

A joint solution of equations (IX) and (XII) gives us, as it is well known, a transverse wave with the density of energy flow equal to:

$$\vec{P}_\perp = [\vec{E} \times \vec{H}];$$

A joint solution of equations (X) and (XI) gives a longitudinal wave with the density of energy flow equal to:

$$\vec{P}_\parallel = \frac{1}{2} [c^2 \rho \cdot \vec{A} + \varphi \cdot \vec{j}];$$

As distinct from the emitters of transverse waves (dipoles of the cylindrical symmetry) the emitters of longitudinal waves should have spherical symmetry, i.e. to be the monopoles.

During the analysis of the known physical fields we can see that most of them show themselves in a small volume near the sources, i.e. nuclear field, field of weak interaction, electrostatic field (which is compensated by the fields of charges of other sign) and magnetostatic field, though the latter can spread for the distances similar to the size of Galaxy. However, electromagnetic

waves and gravitational field are really long-distance fields. At the same time both fields decrease according to the analogous law: inversely to the square of distance.

All this gives us a thought that the gravitational field can be undulatory just as the electromagnetic field. But unlike the latter it is some other class of waves, i.e. longitudinal, but not transverse. The penetrability of these waves should be very high. Admittedly, telecommunication by these waves can be made through the entire globe.

We can suppose that typically wave phenomena should be observed in gravitational field, i.e. diffraction and interference.

Material on this question was stated by the author in detail in 1991 in the article "Symmetrization of the Maxwell-Lorentz equations" in collected articles "Problems of space and time in modern natural science", part 15, Academy of Science, Russian Federation, Leningrad, 1991.

Table 1

		Statics in time		Dynamics in time			
Intensity of fields		$\vec{E} = \vec{V} \times \vec{B} \quad (\text{I})$	$\nabla \times \vec{E} = 0 \quad (\text{V})$	$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \quad (\text{IX})$		Scalar products	Vectorial products
	Sources of fields		$\nabla \cdot \vec{D} = \rho \quad (\text{VI})$				
		$\rho = -\frac{1}{c^2} \vec{V} \cdot \vec{j} \quad (\text{II})$		$? \quad (\text{X})$			
			Equations of connection				
		$\vec{J} = -\vec{V} \cdot \rho \quad (\text{III})$		$\nabla \cdot \vec{j} = -\frac{\partial \rho}{\partial t} \quad (\text{XI})$			
			$\nabla \cdot \vec{B} = 0 \quad (\text{VII})$				
		$\vec{H} = -\vec{V} \times \vec{D} \quad (\text{IV})$	$\nabla \times \vec{H} = \vec{j} \quad (\text{VIII})$	$\nabla \times \vec{H} = \frac{\partial \vec{D}}{\partial t} \quad (\text{XII})$			
		Dynamics in space	Statics in space				

Time is a Physical Substance

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One hundred years ago in 1889 Russian physicist I.O. Yarkovsky suggested a thought [7] that attraction of bodies to the Earth is stipulated by inflow of ether in it, which is partially transformed into substance in bowels of the Earth. This thought showed a possible way to overcome the problem of warming-up of the Earth by particles falling on it. J. Maxwell wrote about it when he considered the hypothesis by Lesaje, which explained the gravitational interaction by the pressure of flow of "extraworld corpuscles".

An important consequence about the continuous growth of the Earth's mass followed from the hypothesis by I.O. Yarkovsky that found its confirmation in further development of Earth science.

It was showed in works by I.V. Kirillov [2-4] that 250-350 millions years ago all continents closed up without any space on the surface of the globe of two time smaller diameter. There is also a consequence from his works that gravity in this epoch was two time lower than today.

L.S. Smirnov and Ju.N. Lubina [6] paid their attention to the fact that in ancient sediments natural angles of slope of sands in aqueous medium greatly exceed modern ones. They worked several thousands of their measurements and data from literature and found that

gravity on the surface of the Earth grew in several times during last 1,5 billion years.

Taking into account the simultaneous two time growth of gravity and radius of the Earth we naturally come to a conclusion that mass of the Earth grew in 8 times during 250-350 millions years. A hypothesis by P. Dirac that the cause of swelling of the Earth is a decrease of value of gravitational constant should be rejected since it is not true.

Let's show that average density of the Earth during the period of 250-300 millions years practically didn't change. Acceleration of free fall on the surface of the Earth can be found by the formula:

$$g = \frac{\gamma M}{R^2} = \frac{\gamma}{R^2} \cdot \frac{4}{3} \pi \rho R^3 = \frac{4}{3} \pi \rho \gamma R \quad (1)$$

where g is an acceleration of free fall,
 γ is a gravitation constant,
 M , ρ , R are the mass, density and radius of the Earth.

Let's find the density of the Earth from this formula:

$$\rho = \frac{3g}{4\pi\gamma R}; \quad (2)$$

From this formula we can see that simultaneous growth of acceleration of free fall and radius of the Earth in two times, taken place in the period of 250-300 years don't affect the value of its density.

Let's consider possible parameters, which define the growth of mass of the Earth, on the assumption of the hypothesis by I.O. Yarkovsky. Let's regard that the density of energy flow, which flows into nuclei of atoms from outside, is defined by the density of energy of gravitational field on the surface of nuclei, and let's take the speed of movement of the flow equal to the speed of light:

$$\omega = \frac{G^2}{8\pi}; \quad (3)$$

where G is the tension of gravitational field, which in its turn is equal to:

$$G_n = \frac{\sqrt{\gamma m_n}}{R_n^2}; \quad (4)$$

where m_n and R_n are the mass and radius of nucleus. It follows that the density of gravitational energy will be equal to:

$$\omega = \frac{\gamma m_n^2}{8\pi R_n^4}; \quad (5)$$

The value of the flow of gravitational energy, which flows into the nucleus, will be equal to:

$$\Delta W = \omega \cdot 4\pi R_n^2 \cdot c \cdot \Delta t; \quad (6)$$

where c is the speed of the flow, Δt is the time of its inflow. Taking into account the ratio of mass and energy:

$$mc^2 = W, \quad (7)$$

let's find the increment of the mass of nucleus during the time Δt taking into account the formula (5):

$$\Delta m_n = \frac{\Delta W}{c^2} = \frac{\omega}{c} \cdot 4\pi R_n^2 \cdot \Delta t = \frac{\gamma \cdot m_n^2 \cdot \Delta t}{2 \cdot R_n^2 \cdot c}; \quad (8)$$

Since densities of nuclei can be considered to be equal to each other, then:

$$R_n = R_N \cdot A^{1/3}; \quad (9)$$

where atomic weight is defined by the ratio between the mass of nucleus and nucleon:

$$A = \frac{m_n}{m_N}; \quad (10)$$

From formulas (8), (9) and (10) we will get:

$$\frac{\Delta m_n}{m_n} = \frac{\gamma \cdot m_N \cdot A^{1/3} \cdot \Delta t}{2 \cdot R_N^2 \cdot c}; \quad (11)$$

Changing the increments on differentials we will get:

$$\frac{dm_n}{m_n} = \delta_A \cdot dt; \quad (12)$$

$$\text{where } \delta_A = \delta_N \cdot A^{1/3}; \text{ and } \delta_N = \frac{\gamma \cdot m_N}{2 \cdot R_N^2 \cdot c}; \quad (13)$$

in which connection the value $\delta_N \sim m^{1/3}$, i.e. it changes very slowly. That's why to be simple we will consider it as a constant in the first approximation. Let's find the value δ_N :

$$\delta_N = \frac{6,67 \cdot 10^{-8} \cdot 1,6735 \cdot 10^{-24}}{2 \cdot (1,56 \cdot 10^{-13})^2 \cdot 3 \cdot 10^{10}} = 0,76445 \cdot 10^{-16} \text{ sec}^{-1};$$

Considering that the relative increase of the mass of the Earth is equal to the same increase for nuclei of atoms

$$\frac{dM}{M} = \delta_A \cdot dt \quad (14)$$

and solving this equation we will get:

$$M = M_0 \cdot \exp(\delta_A \cdot t); \quad (15)$$

Let's find the period of doubling of the Earth's mass:

$$2M_0 = M_0 \cdot \exp(\delta_A \cdot \tau_A); \quad \ln 2 = \delta_A \cdot \tau_A;$$

$$\tau_A = \frac{\ln 2}{\delta_A} = A^{-1/3} \cdot \frac{\ln 2}{\delta_N}.$$

Thus: $\tau_A = \tau_N \cdot A^{-1/3}. \quad (16)$

where $\tau_N = \frac{\ln^2}{\delta_N} \quad (17)$

is a period of doubling of mass of nucleon numerically equal to:

$$\tau = \frac{0,69315}{0,76445} \cdot 10^{16} = 0,9067 \cdot 10^{16} \text{ sec} = 287,33 \text{ mln. years}$$

Let's calculate the average value δ_{av} taking into account the elementary structure of Earth's substance on the basis of Brown's and Masset's data [1]. (See table 1).

Table 1

#	Element	n%	A	A ^{1/3}	A ^{1/3} (n%)/92
1	Oxygen	32.0	16	2.5198	0.87645
2	Iron	25.0	56	3.8258	1.03963
3	Silicon	14.5	28	3.0366	0.47858
4	Magnesium	12.5	24	2.8845	0.39191
5	Sulfur	8.0	32	3.1748	0.27608
	TOTAL:	92.0	-	-	3.06274

It follows from the table that $A_{av} = (3.06274)^3 \approx 28.73$; from this

$$\delta_{av} = \delta_N \cdot A_{av}^{1/3} = 0,76445 \cdot 10^{-16} \cdot 3,06274 = 2,3368 \cdot 10^{-16} \text{ sec}^{-1},$$

as well as

$$\tau_{av} = \tau_N \cdot A^{-1/3} = \frac{287,33}{3,06274} = 93,8 \text{ mln. years.}$$

On the assumption of that mass of the Earth increased in $\delta = 2^3$ times, let's find the time of its increase: $T = 3\tau_{av} = 93,8 \times 3 = 281,4$ mln years. The received figure keeps with the interval of 250-300 mln. years given in the works by Kirillov. Let's calculate the value δ_e for an electron with a supposition that its density is equal to the density of nucleon:

$$\delta_e = \delta_N \left(\frac{m_e}{m_N} \right)^{1/3} = 0,76445 \cdot 10^{-16} (1837,4)^{-1/3} = 6,24 \cdot 10^{-18} \text{ sec}^{-1}.$$

$$\tau_e = \frac{\ln 2}{\delta_e} = 3,52 \text{ billion years}$$

accordingly.

Let's suppose, that the mass of an electron also increases by exponential law:

$$m_e = m_{e0} \cdot \exp(\delta_e \cdot t); \quad (18)$$

with this, if m_e is the mass of an electron in the given moment of time, then m_{e0} is the mass of an electron in the moment of time, which is distant back on the value t . therefore,

$$m_{e0} = m_e \cdot \exp(-\delta_e \cdot t); \quad (19)$$

Then the energy of photon emitted by atom of hydrogen will depend on time in the following way:

$$E_{ph} = h_1 \cdot \omega = \frac{e^4 m_{e0}}{2h_1^2} \left(\frac{1}{n^2} - \frac{1}{k^2} \right) \quad (20)$$

where $h_1 = \frac{h}{2\pi}$ is a reduced Plank's constant, ω is a cyclic frequency, e is a charge of an electron, n, k are the main quantum numbers. From this the relative change of frequency will be equal to:

$$\frac{d\omega}{\omega} = \frac{dm_{e0}}{m_{e0}} = -\delta_e \cdot dt; \quad (21)$$

The passage time of the way dl by photon is equal to:

$$dt = \frac{dl}{c}; \quad (22)$$

From this:

$$\frac{d\omega}{\omega} = -\delta_e \cdot \frac{dl}{c}; \quad (23)$$

So, atom of hydrogen will emit two different photons in the interval of time of dt . These photons are different from each other by their frequency at the value of

$$d\omega = \omega \cdot \delta_e \cdot dt;$$

If we compare the photon, which came from the source situated on a distance of dl from us, with a laboratory photon, then the relative change of its frequency will be equal to:

$$\frac{d\omega}{\omega} = -\delta_e \cdot \frac{dl}{c}; \quad (24)$$

i.e. the farther the source of radiation is situated from us, the more its spectrum will be shifted in the direction of lower frequencies. E. Hubble discovered this phenomenon known as a «red shift» in 1929 and it is described by the formula:

$$\frac{d\lambda}{\lambda} = -\frac{d\omega}{\omega} = H \cdot \frac{dl}{c}; \quad (25)$$

where l is the wavelength,
 dl is a distance to the object of observation,
 H is Hubble's constant.

Now there is a following accepted value of Hubble's constant:

$$H = 75 \frac{km}{c \cdot MPC} = \frac{75 \cdot 10^3}{3,086 \cdot 10^{22}} = 2,4303 \cdot 10^{-18} \text{ sec}^{-1},$$

where 1 MPC is 1 megaparsec equal to $3,086 \cdot 10^{22} \text{ m}$.

However, the value of the constant found by Hubble himself was equal to 530 (km/sec MPC), then in 1952 Baade gave a value equal to 290 (km/sec MPC); later a value of 180 (km/sec MPC) was received, and at last the value, which is accepted now, is given in the limits of 50-100 (km/sec MPC). The value of Hubble's constant calculated by the formula (24) has a value of:

$$H = \delta_e = 6,24 \cdot 10^{-18} \text{ sec}^{-1} = 192,6 (\text{km} / \text{sec MPC})$$

i.e. it blends with the dispersion of values given by different authors [9] (see Table 2).

The result received by us is good to explain the "red shift" without using of the idea on extension of the Universe!

Table 2

#	Author	Year	H km/sec. MPC
1	E. Hubble	1929	530
2	V. Baade	1952	290
3	V. Baade, H. Swop	1955	100
4	E. Sandidge	1962	98
5	S. Vandenberg	1965	100
6	E. Sandidge	1968	75
7	E. Sandidge, G. Tammenn	1975	55
8	R. Tallu J. Fisher	1977	90
9	J. Voculaer	1979	100
10	G. Tammenn	1982	50
11	M. Aaronson	1982	85

So, we got a connection between the mass of the Earth and time on the basis of Yarkovsky's hypothesis. Taking into account the formulas (1) and (14) we will get:

$$\frac{dM}{dt} = \delta_N \cdot A_{av}^{1/3} \cdot M; \quad \frac{dg}{dt} = \frac{1}{3} \cdot \delta_N \cdot A_{av}^{1/3} \cdot g; \quad \frac{dR}{dt} = \frac{1}{3} \cdot \delta_N \cdot A_{av}^{1/3} \cdot R; \quad (26)$$

Thus, we obtained that speeds of growth processes of different physical parameters (mass and radius of the Earth, acceleration of free fall) are proportional to the values of these parameters. **Therefore, the value itself can serve as a measure of past time and the speed of change of the value of parameter as a measure of time rate.**

Really, the analysis of distributions of zones with increased value of acceleration of free fall on the Earth shows that location of all ancient civilizations get into these zones. It indicates the higher time rate of evolution in these regions, which contributed to the quicker development of cultures of these civilizations.

As it is known, acceleration of free fall is less in area near the pole in southern hemisphere of the Earth than

in north hemisphere on the value $\frac{\Delta g}{g} = 30 \cdot 10^{-6}$.

The difference in time of southern hemisphere from northern hemisphere on the segment of time Δt should correspond to this value according to the formula (26) and it is equal to:

$$\Delta t = 3 \cdot \frac{\Delta g}{g} \cdot \frac{1}{\delta_N} = \frac{3 \cdot 30 \cdot 10^{-6}}{0,76445 \cdot 10^{-16}} = 117,8 \cdot 10^{10} \text{ sec} = 37,33$$

thousand years.

Therefore, ***evolutionary processes in northern hemisphere should surpass the same processes in southern hemisphere.*** Actually, we know that the whole range of ancient animals like marsupials had already disappeared in northern hemisphere and remained only in southern hemisphere. From the other side, approximately all ancient civilizations existed only in northern hemisphere.

As it is known, in one's time it was supposed to make a analogy of time with the entropy of closed systems, which increases continuously like time does, to have a pictorial view of direction of time arrow.

However, the analysis made above, which relies on geological experimental data, shows that it is better to correct the course of time with changes of mass and radius of the Earth as well as with the change of acceleration of free fall. These changes are connected with deep processes in Nature called by the inflow of some positive energy from the surrounding vacuum to the Earth and accordingly into nuclei of atoms.

We should do only one step from the supposition on connection between time and process of energy inflow into nuclei of atoms to authentication of time with the flow of energy itself, and we will do it.

So, let's suppose that time is some physical substance, which has positive energy and flows into nuclei of atoms from the surrounding vacuum. Thus, in our notions of time we share A.N. Kozyrev's opinion [5], which considers that internal energy of stars grows due to the flow of time.

Inflow of some physical substance, which has energy and momentum, into bodies from the surrounding vacuum should lead to their mutual attraction as it was shown in the works by V. Thomson, who proved that attraction between bodies appears in the case of simultaneous inflow of some liquid into these bodies as well as in the case of outflow. That's why, taking into account Thomson's results, **we can suppose that time represents a physical substance, which has positive energy and flowing into nuclei of atoms or has negative energy and flowing out of them.**

The case of outflow is more preferable since gravitation energy is negative, as we know.

This substance can be structured, for example, due to the wave process, i.e. it can represent a longitudinal wave, which enters nuclei or leaves them. In this case an attraction between bodies also appears, as it was shown by K. A. Bjerknes [8].

In further works we will try to build a theory of gravitational interaction of bodies on the basis of Yarkovsky's hypothesis.

Where is the source of this substance-time? If we suppose that the surface of elementary particle separates our space from some other space, then the outflow of substance-time comes from another space to our space. In the case of three-dimensionality of these spaces we should speak about seven-dimensional space-time, which includes our and another Universe, and they are connected by the flow of substance-time.

It is possible that this process of transmitting of substance-time and accordingly energy and mass from one Universe to another one takes place as periodical oscillation from one side to another.

Transmission of signal by means of the flow of substance-time, i.e. modulation of this flow, can allow to produce an immediate communication between points of our Universe though the space of another Universe situated inside of elementary particles.

Thus, it is possible that the entire Universe is connected together through time and all processes of the universe are synchronized.

Let's enumerate the results obtained in the given work:

1. The hypothesis by I.O. Yarkovsky on the reason of growth of mass and radius of the Earth is analyzed and its productivity is shown.
2. Numerical values of constants of growth of mass and radius of the Earth as well as acceleration of free fall are obtained.
3. The "red shift" is explained on the basis of Yarkovsky's hypothesis without attraction of hypothesis on expansion of the Universe.
4. Numerical value of Hubble's constant is obtained.
5. The explanation of correlation between location of ancient civilizations and zones of increased gravity is given.
6. The explanation of advanced evolutionary development of northern hemisphere of the Earth is given and time of this advance is calculated.

7. The notion of physical substance-time, which is the cause of growth of mass and energy of heavenly bodies, is introduced.
8. The supposition on nature of gravitational interaction of heavenly bodies due to physical substance-time is made.

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Experiments on Change of the Direction and the Rate of Time

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Professor N.A.Kozyrev, Russia, who wrote some papers on causal or asymmetrical mechanics, made the first experimental study into the physical properties of Time. Experiments managing the direction and rate of Time were made. Since 1967 in Moscow Aviation Institute some research works were made under the direction of Professor Felix Yu. Zigel (up to his death in 1988) on UFOs, which had some technical forms. According to the work on State Budget topic "Preliminary researches on abnormal phenomena in the atmosphere" a lot of important information was collected on this phenomena. The information was used to determine connections between the cause and effect, and some physical processes were determined by authentic cases of traces and fragments, cinema and photos, and telemeter images of UFOs from 1987 up to the present time. There is data about influences of some parts of these objects and their body (surface of device) on the rate and direction of Time. To confirm this last statement a series of experiments was made with 4 types of laboratory systems (and in the present time one more system for new experiments is developed).

In experiments on deceleration and acceleration of physical Time in a small closed area of space (made since 1988) ***the effect of electromagnetic field influence on space-time continuum was tested***. The experimental system used to investigate such kinds of effects consists of a set of electromagnets connected in series and in parallel and they are installed on spherical surfaces. In various experiments from 3 to 5 Electromagnetic Working Surfaces (EWS) were used. All EWS layers of various diameters were installed inside each other (similarly to a Russian doll "matrioshka"). The maximum EWS size was about meter, the minimum EWS diameter (internal) was 115 mm, which is the quite sufficient to allow experiments

with some control equipment, detectors and animals (various kinds of insects and laboratory mouse) to investigate the so called effects of ***converging spherical electromagnetic waves***.

The measurements of Time rate were made by all known modern means of measurement: all kinds of electronic, quartz, mechanical, nuclear clocks were used; as well as the specially produced duplicated quartz generators (to compare frequencies of standard heat-shielded generators); fiber-optic line diodes and other ways were tested. Though some kinds of measuring devices, for example, quartz clock, can be influenced by other physical factors, the duplication method of measurement allowed us to reduce the error of measurement. Thus a change in the rate of Time was produced (Professor Kozyrev named this "density of Time"). We can write t/t_E , where " t_E " is the normal Time of the Earth space and " t " is the local Time inside of the experimental system. This change in the rate was detected as several seconds per hour, but in one experiment the deceleration of the Time was measured as minus 4 minutes per 8 hours (minus 30 sec per hour) due to some incompletely understood reasons. Slowing down of the rate of Time up to minus 1,5 sec per hour and acceleration up to plus 0,5 sec per hour was produced and explained. If we accept the usual Earth Time as $t_E = +1$ it will become clear that we investigated a change in the speed of Time through a very small range: $+0,99 < t/t_E < +1,01$. So, the tested subjects and animals at any mode of operations (slowing down or acceleration) were moved into the Future faster or slower than those in normal space.

Through experiment it was established that the processes of slowing down and acceleration of Time are absolutely different. The slowing down of Time was smoother and steadier than acceleration, which showed sharp jumps. The mode of acceleration is unstable and it depends on some external factors. In particular, the instability of Time acceleration is connected to the period of day or night and also the Moon phase, probably to other reasons. One of the reasons is human presence near the Time Machine. Even small external effects, for example mechanical vibration, can produce a great result and change the value of the effect.