systems are:

- A qualitative and quantitative set of elements (C);
- A qualitative and quantitative set of energies (E);
- A qualitative and quantitative set of information (I);
- Configuration of the energy-element-informational path (S);
- The rate of change of the energy-element-informational state (ν)

Physical and biological objects are considered (Bobukh, 2001; Bobukh, 2002; Bobukh, 2012a) as systems of qualitative and quantitative sets of energies $e_1, e_2, \dots, e_n = E$, elements $c_1, c_2, \dots, c_n = C$ and information $i_1, i_2, \dots, i_n = I$. Function $f(E, C, I)$ is the characteristic of the energy-element-informational state of the system.

Figure 1 shows the schematic arrangement of hydrogen H, p-, s-, d-, f- elements depending on the values of the energy-element-informational function $f(E, C, I)$ of each individual atom of the element as well as properties of systems formed from the atoms of H, p-, s-, d-, f- elements.

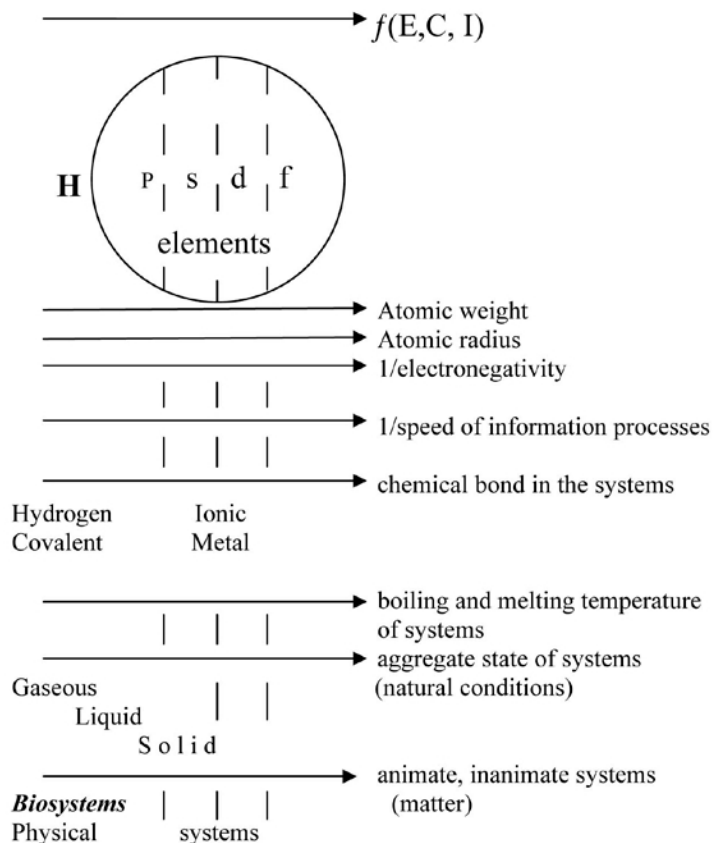


Fig. 1. Energy-element-informational function $f(E,C,I)$ and properties of systems of H, p-, s-, d-, f- elements

Analysis of the established bonds makes it possible to designate elements that form systems with the lowest values $f(E,C,I)$: element H as well as p- elements of the 2, 3 periods, IV-VI groups (H, C, O, N, P, S, Si – biogenic elements).

Biogenic elements have relatively low values of the atomic mass and atomic radius and high values of electronegativity and *the rate of information processes*. In the formation of molecules (CH_4 , NH_3 , H_2O) a covalent chemical bond is realized by the valence electrons, the atoms tend to sp^3 -hybridization (H atom gives its single $1s^1$ electron; C, O, N, P, S - p electrons). Due to the intramolecular bond of H with C, O, N, P, S formation of DNA helical structure is possible (Fig. 2).

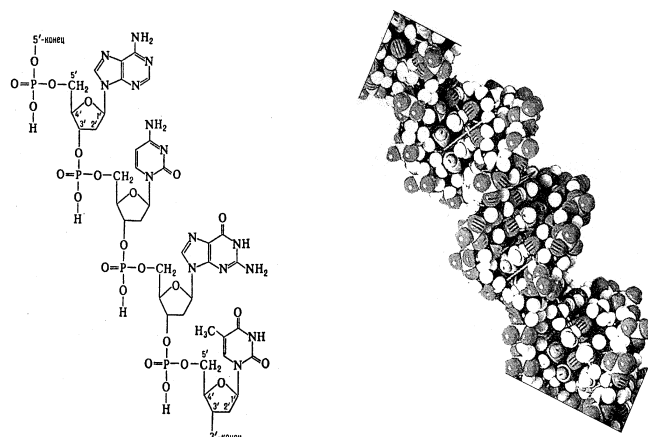


Fig.2. Structural formula and volumetric model of DNA

Usually by the properties of a chemical element are meant, firstly, the properties of its free atoms and, secondly, the properties of its elementary substance. Most of these properties have a clear periodic dependence on atomic numbers of chemical elements (a relevant number of protons in the atomic nucleus). Among these properties the most *studied*, significant, being of particular importance in explaining or predicting chemical behavior of elements and compounds formed by them are the following: *C* (atomic mass, atomic and ionic radii); *E* (ionization energy of the atoms, electron affinity energy, electronegativity, atomization energy of elementary substances, oxidation level, oxidation potentials of elementary substances).

As for the establishment of periodic dependence of change of the information properties (I – perception, transformation, accumulation, storing and communication) of atoms and systems they formed, these researches are just only beginning.

A group of physicists from the Max Planck Institute in Germany managed to "record" information about the quantum state of a photon to a single outer-shell electron (the outer shell configuration is $5s^1$) of a rubidium atom. The scientists have generated a photon and directed it at a rubidium atom. After the photon interacted with the electron, the researchers studied the behavior of the latter and came to the conclusion that the quantum state of the photon that "had hit" it could be quite accurately judged by the nature of motion of such electron round the atomic orbit. That is, the information has been recorded to the electron and, most importantly, the scientists succeeded in reading it.

It is probable that similar processes of “recording” – “reading” at the atomic level take place in nature, in the natural environment. For example, interaction of a photon (light – in a narrow sense) and $1s^1$ electron of a hydrogen atom causes a change in the informational state of the latter

(“recording”). The hydrogen atom with a changed informational state, being an active participant of the construction of H₂O, DNA molecules, will change the informational state of the “reading” atoms C, O, N, P, S and the whole molecule of H₂O, DNA.

Thus, with maintained energy (E), element (C) characteristics, H₂O^I, ДНК^I molecules will have an altered information characteristic (I) and so an altered energy-element-informational state of the system as a whole.

2. Motion. Change of Function of Energy-Element-Informational State of Systems

The rate of the system transition from one energy-element-informational state to another is:

$$v = \frac{\Delta f(E,C,I)}{\tau} \quad (1).$$

This equation (1) is a mathematical expression of the essence of matter which is the motion of the energy-element-informational unity.

Using the characteristic of change of $\Delta f(E,C,I)$ and the equation (1) we can describe the rate of change of state of systems of various space levels, such as nano ($\Delta f(E,C,I)_{\text{atom H}}$, C – a hydrogen atom $1,67 \cdot 10^{-24}$ g; DNA), micro (cell), macro (organism), and mega ($\Delta f(E,C,I)_{\text{Universe}}$, C – the Earth $5976 \cdot 10^{21}$ kg, the Sun $2 \cdot 10^{30}$ kg, the Galaxy $\sim 10^{11}$ of the Sun’s masses).

The way (S) of natural change of the energy-element-informational state of a system located anywhere on the surface of the Earth has a complicated cyclical pattern (Fig. 3) due to the mechanical motion of the Earth around the center of the Galaxy (1), the Sun (2) and its own axis (3). The state of the Earth – the Sun – the Galaxy physical system changes continuously and quite rapidly.

The Galaxy as a whole is moving relative to the background radiation at a speed of 620 km/s. The linear speed of movement of the Solar System around the center of the Galaxy is 220 km/s. The linear speed of movement of the Earth around the Sun is 29.765 km/s. The linear speed of the Earth’s rotation at the equator is 0.465 km/s.

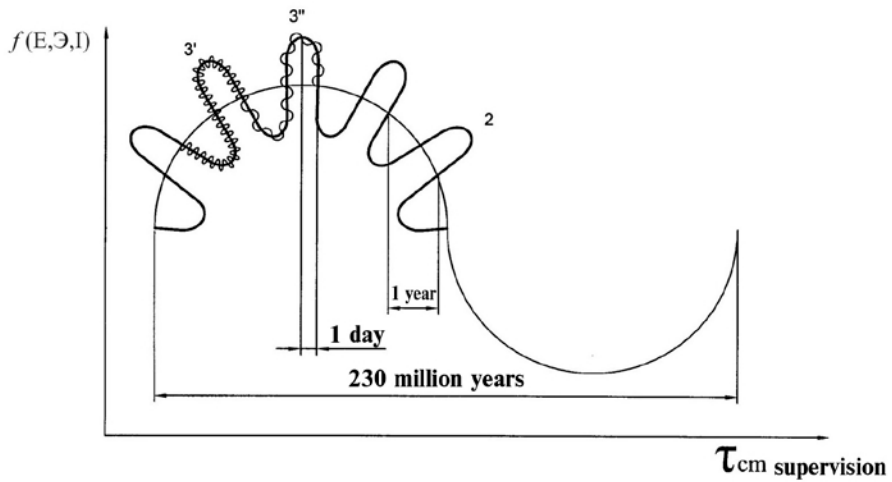
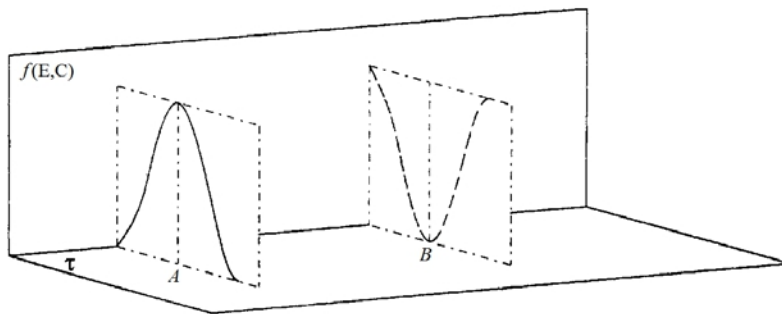


Fig.3. The equilibrium trajectory of change of the energy-element-informational state of any point on the Earth's surface the form of which is determined by the trajectory of the mechanical motion of the Earth around the center of the Galaxy (1) the Sun (2) and its own axis (3).

The change of state of the Earth – the Sun – the Galaxy physical system on the “spiral on a spiral, on a spiral” complex trajectory sets the same “mirror” trajectory (Fig. 4) of change of the energy-element-informational state of the system of biogenic elements H, C, O, N, P, S, generates a DNA helix, a cell, an organism.



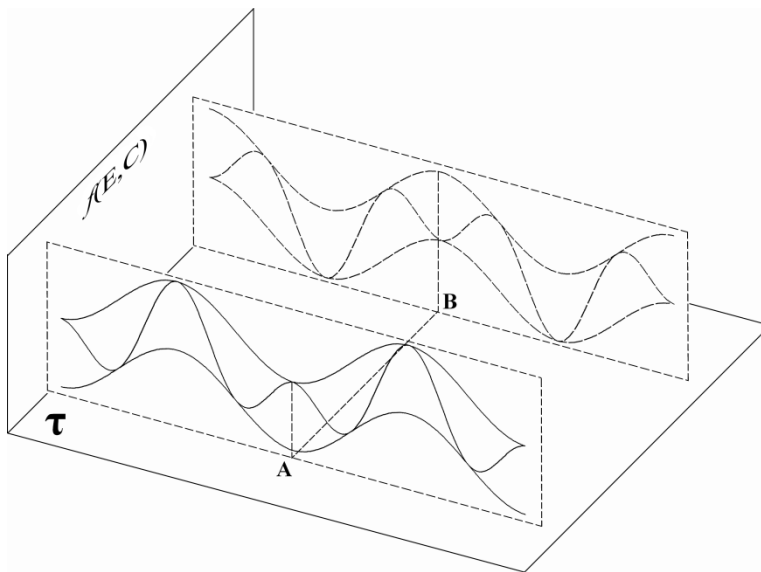


Fig.4. Diagram of dependence of change of the energy-element-informational function $f(E,C,I)$ of biosystem (B) on the change of energy-element-informational function of the Universe (A). Diagram of Le Chatelier-Braun Principle

Due to the low values of the energy-element-informational inertia, the systems based on biogenic elements (perceived as biosystems) are able to change their states $\Delta f(E,C,I)_{\text{biosystem}}$ with speeds coherent with the natural rate of change in the characteristics of the environment $\Delta f(E,C,I)_{\text{Universe}}$.

The energy-element-informational *motion of the Universe "creates" a man* like all other biological systems (Fig. 5).

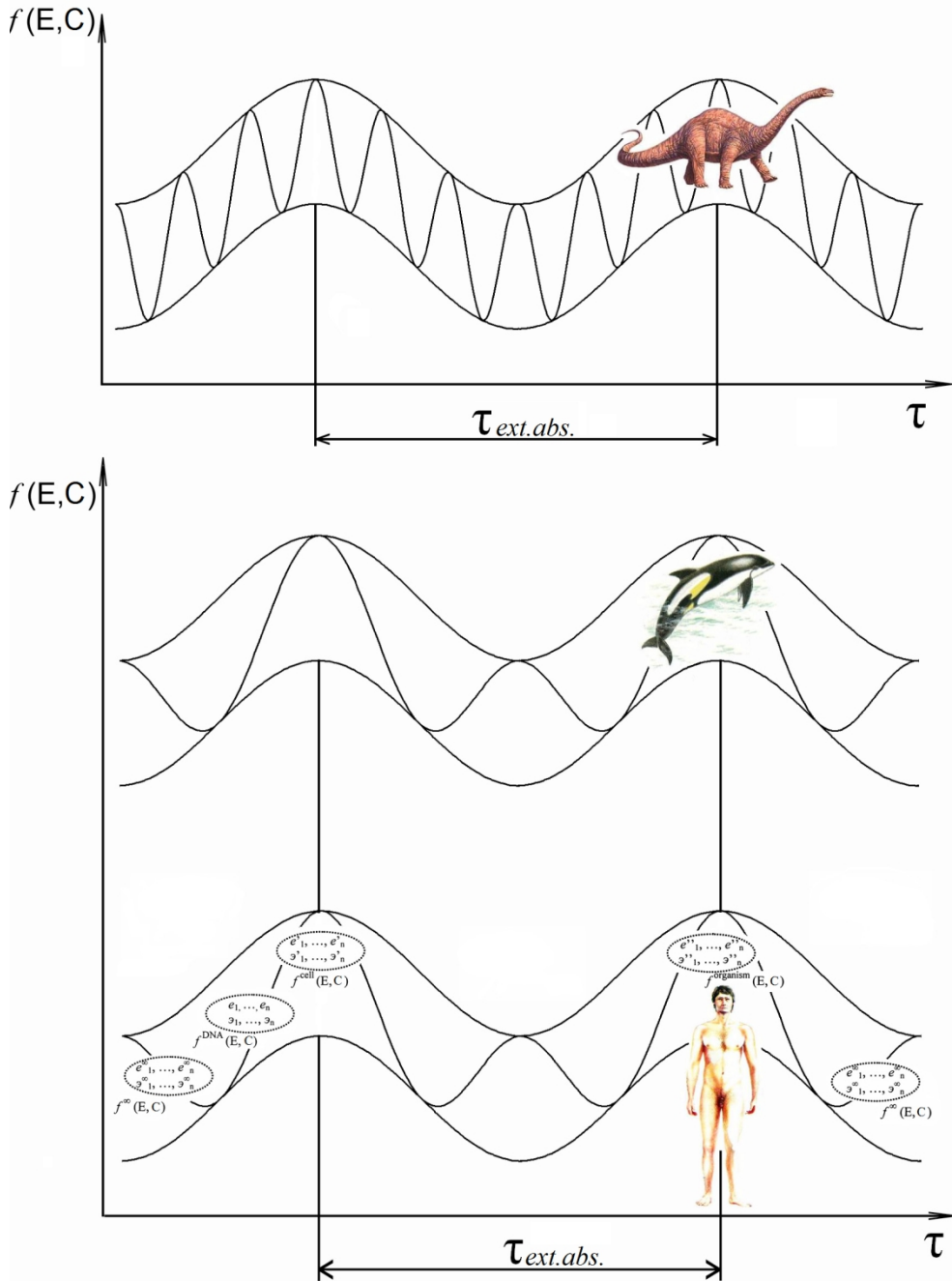


Fig.5. Organization and development of biological systems (DNA \rightarrow cell \rightarrow organism) taking place due to changing of the function of energy-element-informational state $\Delta f(E,C,I)$ of the environment; $\tau_{outside\ observer}$ is the length of time reviewed by an outside observer

A billion years ago a day lasted just 15 hours. But only blue-green algae or cyanobacteria, inhabiting the Earth at that time, could “see” it. Approximately 530 million years ago the Earth rotated so fast that a day lasted 21 hours. Its current rotation period is 24 hours. The rate of rotation of our planet around its own axis is slowing down.

We might say that the “Dinosaur” biosystem is organized by the Earth – the Sun – the Galaxy physical system at relatively high rotation rates of the Earth around its own axis. Organization of the “Man” biosystem is possible only at lower rotation rates of the Earth.

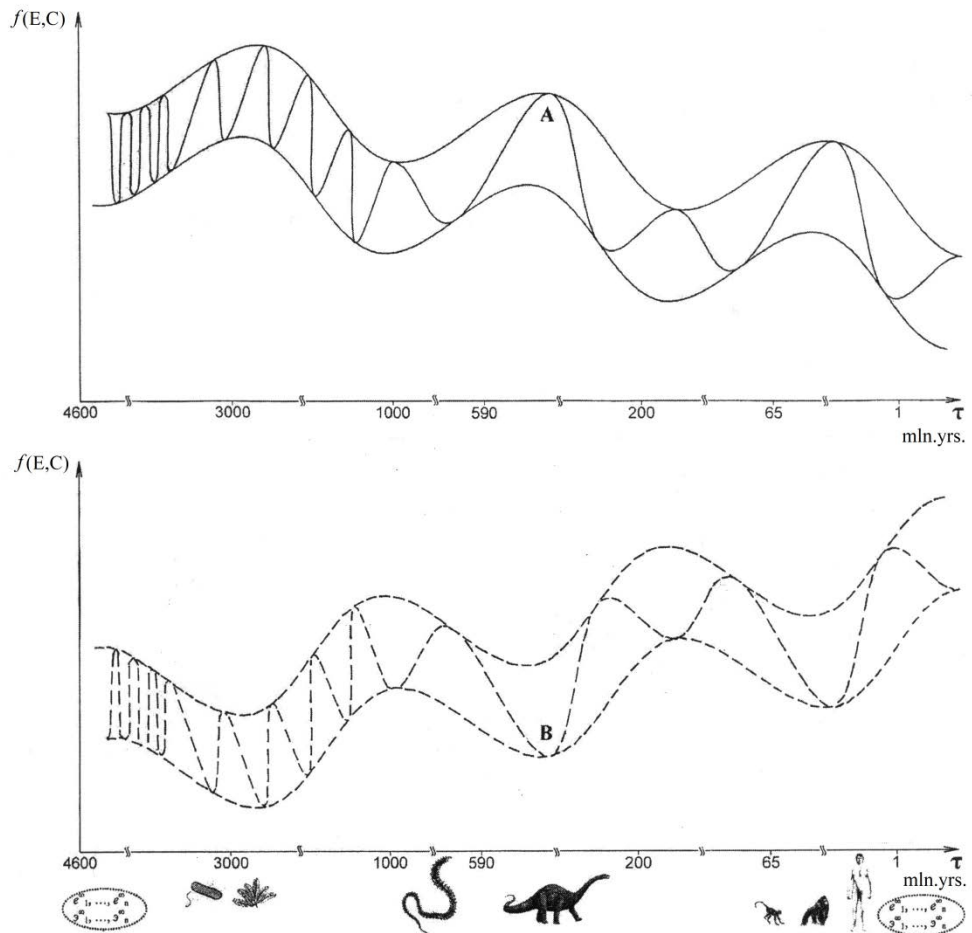


Fig. 6. Changing of the function of energy-element-informational state $\Delta f(E,C,I)$ of the Earth (A) and biosystems (B)

A “dramatic failure” (for example, sudden change of the speed of the Earth’s rotation at its collision with a large space body) in the natural mechanical motion of the Earth – the Sun – the Galaxy physical system on

any part of the “spiral on a spiral, on a spiral” trajectory can cause a disruption of coherence of oscillations of the energy-element-informational functions of biosystem and the Universe and result in the death of all or some of the biological systems existing at the moment of collision and organization of new biosystems meeting new requirements of coherence (Fig. 6).

3. Model of Life (Energy-Element-Informational)

In the practice of materials science to describe the state of an isolated physical system the scientists use the diagrams (Fig. 7) of element, energy – properties that are discrete in time. In this case it is possible to consider the state-property relationship both in each given point in time and throughout the a-B-d path.

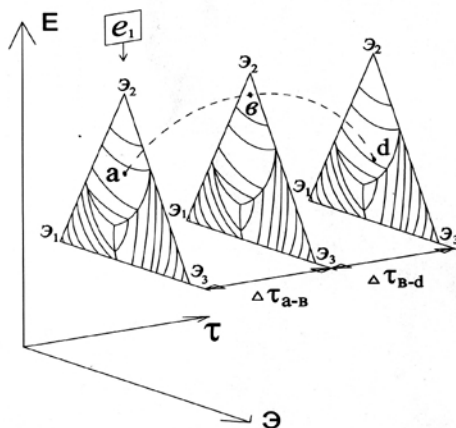


Fig.7. Diagrams of change of the energy-element state of a physical system, coordinates E-C- τ

When plotting diagrams of biosystems, the information content should be taken into consideration (Bobukh, 2009). A diagram shown in Fig. 8 plotted in E-C-I coordinates for biogenic elements H,C,O,N,P can serve as a tool for study of the energy-element-informational properties of prior-to-DNA, DNA structures, principles of cell, organism formation.

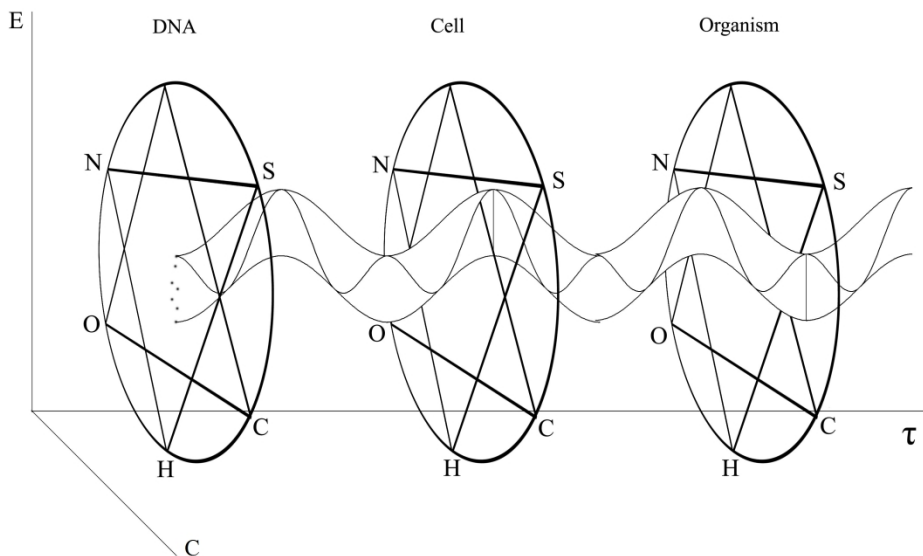


Fig.8. Diagrams of change of the energy-element-informational state of a biological system, coordinates E-C-I(τ)

Processes of organization and functioning of the energy-element-informational unity as a living system (biosystem) are the continuous time processes.

Such processes of continuous transition of an open biological system from one energy-element-informational state into another may be described (Bobukh, 2012b) with the help of a kinetic diagram (Fig. 9).

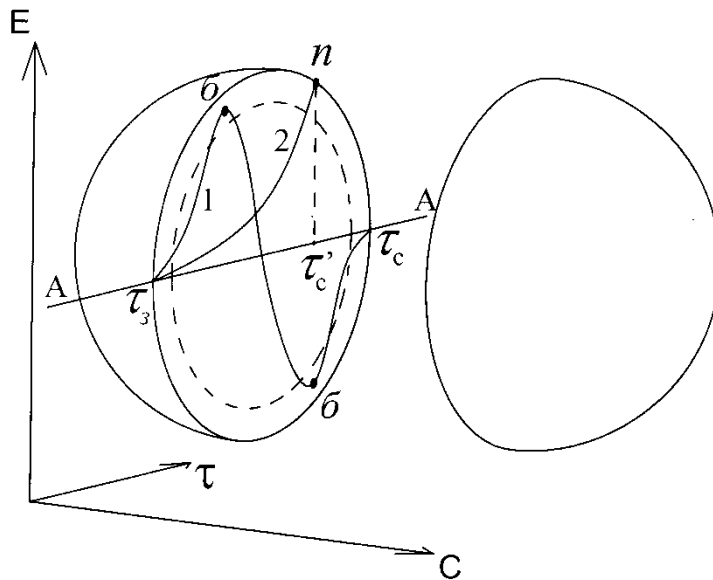


Fig. 9. Model of life of a biological system in the energy-element-informational space; A-A is a line of the energy-element-informational equilibrium; τ is a lifetime of the biosystem from birth (3) to death (c)

The model of life (Fig. 9) is part of the energy-element-informational space within which the natural processes of fluctuation of $f(E, C, I)$ relative to the A-A equilibrium line take place. The graph above shows the passage of the $f(E, C, I)$ value through a maximum over $t_3 \div t_c$ period of time from birth (coming into existence) to death.

Technical definition: Life is motion $v = \frac{\Delta f(E, C, I)}{\tau}$, a change of the energy-element-informational function $f(E, C, I)_{\text{of biosystem}}$ in the form of oscillations relative to an equilibrium state; a value of the amplitude of oscillations changes and, throughout the lifetime of the biosystem, passes through a maximum; the biosystem equilibrium state changes in accordance with changes in the equilibrium trajectory of the Earth as it moves in the energy-element-informational space of the Universe following the “spiral on a spiral, on a spiral” path ...».

The surface on which the point of diversion of $f(E, C, I)$ from the equilibrium state limits (rotation figures of Fig.10: ellipsoid, sphere, egg) the energy-element-informational (*en-el-info*) space in which the Universe organizes life.

Values of time $\tau_3 \div \tau_c$ and volume V_f (E,C,I) of existence of a biosystem can serve as a technical quantitative and qualitative characteristic of its life.

$f(E,C,I)$

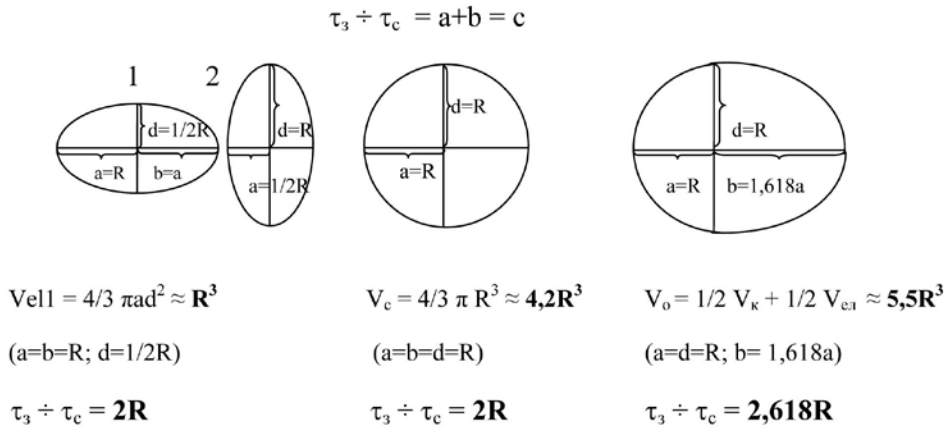


Fig. 10. Models of life (ellipse, sphere, egg) and values of quantitative and qualitative characteristic of life (time $\tau_3 \div \tau_c$, volume V_f (E,C,I))

Figures in the form of ellipses 1 and 2 have equal volumes $V_{e1} = V_{e2} = R^3$, wherein $(\tau_3 \div \tau_c)_1 = 2R$; $(\tau_3 \div \tau_c)_2 = R$. The values of volume and time are as follows: within the sphere $V_{III} = 4,2 R^3$; $\tau_3 \div \tau_c = 2 R$; within the egg $V_{IV} = 5,5 R^3$; $\tau_3 \div \tau_c = 2,618R$.

Comparative analysis of time and volume of change of $f(E,C,I)$ in the en-el-info space shows that it is the egg that has an optimal ratio and the largest values of the quantitative and qualitative characteristic of life ($\tau_3 \div \tau_c$, V_f (E,C,I)).

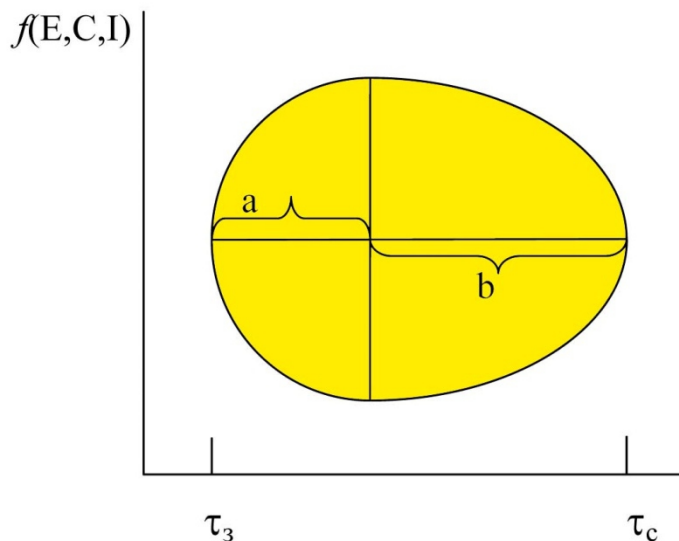


Fig.11. The “Golden Egg” of Life

The golden ratio has been recognized a universal law of living systems. Therefore the laws of the golden proportion were used to make mathematical calculations needed to produce a figure of an egg and its geometrical representation. The golden ratio is a proportional division of a line into unequal parts wherein the smaller segment refers to the bigger one as the bigger one to all $a : b = b : c$. The segments of the golden proportion are expressed as an infinite irrational fraction 0,618... if “c” is taken as 1, $a = 0,382$; ($c : b = b : a = 0,382$; $b = 1,618a$). Numbers 0,618 and 0,382 are the coefficients of the Fibonacci sequence.

Fig. 12 shows en-el-info models of life of biosystems 1 and 2. Both systems were born (came into existence) at the same time $\tau_{31} = \tau_{32}$. The lifetime of system 2 is longer than the lifetime of system 1; $\tau_{32} \div \tau_{c2} > \tau_{31} \div \tau_{c1}$. The volume of “development” of the en-el-info space by system 2 is bigger than that of by system 1; $V_{f(E,\exists,I)2} > V_{f(E,C,I)1}$.

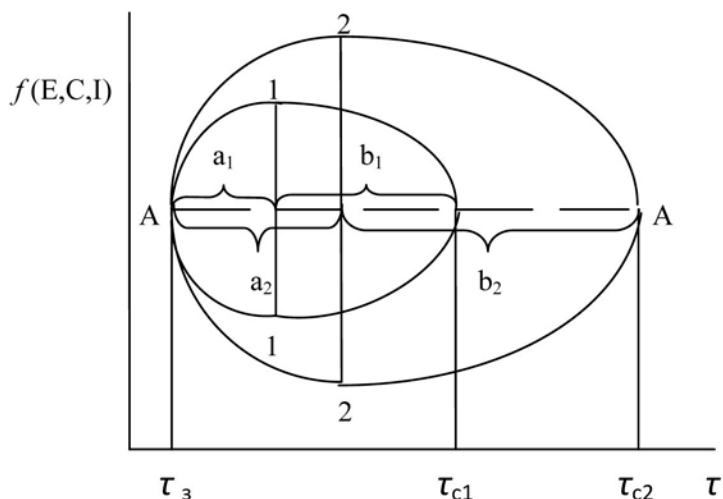


Fig. 12. Energy-element-informational model (egg) of life of biosystems 1 and 2;
 τ_3 – time of birth (coming into existence), τ_c – time of death

Comparative graphical analysis of models 1 and 2 shows that the more vigorously the value of $f(E,C,I)$ increases in the initial period of organization and functioning of the biosystem (from the moment of its birth τ_3 to achieving maximum values of $f(E,C,I)_{1-1}$,

$f(E,C,I)_{2-2}$) the larger the value of segment a ($a_2 > a_1$) will be and, as a natural result of the golden ratio principle, the value of length c ($c_2 > c_1$) and volume of life increases.

Man, as a biosystem endowed with brain, being aware of the regularities of natural en-el-info processes, has the ability to artificially influence the amount and quality of his life by purposefully changing the value of $f(E,C,I)$.

The following calculations

- 1) $a = 22,9$ $b = 37,1$ $c = 60$;
- 2) $a = 38,2$ $b = 61,8$ $c = 100$,

made using an egg as a model of life show that if the maximum of increase in the value of $f(E,C,I)$ is reached at the age of 22.9, then the total length of life is 60 years; if the maximum of increase in the value of $f(E,C,I)$ is reached at the age of 38.2, then the total length of life will probably reach 100 years.

The total length of time of living of a person who purposefully, actively increases the value of his/her energy-element-informational unity $f(E,C,I)$ of the biosystem, for example, with other conditions being equal, ***due to growth of the information content*** (studies, education) ***will be large***.

Director of the Institute of Human Brain of RAS S. Medvedev said: Active creative work of the brain increases our lifespan. For example, the

process of creation awakens the brain regions important for the person's emotional activity, including those in hypothalamic structures affecting the endocrine system which is directly connected with the aging processes. Solving of supertasks can cause formation of new connections and generation of new neurons, nerve cells, in the brain of even an elderly person. Length of life of people who throughout their lives have to constantly use their heads is significantly higher compared with those whose brains do not experience any severe stresses. [You Need to Work with Your Head. Komsomolskaya Pravda in Ukraine, January 14-20, 2009.]

*Director of the Russian Gerontological Research Center V. Shabalin said: In the Stone Age the average duration of life was 18-20 years. In the Middle Ages it was about 30-40 years. It was only in the late XIX century when the people continued to live to 35 years of age in average, by the end of the XX century the average length of life increased to 70-75 years. That is only in the last century - incredibly fast! - we have begun to live twice as long. **We are that information base** that allows our descendants to move up to a higher level. [The Smart Will Live Up to 150 Years Old and the Lazy Will Become Extinct. Komsomolskaya Pravda in Ukraine. October 9-15, 2009.]*

4. Multidisciplinary System Research

The established and described above laws made it possible to present a qualitative picture of organization of life of the Universe (Fig. 13).

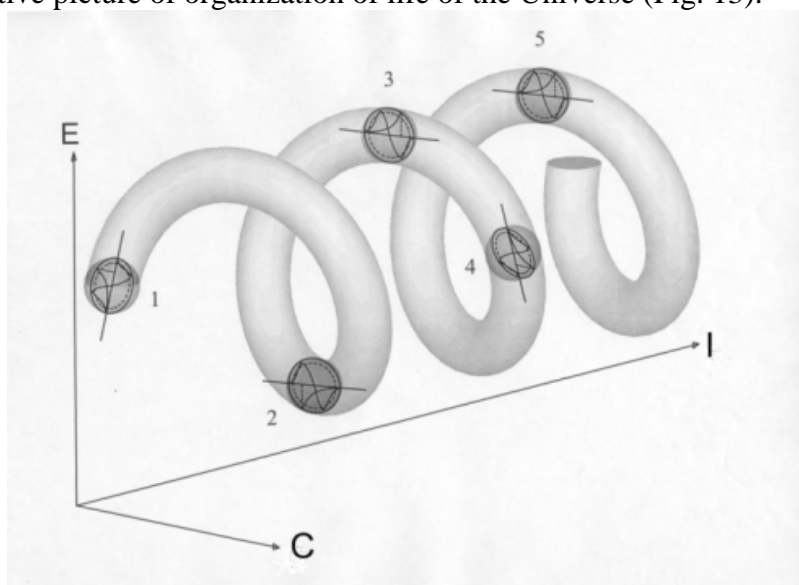


Fig.13. Cyclic change of the function of state $f(E,C,I)$ of the Universe and biosystems 1-5, aligning their equilibrium according to the change of energy-element-informational characteristics of the Universe

Figure 13 shows the cyclic change of energy-element-informational characteristics of the environment occurring during the time that is commensurable with the duration of the existence of successive generations of biosystems. In this case we should talk about alignment of the equilibrium state in each of the generations with a gradual transition from the energy-element-informational properties inherent in system 1 to the energy-element-informational properties inherent in systems 2, 3, 4 and 5 by means of alternation of generations in harmony with changing characteristics of the environment.

A variety of shapes and properties of the wildlife systems is attributable to the variety of possible options for energy-element (H, C, O, N, P, S, Si)-informational conjugations formed and functioning under various constantly changing energy-element-informational conditions of the environment.

We may say that a qualitative picture of life has been drawn. To perform systemic work on quantitative specification of the picture of life it is necessary to unite the efforts of physicists, chemists, materials scientists, biologists, computer scientists, planetary scientists and astronomers within the multidisciplinary project "*Life. Motion of Energy-Element-Informational Unity of the Matter*".

Foremost objectives of the Project:

- study of patterns of change of the energy-element-***informational*** unity in the periodic table;
- plotting of discrete diagrams of energy-element-informational state-property of ***helical structures*** on the basis of elements H, C, O, N, P, S, Si (prior-to-DNA structures; physical systems)
- establishment of laws of ***the process*** of change of the energy-element-informational state and hence the properties of systems on the basis of biogenic elements H, C, O, N, P, S, Si (helical DNA structure, cell, organism, biosystems);
- ***modeling***, mathematical specification of the equation of Life, a natural energy – element - informational cyclic process of formation, development and evolution of spiral structures of H, p-elements in the past, present and future lifetime of the Universe.

Conclusions

The important role of *information* as an integral part (along with the matter and energy) of the characteristics of systems, qualitative and quantitative indicators of which *should be considered* to fully cognize and describe the properties of material systems, *biological systems in particular*, has been shown.

A concept of the energy-element-informational function of state f (E,C,I) of the matter (nano-mega level) has been developed (the same for both physical and biological systems).

The regularities of Life have been established and a possibility of modeling of Life as a natural phenomenon organized by moving in space and time energy-element-informational triunity of the Universe has been opened.

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