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AD DISPUTANDUM: THE MOST TOPICAL SCIENTIFIC IDEAS THAT WERE HIGHLIGHTED IN TIME OF CORONAVIRUS PANDEMIC

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Formation of a proper worldview has the utmost importance for the humanity (literally being a matter of life and death).

J. L. Synge [1, p. 31]

INTRODUCTION

Much to our regret, the dominant scientific view of the Nature around us and its life worryingly disagrees with the objective reality. If this were not the case, such an uncontrollable pandemic would not have arisen and, by and large, the situation on the planet would be different in every way, while J. L. Synge's words in the epigraph to our article, which he said half a century ago, would be outdated.

Let us remember that the history of science development shows that meaningful and truly fundamental discoveries that are the driving force behind human understanding of the reality around us, are intrinsically interconnected with ***a proper worldview of researchers***. For discoveries are made under the influence of worldview. No *purposeful activity is possible in isolation from a person's worldview*. Just a reminder: a worldview is a set of the person's ideas about their place in the system of objective reality; they are a general expression of the person's attitude to the world and the world's attitude to the person [2].

Unfortunately, while last century saw our country pay due attention to worldview altogether with philosophy and methodology, which are naturally connected with the former [1], we *currently have to admit inexcusable alienation of natural sciences, and first of all physics, from philosophy and fundamental methodology.*

Overall, the worldview of most scientists leaves room for improvement. The hard evidence of this is in fact their disregard of the situation on the planet — when technical advances, pragmatic achievements, and latest technologies in all spheres of human activities comfortably go with an inclination to do without understanding of the principles of how the world works in general, where Earth and mankind belong and what roles they play in it. This is why *they study not the real world itself but its separate models (not so much checked but rather adjusted), basically looking for questions to the existing answers*. For instance, high-cost experimental facilities are built as if to check a model used; finally, a desired outcome is announced and then... a deafening silence about any new results or further new endeavors. The eminent theoretical physicist of the 20th century J. L. Synge referred to such a style of scientific research as a mental disease and called it Pygmalion syndrome [1].

Thus, the grave danger for the humanity lies in the fact that *the dominant science knows too little about global (planetary and cosmic) interconnections* and, serving immediate (more mercenary than scientific!) interests of people, does not *imply the massiveness of consequences initiated by its performance.*

We have to acknowledge that although catastrophic ecological state of our planet as a result of anthropological activities (including those in the nearest space) are evident, state policies of technically advanced countries remain virtually unchanged. For example, hotheads in the USA, trying to invade planet Mars to serve their interests (apparently, primarily for space military superiority), are ready to sanction nuclear explosions on Mars.

[1] All significant scientific research institutes were bound to hold so-called director philosophical-methodological seminars.

We have to give a warning here: in light of the concept where planets in the solar system form a single mechanism (Earth being the only Planet of Life), with all its peculiarities, laws and global interconnections, nourishing ideas of nuclear bombardment of Mars is nothing but the last step towards the launch of the tidal wave of irreversible planetary processes, which may lead to the destruction of Life itself.

This is why the authors consider it their scientific duty to present in this article briefly but accessibly and in detail the key results of the vast research relating to: (1) a really correct mathematical model of objective reality (chapter 1), (2) a physical mechanism of global, terrestrial and cosmic interrelations (chapter 2) and (3) planet Earth as a superorganism — a representative of special form of cosmic life (chapter 3).

This research is associated with the prominent physicists of the last century: H. Minkowski, A. A. Friedmann, A. N. Kozyrev (who was supported by scientists with worldwide reputation, such as A. D. Alexandrov, V. A. Ambartsumian, N. N. Bogolyubov, L. S. Pontryagin, and L. I. Sedov), J. L. Synge and G. J. Whitrow, as well as highly respected soviet biologist V. N. Beklemishev and paleontologist B. S. Sokolov, whose ideas and works were followed and developed by the authors of the article.

1. THE WORLD OF MINKOWSKI — A CORRECT MATHEMATICAL MODEL OF PHYSICAL REALITY

The circumstances that fueled coronavirus pandemic somehow raise questions about correctness of dominant scientific views of Nature and its life. These views depend primarily on how proper the ideas about space and time are. People were keen to get to their heart at all times. Unfortunately, historically time as an aspect of objective reality was eliminated at a certain stage of development of STEM disciplines. This resulted from Newtonian mechanics notion, where to solve an array of problems it was acceptable to disregard the internal state of objects under study and consider them as being in the same internal state ("centers of mass"). A thorough analysis of this vital turn concerning time is presented in "The Natural Philosophy of Time", G. J. Whitrow's fundamental work [3]. In other words, the essence of time as an aspect of objective reality was emasculated: a highly essential scientific category of natural sciences was reduced to a parameter in equations in mathematical physics — "time" was equated to "continuance" as defined by Newton [4, p. 30]. Hence, research of *physical properties and particular qualities of time was out of question.*

Objective reality of time re-emerged in 1908 in the renowned report "Space and Time" by H. Minkowski [5]. He immediately made it clear that this was a new Way for physics — that is to say, a revolutionary new conception of space and time, which undoubtedly would lead to dramatic advances. In this report, Minkowski does not define directly the status of time as an aspect of physical reality. Apparently, taking it for granted, he just pursues this point.

It should be pointed out that dialectical materialism depicts space and time as forms of matter existence. This means that time, being organically interconnected with space and making up with it four-dimensional space with single geometry — space-time, has its functional purpose in objective reality.

The core of time contents is fundamental information relating to special processes called informational in cybernetics. They are the key operating mechanism in controlling and developing complex dynamical systems, which are all the objects in objective reality, terrestrial and cosmic (see chapter 2). Thus, time must bear special, specific *physical* properties (and they must be zeroed in on!).

Unfortunately, a few months after his report Minkowski suddenly passed away. Although his work was widely used as a mathematical model of physical reality ("space-time", "World", "world of events") and was highly praised by Einstein himself, the new Way for

physics declared by Minkowski remained deserted. It was not until the early 1920s that A. A. Friedmann picked up Minkowski's mantle. In his monograph "The World as Space and Time" [6] he presented direct and solid elaboration of Minkowski's ideas. As a result of his analysis of space and time views, Friedmann brought up as top of mind the problem of restoring the unique position of time in physics based on causality.

Unfortunately, a sudden disease and death cut short Friedmann's efforts at the peak of his career. Again, the Way paved by Minkowski became empty. Only a quarter century later N. A. Kozyrev independently arrived to the problem of restoring the unique position of time in physics (resulting from his astrophysical research of nature of stellar energy). Friedmann's idea was used in his thirty-year focused research of physical properties of time aspect of objective reality, starting with introducing corresponding views of time and its physical properties into classical mechanics (see [7], and also [8], presenting all Kozyrev's research of time as an aspect of physical reality).

Historically, conception of time-space reality underwent unfounded change as a consequence of general relativity theory. Here, we have to refer to some facts relating to this theory that unfortunately are still ignored.

1. The formula for Mercury's perihelion advance, with which Einstein was credited, his theory being put on a pedestal of "true theory", was in fact determined long before by P. Gerber in his theory [9]. In his first talk, Einstein noted this formula as his version of Gerber's formula. However, later he never mentioned it again [10].

2. O. D. Jefimenko in his unified gravitation theory [10], where Newtonian theory is applied in case of moving or time-dependent gravitating systems, depicts insurmountable vulnerability of Einstein's version of Gerber's formula. It turned out that the current density $\mathbf{J}$ of mass is defined with the following formula: $\mathbf{J} = 4\rho\mathbf{v}$ (ρ — density, $\mathbf{v}$ — velocity), not the known formula $\mathbf{J} = \rho\mathbf{v}$, as it appears from general physics views on current [11].

Then, because physical (not "geometrized"!) light velocity value is introduced by Einstein when his theory combines with Poisson's equation of Newton's theory of gravitation in the limiting case (in order to derive the basic equation of general relativity theory) on the one hand, and because of the additional factor in the current formula on the other hand, quite different values for gravitation velocity with different ways of linearization are obtained [10, 11].

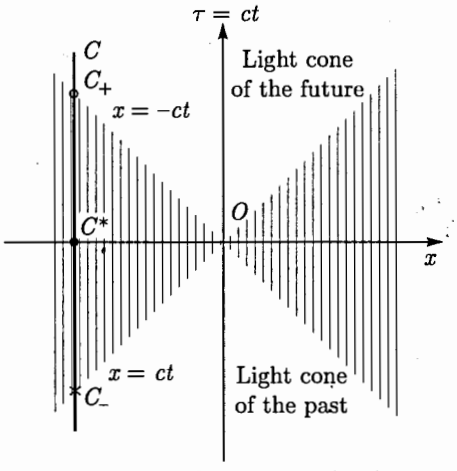
3. Finally, the main point is the real test with an experiment: research with the help of coherent excitation of relativistic nuclei in a crystal (Japanese research groups headed by K. Komaki, Yu. Yamazaki, and T. Azuma) provided high-precision support to the special theory of relativity about slowing down of relativistic "clock", while rendering negative verdict regarding general theory of relativity [12]. Such a conclusion was made based on the fact that no additional nuclei energy levels were registered in these quite precise measurements, nuclei being exposed to enormous acceleration inside the crystal target [13].

4. Minkowski World accounts for the landmark work — relativistic theory of gravitation of Vlasov–Logunov–Mestvirishvili [14].

Formally, if we speak about geometry correctness of Minkowski World, one should test with experiment a hypothesis directly related to the geometry given. Such an experimental test was conducted by N. A. Kozyrev [15] using a method of astronomical observations that he proposed. We will discuss this method [16, 17] in chapter 2, and here it would make sense to consider the special physical aspect of simultaneous events in space-time that is characteristic of Minkowski geometry. It was the aspect verified in numerous astronomical observations by Kozyrev.

Now then, let us examine the characteristic feature of Minkowski space-time: we will show that according to Minkowski geometry, three particular events connected with an observed star are simultaneous with the moment of observation. For this, we will look at plane section of a light cone (x, ct), see figure. Here, C is the world line of the observed star. On the celestial sphere of the observer, it is presented with the star's diurnal circle,

which is a projection of the four-dimensional world line onto the celestial sphere. Event O (see figure) at the top of the light cone is connected with the astronomical observation of the ground observer. Thus, coordinate time of the event equals the moment of observation.



Light cone plane section (x, τ)

It is a known fact that apparent position of a star (with accuracy to refraction for the moment of observation) coincides with its location at the moment when it radiated light that reached the Earth at the moment of observation t. This location presents a projection of four-dimensional event C_- onto the celestial sphere, the event being connected with the star and located at the light cone of the past; coordinate time of event C_- equals $t - R/c$, where R is geocentric distance of the star observed, and c is speed of light. Next, four-dimensional event C^*, coinciding with observation moment, respectively has coordinate time that equals t. Its projection onto the celestial sphere coincides with true (i.e. actual) star position at the moment of observation. Let us also remember four-dimensional event C_+, connected with the observed star and situated on the light cone of the future. It is symmetrical with event C_- relative to event C^*. Thus, it has coordinate time equal to $t + R/c$. Projection of this event onto the celestial sphere coincides with the star position in the future, when the light signal sent from the Earth at observation moment t reaches it.

In accordance with Minkowski geometry, not only event C^* is simultaneous with event O. Two other events are synchronous with it: C_- and C_+, connected with the observed star and situated on the light cone (see figure). The point is that zero interval $\Delta\tau$ of proper time τ specifying simultaneous events is defined with the formula

$$\Delta\tau = \Delta t \cdot \sqrt{1 - u^2/c^2}\,, \tag{1}$$

where u is velocity of the signal involved in the events under consideration. As we see, the obvious simultaneity of events O and C^* is defined with value Δt equal to zero. The simultaneity of events O and C_- and events O and C_+ is due to the fact that all these events are positioned on the light cone. Thus, the simultaneity of events O and C_- is due to zero value $\sqrt{1 - u^2/c^2}$, because $u = +c$ (C_- is on the light cone of the past); in case of O and C_+, $u = -c$ (C_+ is on the light cone of the future) and $\sqrt{1 - u^2/c^2}$ also has zero value.

Hence, with the help of observation method where a receiving system registers instantaneous association of simultaneous events (see chapter 2), we can check correctness of Minkowski geometry and make sure that there are indeed simultaneous events on the light cone. Registering certain response of ground sensor system to projections onto the celestial sphere of four-dimensional events C_- and C_+ upon scanning of diurnal arc of tens of stars and several star systems led Kozyrev to claim it as astronomical proof of Minkowski geometry [15].

Apart from providing support to Minkowski geometry, Kozyrev's astronomical observations confirmed Einstein's famous statement, *"It is not a space point and not a time moment when something happened that has physical reality, but only the event itself"* (i.e. space-time point) [18, p. 25]. An event with coordinate time $t - R/c$ for the moment of observation is already in the past, and the one with coordinate time $t + R/c$ is yet to come, i.e. is in the star's future. Note that the above-cited Einstein's statement was later verified with *Novosibirsk Solar experiment* [19, 20] too.

Thus, the time has come to make a conclusion that a correct mathematical model of physical reality is the space-time model suggested by Minkowski, as well as to turn to important and interesting predictions obtained with the help of relativistic gravitational theory (if we are really keen to learn how the world around us works, i. e. to have a proper worldview).

2. PHYSICAL MECHANISM OF THE GLOBAL INTERCONNECTION

As scientists were looking into the measurement procedure of time, i. e. duration between events, it appeared possible to get an idea of *the inherent interconnection of simultaneous events in space-time.*

The fact is that measurement of time differs from measurement of all other physical values — in order to measure time, one has to use some kind of an irreversible process. (Friedmann suggested [6] that the process used in the clock mechanism be called *basic.*) Naturally, the problem of choice of a *standard clock* arose, which was solved by Whitrow in the 1960s [3]. Whitrow shed light on the nature of a standard clock (which is a clock with an additive scale) and obtained a mathematical formula for the measured time value as a function of the key parameter of the basic process used in the clock mechanism. Most importantly, Whitrow proved this function to be the only one accurate to multiplicative constant, i. e. in most general form

$$t(i,j) = C_\lambda \cdot \varphi_\lambda(\tau_\lambda(i,j)), \tag{2}$$

where C_λ is a scale multiplier for basic process λ; $t(i,j))$ is a duration between events i and j; τ_λ is the key parameter of process λ; $\tau_\lambda(i,j)$ is the measurement of parameter τ_λ over time $t(i,j)$; φ_λ is a monotonic function of one variable, corresponding to process λ.

Uniqueness of function φ led one of the authors (I.E.) to an important conclusion [21] (see also [22]), which follows from the ideas of time universality, i. e. independence of the measured value of duration between events i and j from the mechanism $(\lambda, \mu, \nu, \ldots)$ of the standard clock measuring it.

Indeed, time universality and obvious uniqueness of function φ result in the following relation:

$$t(i,j) = C_\lambda \cdot \varphi_\lambda(\tau_\lambda(i,j)) = C_\mu \cdot \varphi_\mu(\tau_\mu(i,j)) = C_\nu \cdot \varphi_\nu(\tau_\nu(i,j)) = \ldots, \tag{3}$$

which means that all basic processes $\lambda, \mu, \nu, \ldots$ are performed ***consistently*** — there is ***a priori interconnection*** of their key characteristics $\tau_\lambda, \tau_\mu, \tau_\nu, \ldots$, not associated with the phenomenon of action ***"spreading in space"***, but stemming from ***their coexistence in time.*** An example of such an interconnection can be observed in a physical phenomenon behind the Pauli Exclusion Principle, well known in particle physics. In fact, the interrelation (3) reflects common, integrated performance ("proceeding") of basic processes in the time aspect of objective reality, which philosophy associates with the idea of one World process. According to (3), this interconnection comes from the time aspect and ties together events related to one moment in time. In other words, it looks like an immediate action, an action at a distance. This is the very connection that can:

1. Create a metric of space-time [22].

2. Be the reason for a unique phenomenon discovered and dedicatedly researched by Kozyrev, i. e. ***the phenomenon of distant stimulus of external irreversible processes to the state of matter of complex organized systems, to the extent of changing the properties of the matter as well as phenomena unfolding in it*** [7] (see also [8] and [23]).

The presence of such a distant interconnection in objective reality, the one that is not a force one, but at its core, initiating (informational), means that *all the world systems exist in the world's global ocean of interactions.* This initiating impact of external irreversible processes on the state of structured systems is characterized, as provided above, by plentiful

physical properties and special features agreeing with each other. They are discussed in detail in the monograph [23]. It also describes responses of numerous complex systems of various nature to the impact of external irreversible processes. Here, we will only show ***objective reality*** of the discussed *phenomenon of distant initiating impact of external irreversible processes on the state of the matter of structured systems*, which in its turn provides evidence of the objective reality of determining its a priori interconnection of simultaneous space-time events. In addition, we will conclude the discussion in support of Minkowski geometry, which was discussed earlier, in chapter 1.

The fact is that when studying properties of the discussed impact of an external irreversible process there was established a possibility to focus it on the observed system .with the help of a reflecting telescope. Hence, if a priori interconnection of key characteristics $\tau_\lambda, \tau_\mu, \tau_\nu, \ldots$ of basic processes $\lambda, \mu, \nu, \ldots$ pertaining to one moment in time is really objective reality, then upon directing the reflector towards the *true* (actual) location of the observed star [1], its irreversible processes must trigger change of the state of the material system situated in the focal plane of the reflector. For example, if a certain resistor is used as a sensor system, its key characteristic — resistance — must change. In this case, by measuring the right-ascension angular distance $\Delta\alpha$ between the visible stellar line and the telescope orientation, upon which the sensor responds, we can check if this orientation is the one aiming at *the true star location.*

Angular distance $\Delta\alpha$, relative to the Sun, i. e. $\Delta\alpha_\odot$, can be calculated using the formula for trigonometric parallax π of the star in arc seconds:

$$\pi = \frac{1 \text{ a. e.}}{1 \text{ year}} \frac{\mu_\alpha}{c\Delta\alpha_\odot}, \tag{4}$$

where μ_α is the star's right-ascension proper motion. Its value obtained in observations can be calculated with the formula

$$\Delta\alpha_\odot = \Delta\alpha - A_\alpha, \tag{5}$$

where A_α is the difference between the mid-position and the apparent position, displaced with regard to the mid-position as a consequence of annual aberration, nutation, proper motion and precession from the beginning of Bessel year.

It was value $\Delta\alpha_\odot$ calculated using formula (4) with the help of known data from the catalogue of trigonometric stellar parallaxes coinciding with the same value obtained using formula (5) based on observations of numerous different stars that gave Kozyrev reason to prove conclusively that the registered sensor response is the response to the ***true*** star position. In other words, he made a conclusion that instantaneous interconnection is physical reality and suggested a new ***direct*** method to derive trigonometric parallaxes of stars [16].

The method of astronomical observations suggested by Kozyrev offers exciting prospects for developing ideas about physical reality and unique interconnections of material systems. In addition, it raises the possibility to conduct challenging experiments studying the influence of cosmic processes on the existence and development of ground systems. That is why Kozyrev's observations were replicated by Novosibirsk group of researchers (initiated by the director of the Sobolev Institute of Mathematics, SB RAS, Academician M. M. Lavrentiev) [24] (see also [8, para. 4.2]) in the Crimean Astrophysical Observatory. Some time later astronomers of the Main Astronomical Observatory in Kyiv saw the same results in their observations [25].

Thus, with the help of astronomical observations it was scientifically proved that a priori interconnection of events in space-time associated with one moment is objective reality.

[1] Taking into consideration the fact that the discussed impact intrinsically does not experience refraction, the observations are carried out in meridian, where light refraction is virtually absent.

Amid preparations for these astronomical observations, the scientists confirmed the fact that the discussed impact is inherent in the *time* aspect of physical reality, because it was discovered that the refraction phenomenon for this impact, unlike light, is absent. This means absence of a material carrier of a priori interconnection of simultaneous events — *the "spread" of its action in space is missing.*

As stated above, this method of astronomical observations provides us with an opportunity to review our ideas about physical reality. For instance, it turned out possible to check the accuracy of Minkowski geometry. The point is that, as was shown in chapter 1, Minkowski geometry has a characteristic feature: it depicts two other events that are simultaneous with the moment of observation t: one with coordinate time $t - R/c$ (located on the light cone of the past, see chapter 1) and the other one with coordinate time $t + R/c$ (located on the light cone of the future). Therefore, registering a sensor response to the projections of these events onto the celestial sphere presents irrefutable evidence of objective reality of Minkowski geometry, which was discussed in chapter 1 [1]. Indeed, Kozyrev immediately noted these two responses of his sensor, which led him to make a conclusion about physical reality of Minkowski geometry [15].

Thus, let us formulate a robust epistemic conclusion: *all organized systems of objective reality exist in the world's ocean of interactions owing to irreversible processes.* No doubt, such an ocean plays a certain initiating role in emergence, existence and development of natural systems. This is why modern high-precision long-term experiments and technological processes [2] should take into account this ocean of interactions, monitoring its state through behavior of a corresponding reference system. As research based on the data obtained in a special multi-channel geophysical monitoring Dubna–Nauchny–Novosibirsk (see monograph [23]) has shown, a corresponding geological system (a mineral or a mineral aggregate) can be used as a reference system, as well as its key integral characteristic — mass.

Astronomical observations using Kozyrev's method present quite a promising new opportunity: it became possible to monitor the state of complex organized systems, including living ones, which exist under the influence of a cosmic object such as a star or a star system. This is why, while discussing two new extensive lines of focused research into physical qualities of properties of the time aspect of objective reality in the monograph [8], one of the authors (I.E.) managed to quite thoroughly define a range of complex studies based on observational data from astronomy, geology and biology (see [8, p. 217–222]).

Finally, we should note one more reason why gaining an insight into properties and phenomena associated with irreversible processes [3] is important and essential. It is arming physics with a way to supply natural sciences with a unified approach to studying the known general characteristics that are inherent in natural, especially living, systems. To be precise, integrity on the whole and sameness in origin inherent in the world, as well as its extraordinary efficient and propitious self-preservation (see [23, p. 23–24]).

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[1] It is necessary to mention that in observations of sensor response to the projection of the event associated with a star at the moment when it radiated light that reached the Earth at moment t, i.e. with coordinate time $t - R/c$, this projection coincides with the apparent star (if observations are conducted with virtual absence of refraction). Therefore, in order to settle the question about the influence of light radiation on the sensor, the observations were carried out with the telescope aperture covered with duralumin shield (which is "clear" for the discussed interconnection of simultaneous events).

[2] First and foremost, in experiments and technologies where complex, organized systems or non-stationary processes are involved, and where we see the known absence of exact reproduction of obtained results (especially in biology and medicine).

[3] We will note here that Kozyrev highlighted irreversible processes as a phenomenon associated with time direction twenty years before the appearance of famous ideas of I. Prigozhin about a "constructive role" of irreversible processes in emergence, existence and development of complex systems, about "time and complexity in physical sciences" (see, for example, [26]).

3. ON THE STATUS OF PLANET EARTH

This chapter appeared for the following reasons. In order to make physics serve as a truly theoretical basis for all modern natural science (as commonly cited), physicists must be quite informed about fundamental ideas of natural sciences. Such knowledge not only expands the horizons of researchers but also arms them with necessary creativity. A clear illustration of this could be theoretical research by Kozyrev, who drew on the views of natural science about causality and time when he laid the groundwork for causal or asymmetric mechanics, which completed classical mechanics, where such ideas were missing [1].

In this chapter, we will talk about the fundamental ideas of natural science regarding the status of our planet. These ideas are of enormous importance in providing a prosperous future for planet Earth. Being accurate, they will develop the proper attitude to any activity on the planet (first of all it refers to colossal exploitation of natural resources and using electromagnetic radiation). Being incorrect, they will provide erroneous view of Earth and send the humanity down the road to self-destruction.

The previous chapter was devoted to the unique global interconnection of open organized structured systems whose physics has just started to develop [27]. As previously noted, in terms of its properties and phenomena this interconnection cannot remain uninvolved into emergence, existence and development of natural systems. Logically, it would be natural to suppose that biological systems with their widely known properties of autoregulation and adaptation, as well as extremely efficient and propitious self-preservation must be involved in the discussed global interconnection. V. M. Danchakov initiated the studies of response of the state of living systems to distant impact of external irreversible processes. His early basic research [28] showed that living systems are better equipped in "susceptibility" to the discussed global interconnection than non-living ones. This was categorically proved with an important result obtained by V. A. Gusev and N. I. Nejgel' (NPO "Vektor") in the course of preliminary biophysical studies before *the Solar experiment* [19, p. 99], where cells of *E. coli* microorganisms were used as a biological receiving system. This research revealed that while cells of *E. coli* microorganisms give reaction with all the known properties to an external irreversible process (the process of liquid nitrogen evaporation), completely identical experiments with bacteria viruses (*lambda* bacteriophage was used) did not point to their response to the impact. It is important to highlight the fact that with regard to matter organization, bacteria viruses are a completely different system: it contains DNA in *passive preserved* form, which is of great significance. Hence, comparative analysis of reaction of biological systems of different level of matter organization to a certain external irreversible process might contribute toward exploring and putting more clarity into the notion of *life*.

Thus, it makes sense for us to pay attention to fundamental ideas in natural science related to open structured systems, which is true about all natural systems.

Modern science defines life as a form of matter existence, taking into account the fact that in its potential it is the highest one in comparison to physical and chemical forms of existence. Life is considered to exist in a cell, where running physical and chemical processes bring into action metabolism and cell fission. It is believed that a living cell creates all the variety of living organisms through adaptation to the environment, whereas the core of the living matter is genetic information necessary for replication.

[1] The situation is described in detail in the article "Terra incognita discovered by N. A. Kozyrev"[8, p. 249–271].

Let us note here that questions about location and storage of the necessary genetic information, which demonstrates incredible (!) constancy in time [1], are far from being purely rhetorical in light of the unique properties and phenomena of the time aspect of physical reality discussed in chapters 1 and 2. In principle, working out the procedure of various non-living biological constructions converting into a living organism while going by the assumption that genetic information (as logic suggests!) must be stored in the time aspect of space-time [2], one can start "probing" the time aspect.

In fact, the notion of "life" is more or less precisely defined by naming the properties that make it different from non-life, because currently the essence of life is not unanimous (there are numerous definitions of this notion, many of which contradict each other). Overall, the majority of scientists agree that biological demonstration of life is defined by organization, metabolism, development, adaptation, response to stimuli and reproduction. It is essential to remember though that all revealed characteristic features and laws as applied to the notion of "life" are true to the extent of biological postulates and ideas developed for organisms existing solely on Earth. Their appearance and development are closely connected with the history of the planet development and are attributable to the specific features of physical-chemical processes in unique terrestrial conditions. For instance, analysis of multiple materials of various biological sciences in the work by N. Horowitz [29] brings us to the conclusion that *all terrestrial organisms are the same at the basic level* and *there is only one form of life*, whose birth is associated with planet Earth.

Today, there is virtually no doubt that the history of life (biosphere) and the history of Earth development are inseparable. It is fair to say that Earth is a planet of Life, populated by its abundant and diverse forms. However, Earth is not just the cradle of humanity and our habitat. Regarding its operation processes and its mode of existence, our planet fully fits the definition of one whole super-organism — it is living itself.

The idea of Earth being a self-sufficient single organism is actually not new. It came to the 20th century from the depths of classical antiquity (see review [30]).

Scientifically, the idea of Earth as a *single living organism* was first proved by the eminent soviet biologist V. N. Beklemishev. The concept of "Geomerida" was put forth and formulated in 1928, when Beklemishev was dealing with problems of individuality in biocenology and common principles of life [31, 32]. Guided by biological principles, he spotted in "living matter" ***biological integrity of ground vegetation on Earth as a high-order biosystem, developing in a very special way***. According to his concept, this "infinite, crawling around living world" presents an extremely complex, nonetheless integrated object reflecting the ultimate form of biocenosis. In the hierarchy of living beings, Beklemishev approached "understanding of organisms on all Earth as a single organism". *The essence of the concept about living Earth lies in the fact that* ***"it wasn't so much that parts aggregated into one whole, but rather that the whole in its evolution urged parts to build up"***. When the question arose as to how to name this Creature, he thought it appropriate to coin a scientific term "Geomerida". According to Geology dictionary [33], Geomerida is ground vegetation, the combination of Earth organisms.

A thorough analysis and evaluation of Geomerida concept can be found in the works by E. N. Mirzoyan [34] and [35], as well as A. A. Lyubishchev [36]. The key points of Geomerida concept were extensively reflected in the works by B. S. Sokolov [37, 38].

It should be noted that a massive surge of interest in the idea of living Earth occurred in the 1970s. A howling success in the west was the theory of the English scientist J. Lovelock, the so-called "Gaia hypothesis", which was embraced by the scientific

[1] In 2012, it became possible to revive the oldest plant to this date — narrow-leafed campion (*Silene stenophylla*) from the carnation family, whose seeds were extracted from the late Pleistocene — see: E. Naymark. Plant remaining in permafrost for 30 thousand years blooms — E-resource: https://elementy.ru/novosti_nauki/431769; and the articles published there.

[2] The fact that all organisms with no exceptions use identical genetic factors also supports the idea.

community as a radically new hypothesis of a model of our planet. In his research, its author drew from the idea that Earth must act and function as a super-organism consisting of the entirety of living creatures (including human beings) and their material shell. That being said, as S. N. Kirpotin stated [39], Lovelock's hypothesis is *planet-centered*, not *person-centered*, which means that from the viewpoint of "Gaia hypothesis", humanity might look "as an aberration, an acute illness, quickly spreading on account of other organisms and destruction of natural cycles. The human race is a kind of cancerous growth on the body of our planet".

From a certain, philosophical point of view, it is no wonder that not only biological oneness of ground vegetation of Earth is referred to, but also planet Earth itself fulfills the qualities of a living object. Besides, it constitutes a well-organized, intricately ordered system, whose main elements are the core and all the shells enfolding it — geospheres, where living matter is inseparable from its inert basis. The rock-mineral layer serves as a framework (a skeleton) and is a receptacle for living flesh. In a body of any animal, numerous heterogeneous microorganisms coexist (co-reside). Certain parasitic fauna forms inside or on the surface of the "owner" — in skin creases, fur and hair. Interrelations on Earth work the same way. Representatives of organic life are widely dispersed: they live in water, air, on and underneath the ground, at different altitudes and depths, enjoying all forms of symbiotic relationships. This is commensalism — "sharing a table", in which one organism feeds on the leftovers of another's meals without harming the latter; mutualism — mutually beneficial and interdependent co-residing; inquilinism — one organism uses another for permanent housing.

The planet is a *single system of consistent interaction among geospheres*. Its operation and self-regulation are provided by interactions among all ranks of geobiological factors. All global processes in geospheres (both separately and collectively) run closely interrelated with each other, like internal organs of a single living creature. The matter-energy exchange among geospheres reflects a form of planetary metabolism, running homeostasis-like fashion (for more detail, see [40]). It provides the system with the ability to self-regulate — to keep a relative stability of its internal state by means of well-coordinated responses in functional interconnection of all its geobiological elements (ranging from minerals and separate creatures to geospheres). Each one performs its function.

The view of cybernetics about organization within living systems was presented in 1962 in the report of one of the founders of cybernetics A. A. Lyapunov "About control systems of living nature and general understanding of life processes" (see [41]). The report stated that any manifestation of life can be translated into the language of science about controlling processes, i. e. cybernetics. Division of living matter into cells, organs, populations, species, etc. corresponds with the hierarchy of controlling systems. Regarding the concept of Geomerida (a high-order biosystem), its every structural subdivision is controlled by its own "*autonomous system, vigorously affecting everything subsidiary and in its turn subordinate to a slowly operating controlling system of a higher hierarchical unit*". The state of every matter (including living matter) can be characterized with a combination of physical-chemical parameters (mass, chemical composition, energy, electro- and magnetic potential, etc.). Lyapunov defines the notion "living matter" as "*bounded and homogeneous, relatively stable, having enhanced stability, producing preservation responses and possessing controlling systems*". Matter accepts information about external impact (physical-chemical signals), "processes" it and sends signals with renewed information via certain information channels. Lyapunov defined life as "*highly stable state of matter, which utilizes information coded by the state of individual molecules to evoke preservation responses*". In other words, when transmitting some energy and/or matter via certain channels, a controlling process triggers actions that lead to transformations of far larger amounts of energy and/or matter. This Lyapunov's principle of energy transformation was later developed and specified by L. N. Gall'. This is

the difference between living and non-living according to her, "Molecular system as part of living system utilizes and processes energy enhancing its quality, whereas in non-living system energy is not processed (even if it is utilized)" [42, p. 318].

There are numerous examples of transformation of incoming energy into higher-quality energy through close coexistence of organisms. For instance, herbivorous ruminants' (such as the cow) stomachs offer favorable conditions for feeding, growth and reproduction of microorganisms' population. These microorganisms, in their turn, provide the cow with the ability to ingest complex carbohydrates (cellulose) and non-protein nitrogen-containing substances. In fact, their population functions as a self-sustained internal organ in the chain of the cow's digestive tract. Thanks to such coexistence (symbiosis), highly nutritious products are produced — milk, meat.

Earth as living Geomerida fully meets all the criteria highlighted by Lyapunov and Gall'. The entirety of living nature seems to be the crucially important characteristic of the state of the planet. Biological integrity of continually functioning living ground cover of Earth is intrinsically a symbiosis of planetary scale, providing transformation of incoming energy into higher-quality energy. Cosmologically, the Earth is an unusual material system producing matter of higher quality at every stage of its evolutionary development. It creates existence conditions and provides them to all terrestrial creatures. Therefore, Geomerida can be truly considered a life-giving system, all its parameters fitting the description of a super-organism, which can generate living matter. Finally, Earth is in fact an incubator with a smoothly running process of production of living matter — the thinking matter. Emergence of the human being — the carrier of Reason energy — became its ultimate product at the present stage of evolution. Thinking matter gifted with Reason meets its highest standards.

In conclusion, we should highlight another important feature distinguishing a subject from a non-living object. This is primarily a possibility of an organism to take care of its self-preservation independently. Living beings operate a reasoning mechanism, capable of hazard recognition as well as identifying favorable situations.

This brief review of contemporary ideas about the status of Earth through the lens of the mechanism of global interconnection, which was thoroughly addressed in chapter 2, bears convincing evidence of undeniable fairness of warnings issued by the authors in the introduction.

CONCLUSIONS

Let us remember an apparent unwritten rule: when introducing a scientific idea (or when rejecting one that is already used successfully, as it happened with Minkowski's space-time), one must obtain a proper direct experimental evidence of the correctness of the taken step. Disconcertingly, this seemingly obvious rule is not always followed. In particular, when rejecting Minkowski's idea of space-time, this rule was ignored. Thus, to have a clear illustration here, let us summarize the direct experimental results considered above, which fully supported the scientific ideas discussed in chapters 2 and 3.

1. Einstein's statement about reality of space-time events was proved.
2. The reality of Minkowski space-time geometry was proved.
3. The reality of a priori interconnection of space-time simultaneous events was proved.
4. The absence of a material carrier of the discussed a priori interconnection (i. e. *absence of its action spreading in space*) was proved.
5. The reality of instant interconnection was proved.

Truly correct scientific ideas are marked by immediate appearance of notably new lines of research, because they open the door for new observational and experimental opportunities. Such breakthrough observational and experimental opportunities are made available thanks to the method of observations suggested by Kozyrev. It climaxed his multi-year research of physical properties of the phenomenon of distant impact of external

irreversible processes on the state of matter of complex organized systems (see chapter 2). Kozyrev authored three works dealing directly with the new method of astronomical observations: on the method itself [16], on the reality of Minkowski geometry [15], and on several properties of the time aspect [17] — unfortunately, he suddenly got ill and had an unexpected death.

In summary, we will name the advantages of the astronomical method of observations suggested by Kozyrev based on the immediate interconnection of simultaneous space-time events. This method provides an opportunity:

1. To receive information about the state of a space object unattainable with any other observational method. This information is associated with three different times: this object's past, its present and its future (see chapter 1 and Kozyrev's work [17]).

2. To spot space anomalies that were not registered with the help of other observational methods. For example, first exploratory scanning of diurnal arc of Hamal star (α Arietis), starting in the constellation of Aries and ending in the constellation of Leo, with two detectors (located in different receiving systems) registered new (impossible to register with other methods of astrophysical observations) large-scale anomalies (see [43]).

3. To explore the impact of star processes in various star systems on the state of matter, including living systems.

4. To explore such an immaterial object as four-dimensional event (see results of the *Solar experiment* presented in monograph [19, 20]).

5. To follow the behavior pattern of the state of the systems of different nature (including living systems) that are under the influence of just one specific cosmic object.

6. To give instruments to communicate to a complex organized system a new (unusual for it) internal state (see results of the *Solar experiment* presented in monograph [19, 20]).

7. To develop an approach to studying the mechanism of immediate interconnection of simultaneous space-time events for its practical use.

In conclusion, we will state here three large complex lines of research that are of great current interest, which lie in the foreseeable future of exploring the ideas considered in chapters 1 and 2:

1. Using the opportunity to monitor the state of the ocean of interactions discussed in chapter 3 with the help of a reference system, for which a certain mineral or a mineral aggregate is used (see chapter 2).

2. Using a reference system as an instrument to study the reasons for the known absence of exact reproduction of results obtained in experiments and technologies involving complex organized systems or non-stationary processes.

3. Study of development of the living system existing under the influence of a cosmic object such as a star or a star system.

It is no exaggeration to say that the above scientific prospects ripened after two historical milestones. Firstly, it is Kozyrev's thirty-year focused research of properties and phenomena of time as an active aspect of physical reality. (We should say here, the long list of Kozyrev's discoveries and achievements given in monograph [8, p. 268–269] is highly impressive.) Secondly, it is the thirty-five-year research by I. A. Eganova with co-authors (with the assistance of and input from Academician M. M. Lavrentyev) — this research is documented in monographs [44, 8, 19, 20, 23] and corresponding articles quoted there. We will note that the mentioned publications in full text are available at http://nkozyrev.ru/.

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