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The Ether and Universe



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Scientific notions of the cosmos have their origins in the concepts of space, time and matter. Assumption of the postulates of both special theory of relativity and general theory of relativity has not allowed getting a non-contradictory physical model of the universe. We propose the following idea of the universe. Space embraces everything. It is non-deformable, three-dimensional, Euclidean. The visible space is filled by with ethereal medium. The physical model of the ethereal medium consists of two equal, but opposite in sign, types of particles. The particles are strongly attracted together forming a homogeneous space. Opposite in sign its particles move relative to each other frictionless. In the ethereal medium linear, circular and other movements of physical bodies as well as shear deformations may exist infinitely long. A magnetic field is the consequence of torsion; shear deformations of the ethereal medium. The ethereal medium has a certain electromagnetic density and elasticity. Physical bodies (elementary particles, gases, liquids, solid bodies, plasma et al.) take place in the space and ethereal medium. Gravitational influence of one physical body on the other is realized by means of the ethereal medium. Dynamical processes in the ethereal medium and movements of physical bodies may be fixed in time. Time is local, irreversible, one-dimensional, unilateral, - from the past to the future.

We are to admit no more causes of natural things that such as are both true and sufficient to explain their appearance.

Rule I from the Rules of reasoning in Philosophy. I. Newton. Mathematical principles of natural philosophy. Optics. Britannica, V.32. Second Edition. Chicago. 1994.

1. Introduction

The concepts of space, time and matter underlie scientific notions of the universe. The most acknowledged by physicists now, the special theory of relativity (STR) postulates the principle of the unity of space and time categories. At the same time, the STR negates the existence of special matter - ether or vacuum, in which, as is known, all kinds of electromagnetic waves propagate. An assumption of the postulates of both the special theory of relativity and the general theory of relativity (GTR) has not allowed one to get a non-contradictory physical model, which could unite the observed phenomena in the field of electromagnetism, gravitation, inertia etc. [1]. Such a situation has existed already for more than 90 years and in the opinion of many eminent scientists (W. Ritz, A. Poincare, H. Reichenbach, V.F. Mitkevich, N.P. Kasterin, A.K. Timiryazev, L. Brillouin et al.) it demonstrates a steep decline in our notions of the universe fundamentals. In our opinion, the development of a vacuum (the ethereal medium) physical model that is consistent with the known phenomena arising during the propagation of light and electromagnetic waves and explains the nature of inertia and gravitation, will allow one to correct the existing situation.

Newton, in his time, represented light as a stream of corpuscles, i.e. particles propagating rectilinearly. When meeting an obstacle (a mirror) such corpuscles recoiled just like balls recoiling from a solid surface. C. Huygens has developed the wave theory of light. In "Treatise of light" he supposes that light propagates as an elastic impulse in a special medium - ether filling all the space. Works of A. Fresnel have shown definitely, that light is of a wave nature. Experiments of H. Hertz have allowed one to confirm J.C. Maxwell's guess of the electromagnetic nature of light waves.

At the same time, the electromagnetic wave theory of light is not free from inconsistencies. For example, it is precisely known that the displacements in such a wave happen in a direction, transversal to the direction of propagation. However, such a type of displacements is typical only of solid bodies. Examining a very high speed and very low attenuation during propagation of light from rather far galaxies, we come to conclusion, that ether, as a bearer of an electromagnetic wave, is close in properties to an absolutely solid body with very high elasticity. At the same time, ether can penetrate physical bodies without any friction, and all these bodies, including solid ones, can move completely freely in ether.

Thus, a logically consistent and physically justified theory of ether (vacuum) has not been developed so far. At the same time, a rejection of the presence of ether means a rejection of a light-bearing medium supplying us with life-giving energy from the sun. In everyday life, each of us uses radio and TV sets, receiving through ether, surrounding the Earth or satellites a useful signal from the near-earth space. It is precisely the wave equations, obtained on the assumption of the presence of a medium with certain and known properties that allow one to calculate trajectories of electromagnetic waves propagation exactly.

If we accept the corpuscular theory directly then it is necessary to admit that the sun, radiating photons in a wide range of energies, would send them to us with different velocities. However, as is well known, their velocity of propagation is constant and is equal to

$C = 2,9979246108 \text{ m/s}$ [2]. A constancy of the waves propagation velocity is characteristic only of homogeneous media.

Thus, the wave theory of light faces less logic inconsistencies, than the corpuscular one. However, the wave theory of light requires necessarily a medium - carrier of waves. This imperceptible medium termed, ether (the ethereal medium, vacuum) in literature has sharply defined electromagnetic properties [3]. However, a consistent physical model of vacuum has not been constructed so far. The present work offers such a model, which, from our point of view, is logically consistent and meets the known experimental observations physically adequately.

2. Background of the concept of ether

The earliest written evidences of the arrangement of matter and vacuum are known from the works of philosophers of China and Greece [4, 5]. In the middle of the first millenary B.C. Chinese philosophers put forward a hypothesis that all existent consists of two opposite in sign principles - Yin and Yang [5]. Yin and Yang - are categories expressing the idea of the world dualism. The word Yang originally meant sunshine, or what pertains to sunshine and light, that of Yin meant the absence of sunshine, i.e., shadow or darkness. In later development the Yang and Yin came to be regarded as two cosmic principles or forces, respectively representing masculinity, activity, heat, brightness, dryness, hardness, etc., for the Yang, and femininity, passivity, cold, darkness, wetness, softness, etc., for the Yin. Through the interaction of these two primary principles, all phenomena of the universe are produced. This concept has remained dominant in Chinese cosmological speculation down to recent times. Yin and Yang determine not only an evolution, but also an arrangement of all existent in the world. An early reference to it appears already in the Kuo Yü or Discussion of the States (which was itself compiled, however, probably only in the fourth or third century B.C.)

Philosophers of Ancient Greece comprehensively dealt with universe and cosmogony problems. It was precisely they who gave the name ether to all-penetrating, imperceptible and not subject to our feelings substance. The ether model suggested by Democrite [5] seems to be most non-contradictory. He stated that the basis of all elementary particles was ameres - really indivisible, lacking parts. Ameres being an atom's parts possess properties that radically differ from those of the atom. While atoms have gravity, ameres do not have it. The whole aggregate of ameres moving in vacuum, according to Anaximander, is a common world medium, ether or apeiron.

Though phenomena related to electricity and magnetism were known in ancient times, the history of science rise dealing with magnetism and electricity starts with the work of the British queen Elizabeth's court doctor Hilberti published in 1600 [6]. Hilberti noticed a lot of difference between electrical and magnet forces. A magnet stone does not need to be rubbed as glass or sulphur to trigger its magnet properties. A magnet stone attracts only those things that it can attract, while electrified things attract everything. Magnetic attraction cannot be affected by a piece of paper or canvas placed between the bodies or by submersion of these bodies into water, while electrical attraction can be easily destroyed with shields. Finally, a magnetic force tends to orient the bodies in a certain direction, while an electrical one just tends to unite them in formless groups.

Creators of the fundamentals of modern mathematics and physics considered ether to be a material medium. For instance, Descartes wrote that space is filled with matter throughout. According to Descartes, the formation of visible matter, planets, occurs from the ether vortexes. Newton stated that to think "that one body can affect another one located at some distance from it, through vacuum without any "mediator" is so absurd to me that, to my mind, not a single person having the least idea of philosophical matters, can believe it" [7]. At the end of his life Isaac Newton explained the availability of the gravity force by the pressure of the ether medium on a material body. According to his latest views, the ether density gradient is necessary to rush bodies from the ether denser areas to less dense ones. However, to let the gravity manifest itself in the way it is observed by us, the ether should, by Newton, possess very great elasticity.

The subsequent generations of scientists continued studying the ether properties. It appeared that the focal length of an achromatic telescope should be increased if it was directed to the star that the earth is moving to [8]. Arago concluded that the light going out from any star, in all cases of reflection and refraction behaves exactly the same way it would have behaved if the star had been at the same place it is likely to occupy as the result of

aberration, and the Earth had been at rest.

Fresnel accepted the Young's suggestion that the refraction ability of transparent bodies depends on the concentration of ether in them and he began to develop a theory of interaction of ether and a substance. Here is what Whittaker writes on this point in his remarkable review of the development history of the notions of ether and electricity [8]. "Arago has refined this supposition assuming the ether density in any body was proportional to the square of the refraction index. Thus, if C is the light velocity in the vacuum and C_1 – the light velocity in a given material body that is at rest, so that $\mu = C/C_1$ is the refraction index, then the ether densities ρ and ρ_1 in the interplanetary space and body will be, accordingly, correlated by the relation $\rho_1 = \mu^2 \rho$.

Then Fresnel supposed that a body in motion carries a part of the ether that is in it, namely, the part that is the excess of the ether density as compared with the ether density in the vacuum, while the rest ether in this body is motionless. Thus, the density of the moving ether is equal to $(\rho_1 - \rho)$ or $(\mu^2 - 1)\rho$ and the ether with the density ρ remains immovable. Then the velocity with which the ether centre of gravity in the body moves forward in the propagation direction is equal to $[(\mu^2 - 1)/(\mu^2)]\omega$, where ω is a component of the body velocity in this direction. This component should be added to the light wave velocity in the body, then the absolute velocity of light in the moving body will be

$$C_1 + [(\mu^2 - 1)/(\mu^2)]\omega. \quad (1)$$

Hereinafter, an evident drawback emerged in the Fresnel's theory, i.e. his theory required that the relative velocity of the ether and matter should be different for the light of different colours.

Many years later Stokes put forward the same suggestion but in some other form [9]. Assume that all the ether in the body moves simultaneously: the ether that enters the body from the front and at once thickens and the ether that leaves the body from behind where it at once rarefies. With this assumption, the ether mass $\rho\omega$ should pass through a unit area of the plane drawn in any place inside the body at a right angle to the body movement direction in a unit of time. Consequently, the ether in the body has a velocity of drift equal to $-\rho\omega/\rho_1$ in relation to the body, then the light velocity in relation to the body will be $C_1 - \rho\omega/\rho_1$, and the light absolute velocity in the moving body will be $C_1 + \omega - \rho\omega/\rho_1$ or $C_1 + [(\mu^2 - 1)/(\mu^2)]\omega$, as before. In 1851 this formula was experimentally corroborated by Fizeau who measured a shift of interference bands formed by light that had passed through a tube with running water [10].

The first serious attempt to describe the ether mathematically was made by MacCullagh in 1839. According to MacCullagh, the ether is a rigid medium in the world space. This medium exhibits elastic resistance to rotation deformations and is described by the antisymmetric tensor of the second rank whose members of the main diagonal are equal to zero [11]. The successive scientists showed that MacCullagh's ether can be described by Maxwell's equations for the empty space [12].

MacCullagh offered the following equation of the ether medium movement:

$$\varepsilon \frac{\partial^2 \vec{e}}{\partial t^2} + C^2 \text{rotrot} \vec{e} = 0, \quad (2)$$

where \vec{e} is an elastic shift, t is time.

As MacCullagh notes, in this equation, the dielectric permeability corresponds to the reciprocal of the constant elasticity [11].

In his review [8], Whittaker notes that specialists in mathematical physics of the time of

MacCullagh as well as the next generation specialists cast doubt on his work. One can say that it was appreciated only in 40 years when other scientists drew their attention to it. But there is no doubt that MacCullagh really developed the theory according to which oscillations in a medium calculated by dynamics right laws should possess the same properties as the light oscillations. Until the end of the XIX century prominent scientists argued about the ether medium – whether it should be considered a quasi-solid body that undergoes deformations under magnetic and electrical forces, or a quasi-liquid body whose particles execute vortex motions under the influence of the same forces.

One of the most developed definitions of the ether was given by the natural science classic J. Maxwell [13 – translated from Russian]. “Ether differs from ordinary matter. When light moves through air, then it is evident that the medium in which the light is propagating is not air itself, because, first, air cannot transmit shear waves, while compression waves transmitted by it propagate million times slower than light”...

“One cannot assume that the ether structure is similar to that of gas in which molecules are in the state of chaotic movement, since in such a medium, a shear oscillation over one length of the wave attenuates to the value less than a five hundredth of the initial amplitude.... But we know that a magnetic force at some area round the magnet is preserved while steel keeps its magnetism. Since we have no grounds to assume that a magnet can loose all its magnetism just as time passes, we can conclude that molecular vortexes do not require constant expenditure of work to maintain their movement...”.

“Whatever problems we face in our attempts to work out a well-grounded notion of the ether structure, it is beyond any doubt that interplanetary and interstellar spaces are no empty spaces, they are filled with material substance or a body that is most extensive and, perhaps, most homogenous of those that are known to us”.

Maxwell asserted it is unlikely that one can avoid the conclusion about the light consisting of lateral wave motion of the same medium that induces electrical and magnetic phenomena.

Maxwell and later Hertz tried to extend the theory of electromagnetic field to the case when weighty bodies are in motion. In the review [8] it is mentioned that these attempts were not a success. Neither of them took into account the motion of material particles in relation to the associated ether, so in both investigations moving bodies were considered to be just homogenous parts of the medium filling the entire space, those parts differing from one another only by particular values of electrical and magnetic constants. Evidently this assumption does not agree with Fresnel’s theory that explains optical behaviour of moving transparent bodies.

Unlike Maxwell, Stokes showed in 1845 that the aberration phenomenon can be explained if one accepts the concept of noncircuital ether [9]. “Assume that the Earth motion imparts a motion to the neighbouring ether portions. This motion can be considered as superimposed on the vibratory motion of the ether particles during the light propagation, so, in general, the orientation of the light wave fronts will change, influence will be thereby exerted on the direction in which we see a heavenly body and which initially is normal to wave fronts. But if the ether is in noncircuital motion, so that its elements do not rotate, it is easy to see that no influence will be exerted on the light direction in space, the light disturbance propagates as before along straight lines from a star and the normal to the wave front deviates from this line at a low angle u/C at any point, where u is the ether velocity component at a given point expanded perpendicularly to the light propagation line and C is the light velocity. If we assume that the ether near the Earth is at rest in relation to the Earth surface, then it may seem that a star is displaced to the Earth movement direction at the angle measured by the Earth velocity to light velocity ratio, multiplied by the sine of the angle between the Earth movement direction and the line connecting the Earth with the star. The

law of aberration exactly reflects this.

One of the classical physics creators W. Thomson worked hard on designing models and mechanisms of interaction of physical bodies and fields with the ether. For instance, W Thomson noticed that the bar electromagnet that is equivalent to the current circulating in the wire wound around it, can be compared with a strait pipe immersed in an ideal liquid that flows in it at one end and out at the other so that the liquid particles move along magnetic field lines [14]. If two such pipes are placed with homogenous ends facing each other, they are attracted, if they are placed with heterogeneous ends facing each other, they are repelled. This scheme seems attractive due to similarity of magnetic forces action to the interaction of the pipes filled with an ideal liquid.

But there is one fundamental difference that prevents considering this analogy to be rightful. For instance, a ferromagnetic particle attracted by a solenoid remains inside it. At the same time, the particle that entered the pipe with the moving ideal liquid at one end will be evacuated into the space at the other end of the pipe if only to preserve the motion inertia.

Thomson also worked out the concept of the incompressible ether medium composed of the “atoms arbitrarily red and blue” related to each other by rigid ties and located at the Bravais’s lattice sites [15]. By his concept, the ether is presumed to be quasi-rigid and to resist any rotation absolutely. Thomson’s ether can be subject to shear deformation. For the ether model to meet the condition of absolute resistance to rotation, Thomson placed spinning gyroscopes on rigid ties. The gyroscopes can be represented as flows of incompressible liquid. The angular velocity of the motion in every gyroscope can be infinitely great. In this condition the spatial network of differently oriented gyroscopes will exhibit infinitely great resistance to the ether medium rotation round any axis. By Thomson’s concept, the ether model constructed in such a way can transmit oscillations like natural ether.

Virtually Thomson’s model does not agree with modern ideas. It is very complicated. It is difficult to imagine gyroscopes with an infinitely great angular velocity. Rather simple reasoning shows that an infinitely great velocity requires great energy. It is not quite clear how the areas of gyroscopes, in which the rotation occurs round the mutually perpendicular axes, mate. Thomson does not explain what physical mechanism executes rigid ties. At the same time, in our opinion, the concept of the ether medium consisting of “atoms” of two kinds related by rigid ties and located at the sites of a certain lattice seems to be rational.

Then Thomson concluded that the equations of light propagation are no more than the equations of shear oscillations in a solid body [15]. By his model, magnetic induction at any point can be represented by a turn of a volumetric element of a solid body from the equilibrium position. Electrostatic force is equal to

$$\vec{E} = -\frac{1}{C} \frac{\partial \vec{e}}{\partial t}, \quad (3)$$

and magnetic induction is equal to

$$B = \text{rot} \vec{e}, \quad (4)$$

where \vec{e} is elastic displacement. In conclusion Thomson replaced the elastic solid body of a usual type by the ether medium of MacCullagh type.

The ether concept received new development in the context of Michelson’s experiments [16]. At the end of the XIX century A. Michelson decided that if the ray bundle in the interferometer were sent along the equal way in parallel and normally to the Earth movement, then the travel-time difference for these rays could be obtained. He obtained interference bands between the two bundles of light that had passed along the perpendicular trajectories;

but when the device was turned by 90 degrees so that the difference was opposite, the expected shift of the bands did not occur. Michelson considered this result to be the evidence for the Stokes's theory which suggests that the ether near the Earth is moving.

In 1882 P.G. Tet supposed that "had the ether been in motion in relation to the Earth, then the absolute deviations of the lines in the diffraction spectrum should have been different in various azimuths" [17].

Michelson and Morley's experiments continued in 1897 when Michelson tried to define experimentally whether the Earth and ether's relative movement changes with the change of the vertical height over the Earth's surface [18]. However no result pointing to dependence of the light velocity vs. the distance to the Earth's centre was obtained. Michelson concluded that if one had to choose out of Fresnel and Stokes's theories, he should accept the latter's theory and assumed that the Earth's effect on the ether stretches for thousands of kilometres over its surface.

Meanwhile, the dilemma existing in this subject became even more acute under the effect of experimental results that pointed to the direction opposite to that of Michelson. In 1892 O. Lodge [19] watched the interference between two portions of the bifurcated ray of light that were made to move in the opposite directions along the closed trajectory in space bounded by two quickly rotating steel disks. The observations showed that the light velocity is not subject to the adjacent matter to the power 1/200 of the matter velocity. Continuing his investigations, Lodge heavily magnetized the moving matter (it was iron in his experiment) so that the light propagated through the moving magnetic field and electrified it in such a way as to place the beam trajectory in the moving electrostatic field. Appreciable influence upon the light velocity was exerted in no case.

H. Lorentz tried to resolve the contradictions in explaining the ether nature. He transformed Fresnel's hypothesis in such a way that in his theory a weighty body that was in motion transferred the ether excess it contained as compared with the space that is matter free [8]. Lorentz also supposed that polarized molecules of a dielectric, like many small condensers, increased the dielectric constant and it was this (so called) increase in the dielectric constant that moved together with the moving matter. Thus, the flaw in Fresnel's theory, which required that the relative velocity of the ether and matter should be different for the light of different colours, was eliminated. Lorentz theory requires only different values of the dielectric constant for the light of different colours and the dispersion theory provides a satisfactory explanation to this requirement.

In contrast to H. Hertz hypothesis which suggested that a moving body should transfer all the ether contained in it, the validity of H. Lorentz hypothesis was subsequently corroborated by various experiments. In 1901 R. Blondlot carried the airflow through a magnetic field normally to magnetic force lines [20]. The airflow was sent between the condenser plates that were connected by the wire in such a way that they had an equal potential. When the air moved in the magnetic field the electromotive force \mathbf{E}' appeared in the air. According to Hertz theory, this force should generate the electric induction \mathbf{D} of the $\epsilon\mathbf{E}'$ value (where ϵ is the air dielectric permeability that is virtually equal to unit), so, according to Hertz theory, the condenser plates should be charged. According to Lorentz theory, on the other hand, the electric induction \mathbf{D} is determined by equation

$$\mathbf{D} = \mathbf{E} + (\epsilon - 1) \mathbf{E}',$$

where \mathbf{E} is a dielectric force acting on the charge that is at rest; in this case that force is equal to zero. Thus, according to Lorentz theory, the charges on the condenser plates will have only the $(\epsilon - 1)/\epsilon$ part of the value that they should have by Hertz theory, i.e. virtually they will be equal to zero. The result obtained by Blondlot supported Lorentz theory.

An experiment of this kind was performed by G. Wilson in 1905 [21]. In this experiment the space between the inner and outer plates of a cylindrical condenser was filled by a dielectric – ebonite. When a certain potential difference is maintained between the plates of such a condenser, charges are induced on the plates. If the condenser is rotated round its axis in a magnetic field which force lines are parallel to this axis, then these charges will change due to additional polarization that rises in the dielectric molecules as they move in the magnetic field. According to Lorentz theory, the additional charge value is $(\epsilon - 1)/\epsilon$ times greater than the value calculated by Hertz theory. The result of Wilson’s experiment as well as that of Blondlot supported Lorentz theory.

Reconciliation of the electromagnetic theory with Fresnel’s law on light propagation in moving bodies was an evident step forward. But there was a complication that interfered with the immovable ether theory: in its initial form it could not explain the negative result of Michelson and Morley’s experiment. In 1892 FitzGerald speculated that when material bodies moved relative to the ether, their dimensions slightly differed [22]. Later this hypothesis of FitzGerald was accepted by Lorentz. After that the amount of people that have accepted this idea began gradually to increase and it was accepted by physicists-theorists.

Let us consider how this hypothesis explains the result obtained by A. Michelson. If one assumes that the ether is immovable, then one of two rays, into which the initial light ray is bifurcated, directed along the Earth movement should pass its way faster than the other one directed across this movement. This difference might be fully compensated if the way coinciding with the direction of the Earth movement was shorter than that of the ray directed across the movement. It might have happened if the linear dimensions of the moving bodies had always decreased in the direction of their movement in the ratio $(1 - V^2/2C^2)$ to the unit (V is the body velocity, C is the light velocity). Therein lies the meaning of FitzGerald hypothesis for reduction of bodies during their movement through the ether.

Planck came up with another proposal in 1899 [23]. It was based on Stokes theory and implied that both conditions of Stokes theory (the ether movement should be irrotational and its velocity near the Earth surface should be equal to the Earth velocity) could be met if it was granted that the ether was compressed by Boyle’s law and was subject to gravitation. Round the Earth it is compressed like the atmosphere, the light velocity does not depend on the ether thickness.

A few authors including H. Lorentz criticized Stokes theory [8]. This criticism lied in the fact that an irrotational motion of an incompressible liquid was fully determined when the velocity normal component was specified at its border. So if we assume that the ether has the same velocity normal component as the Earth, then it would not be able to have the same velocity tangential component. Hence it follows that in a general case there is no such a motion that would meet Stokes equation. This complexity was not satisfactorily solved by any proposal put up for its solution. One of those proposals is in assumption that the Earth movement creates vortex perturbation which does not influence more stable irrotational motion despite the fact that it is emitted with the light velocity.

A radical revolution in physicists’ ideas of the ether took place after the principles of A. Einstein’s theory of relativity had been published. For instance, in 1905 A. Einstein wrote: “Introduction of the “luminiferous ether will appear to be excess” [24, p. 8]. In 1915 in another work he wrote: “...one should abandon the introduction of the concept of the ether which turned in a useless makeweight to the theory...” [24, p. 416]. In 1920 he wrote: “...the special theory of relativity does not require the absolute negation of the ether” [24, p. 685]. At one moment A. Einstein accepted the ether existence, at another he rejected it. The last A. Einstein’s statement about the ether medium refers to 1952: “By the fact that the special theory of relativity showed physical equivalence of all inertial systems, it proved

inconsistency of the resting ether hypothesis. So it was necessary to give up the idea that an electromagnetic field should be considered as the state of some material bearer" [24, p. 753].

E. Whittaker writes [8, p. 359] that the accepted principle of relativity destroyed all competing concepts of the ether. But not all known physicists appeared to agree to the ether elimination and the theory of relativity itself.

One of the outstanding physicists Paul Dirac described his understanding of vacuum in such a way [25]: "According to these new concepts, vacuum is not emptiness that has nothing inside. It is filled with an enormous number of electrons that are in such a state with negative energy that can be considered to be some ocean. This ocean is filled with electrons without limits up to the negative energy value and so there is nothing like a bottom in this electron ocean. The phenomena we are interested in are the phenomena occurring at this ocean surface and what is taking place at depth is not observable and is of no interest. As long as the ocean is quite homogenous and its surface is flat, it is not observable. But if we take a handful of water and lift it, then the obtained homogeneity breaking will be just what is observed in the form of electrons presented in this picture as the lifted part of the water and the hole left at its place, i.e. positrons".

Another prominent scientist L. Brillouin arrived at the conclusion that "...the general theory of relativity is a brilliant example of the glorious mathematical theory built on sand and leading to an increasing pile of mathematics in cosmology (a typical example of science fiction)" [1]. In his book "A new view on the theory of relativity" he writes that both the theory of relativity and quantum theory appeared at the beginning of the XX century. Then a rapid development of the quantum mechanics began. Spin, Pauli-Fermi prohibition principle, de Broglie waves, Schrodinger equation and many other things were discovered. Experiments supplemented theory, the improved theory allowed prediction of new phenomena. The development of quantum mechanics demonstrated a remarkable symbiosis of theory and experiment that leads to an unlimited growth of knowledge. The situation with the theory of relativity is somewhat different. Tested only by a few experiments it remains logically contradictory. It has not brought luxuriant growth of new scientific trends that might be brought by a fruitful theory. Heavy battles with logical, philosophical and physical contradictions in the theory itself are still going on in its field.

Note that the above reasoned statements made by the world-famous scientists cannot be ignored. The latest scientific achievements, especially those in the field of radio-wave propagation including that in outer space, the discovery of the "dark matter" induce to come back to solving the ether problem.

To sum up, in the XIX century great physicists were developing two competing ether theories. One of them suggested by Descartes, Maxwell and, to a certain extent, H. Lorentz speculated that there were vortexes composed of some very small particles in the ether. Flows of these particles form magnetic fields. The motion of those particles from one charged body to another ensures electrostatic interaction. The other theory developed by MacCullagh, Thomson and Stokes was based on the assumption that ether is a quasi-solid body. Magnetic and electrical fields arise in it from deformations of a certain type.

At present the attempts to develop a non-contradictory theory of the ether medium (vacuum) are going on. As in the main preceding works of the XIX century, two theories are being mainly developed – of quasi-liquid (gas-like) and quasi-solid ether. For instance, K.P. Sinha, C. Sivaram and E.C.G. Sudarshan suggested a model of vacuum as a superfluid medium [26]. In this paper, as well as in several preceding ones, the authors develop a concept of the luminiferous ether being a superconductive liquid consisting of united pairs of fermions and anti-fermions (as, for instance, electron-positron, neutrino - anti-neutrino etc.). This superconductive liquid is considered to be globally stable and is the basis of the universe. The imagined medium can contain tensor bosons that may possess mass or be massless. They

can provide a mechanism for strong electromagnetic and gravitational interaction. According to the authors, the concept is such that the main fermion - anti-fermion interaction can result in the variety of the forces being manifested and seem to be able to provide the basis for the generalized field theory.

In the known work of V.A. Atsyukovsky a model of the gas-like ether is offered [27]. This model is close to L. Lesage's model [28]. Magnetic fields of this ether are formed by vortex structures. There are a number of other modern works of variable validity degree that present ether liquid or quasi-gaseous [29, 30, and 31].

A number of other works present a model of quasi-solid ether [12, 32, 33]. As a rule, these works are based, to a greater or lesser extent, on MacCullagh's model and develop it.

Below we offer and ground the least contradictory model, as we think, namely, the model of quasi-solid ether (ether medium). We suggest the solution of the second great problem – why the ether is carried (partly) by the moving physical bodies at the Earth surface but remains immovable in relation to the planet Earth that moves through space. The ether is presented as an all-penetrating medium consisting of the particles of two types that are equal but opposite in sign. The ether was demonstrated to have certain electromagnetic density and elasticity. The relations and interaction between the space, ether, physical (weighty) bodies and time are explained. The essence of the observed electromagnetic phenomena, inertia and gravitation are grounded.

Due to the fact that recently many researchers have interpreted the term “vacuum” as a synonym of “ether”, we will cite Whittaker: “It seems absurd to me to retain the name “vacuum” for the category that has so many physical properties, while the historical term “ether” is excellently suitable for this purpose” [8].

3. General properties of ether (vacuum)

Modern researchers interpret a physical, homogeneous continual medium (gas, liquid, solid) as matter, filling space uniformly and three-dimensionally and possessing an ability to transmit perturbations (oscillations) with steady speed. The properties of a medium define the perturbations propagation velocity in it. Continual media possessing essentially different expedients of perturbations transmission are known. One of them is noted for by transmitting perturbations along the line coincident with the direction of propagation. Another type of medium is capable to transmit perturbations with the vector of displacement in the direction of the propagation and with the vector of displacement oriented along the normal line to the direction of propagation. There is the third type of medium, in which the displacements happen in mutually orthogonal to each other orientations and to the direction of propagation. The first medium represents gas (liquid), the second - a solid body. The properties of the medium of the third type - ether (vacuum) - have not been fully determined so far. It is known, that ether is characterized by physical constants: velocity of waves propagation, dielectric constant and magnetic conductivity.

Investigations of the processes of radiation, propagation and reception of electromagnetic waves, carried out after J.C. Maxwell, have shown, that ether has a specified value of wave impedance $Z \sim 377$ ohms [3]. Observations on the process of a vacuum-processed condenser charge, current feed into a solenoid, allow one to conclude, that electromagnetic processes have inertia in ether. The established facts and phenomena allow one to state, that ether is a specific medium differing fundamentally from gas, liquid and solid media.

One of the most remarkable properties of ether is the fact that it does not offer resistance to a uniform motion of a physical body. For example, in material (possessing density) media, fundamental particles (electrons etc.) are constantly in mutual motion. A stable state of macro-objects, their fixed relative position can be maintained for an extremely long time. For example, the determined age of some terrestrial rocks and meteorites is $3.8-4.7 \cdot 10^9$ years [34]. All this time a motion, for example, of electrons around atoms composing a crystal lattice of minerals in these rocks and meteorites, takes place without a change of their orbits and deceleration of their circulation velocity around atomic nuclei. From the investigation results of astronomers we also know, that the light from the most remote galaxies comes to us over a period, estimated at millions light years. At any noticeable absorption of light by ether, we would not be able to observe these far galaxies.

Observations of electromagnetic waves and light propagation in ether give the most complete data about its properties. It is known that an electromagnetic wave is a recurrent change of electric and magnetic fields in time and space. This change spreads in all directions from the area of space where vibrations originate [3]. An electromagnetic wave, propagating in space is described by mutually perpendicular intensity vectors of the electrical \mathbf{E} and magnetic \mathbf{H} fields. The intensity vectors \mathbf{E} and \mathbf{H} vary synchronously and perpendicularly to the wave propagation direction. Perpendicularity of the vectors \mathbf{E} , \mathbf{H} and propagation direction causes "shear nature" of an electro-magnetic wave. The vectors \mathbf{E} and \mathbf{H} remaining mutually perpendicular may be oriented arbitrarily in a plane normal to the propagation direction.

There is also a very important property of electromagnetic waves - their polarizability. Light being an electromagnetic wave has properties of polarizability and shear nature (transverse nature). Light can have linear, elliptic and circular polarizations [35]. In the first two cases it is possible to determine the orientation of the vectors \mathbf{E} and \mathbf{H} . It is impossible to fix the direction of the vectors at circular polarization. Chaotically polarized (natural) light is also present. A physical medium can change the light polarization degree, for example, by

distinguishing linear-polarized light in chaotically polarized one, and also by changing a light polarization type, - linear to elliptic, circular etc.

As the light propagates in liquid and solid media some more effects arise - pleochroism (dichroism) and a manifestation of optical activity (a rotation of polarization plane) [36, 37]. The reason for pleochroism is anisotropy of light absorption, namely, the light component, polarization vector of which is oriented perpendicularly to aligned structural elements of medium, is absorbed.

At present many types of natural light polarizers have been developed using the pleochroism effect [38]. Minerals and substances composed of dissymmetric molecules that have neither a centre nor a symmetry plane but only an axis possess an optic activity. Using polarized light for studying a substance has a long history. It began to be used most intensively after William Nicol had introduced polarizers in a microscope in 1828.

The laws of propagation of polarized elastic waves have not been studied as well as those of light waves. In an unlimited continuous homogeneous isotropic solid body, two types of elastic waves may propagate - longitudinal and transversal (shear). Phenomena, similar to the light propagation polarization, are observed in solid bodies during propagation of elastic shear (transverse) waves. Their polarization vector is directed along the normal (in a generally case) to the propagation direction, similarly to the vectors \mathbf{E} and \mathbf{H} in electromagnetic waves. A study of the laws of polarized elastic waves propagation will help to reveal analogies and peculiarities of electromagnetic waves propagation.

A new method named the acoustopolarization method was developed for studying shear waves propagation particularities in a solid body [39]. The method is intended to detect elastic anisotropy, to determine the number and the spatial orientation of symmetry elements, type of symmetry and values of elasticity constants. The method has been approved on media of traversal-isotropic, orthorhombic and other types of symmetries. A basic scheme of observations realized according to this method, does not differ from the polarization observations in optics [40]. Acoustopolarization measurements are carried out by a specially designed device, named acoustopolariscope, Fig. 1 [41]. It comprises a base (1), a pole (2) and a bracket (3). A rod (4) moves in the bracket. In the lower part of the rod and at the base, a transmitter and receiver (5) are fixed in axial position. The sample (6) is fastened on rotating platform (7). The rotating platform is placed on the additional bracket (8) and has a scale (9) for calculating angles of rotating with respect to the mark (10). The basements of transducers have scales and marks in order to inspect rotating angles. Tight contact of the sample and the transducers is reached by springs in the basements. The signal transmitted through the sample is observed on an ultrasonic device. This device has a graded attenuator of the input signal.

Our method of acoustopolarization measurements follows that of [41]. Before the first stage of measurement, the polarization planes of transducers are brought in line (VP-position). The sample is placed between the transducers and fixed in the holder (8, Fig.1). The coupling medium is put on the working surfaces of the transducers. In a sequence of measurements, the rotating platform (6, Fig. 1) is rotated through 360 degrees, and signal amplitudes are measured on the screen of a recording device.

The second stage of measurements is conducted with the polarization planes of the source and receiver intersecting at 90 degrees (VC-position). Again, the measurements are conducted through a 360 degrees rotation of the sample. As a result of these measurements, we obtain acoustopolarigrams of anisotropic samples for parallel (VP) and intersecting (VC) directions of transducer polarization.

Observation by acoustopolarization method in practice requires the use of transducers transmitting purely shear, linear-polarized shear waves into a sample [39]. In addition, it should be noted that the success of measurements depends on the choice of the coupling medium, which makes the contact between the transducers and the sample. As a coupling

medium, we use a highly viscous solution of non-crystallised sugar. Such a coupling medium is very effective: its viscosity can be regulated, it provides the rotation of transducers with respect to the sample, ensures good repeatability of the results.

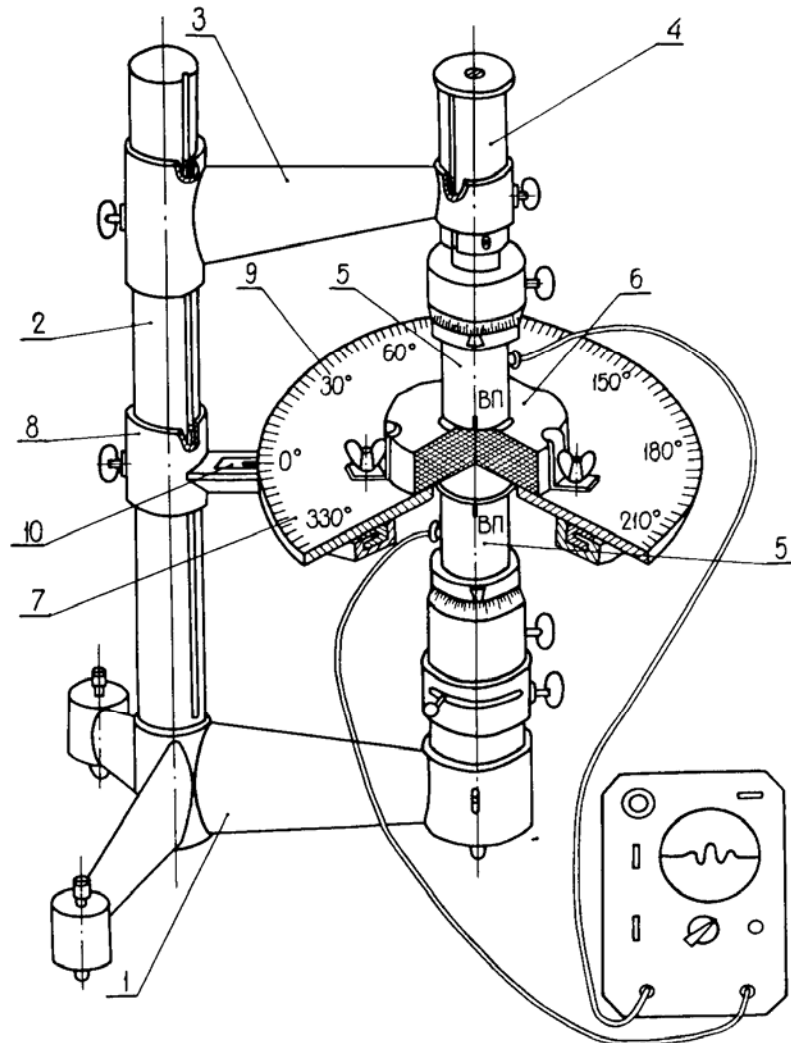


Fig. 1. Design of acoustopolariscope with the rotating platform (Pat. No. 1281993, USSR). 1 - base; 2 - pole; 3 - bracket; 4 - travelling rod; 5 - transducers; 6 - sample; 7 - rotating platform; 8 - additional bracket; 9 - angle scale; 10 - mark.

The acoustopolarigram obtained by parallel (VP) vectors of polarization, allows to judge, for example, the presence of a linear acoustic anisotropic absorption (LAAA) effect and, accordingly, a preferred orientation of structural elements [39]. The acoustopolarigram obtained by VC position allows to making the conclusion about the presence and number of symmetry elements in the given cross-section of the sample, and about their orientation in space.

In Figure 2 experimental acoustopolarigrams for different materials, illustrating particularities of shear waves propagation in them are given. The cubic sample C-t-5 is made of a silicate glass block. It represents a practically isotropic medium (the velocity of a longitudinal wave is 5.77 km/s , of a shear wave - 3.41 km/s). Three pairs of acoustopolarigrams obtained in the directions 1-1', 2-2' and 3-3' for three sides of the sample (Fig. 2a) indicate it. The VP acoustopolarigrams are close by shape to an exact circle. The VC

acoustopolarigrams are small in size and have no precisely expressed maxima. Acoustopolarigrams of a wooden sample have quite interesting shapes (Fig. 2b). The VP acoustopolarigrams, obtained for all three pairs of sides of the cubic sample, differ radically from theoretically calculated ones. An analysis displays, that the amplitude of shear waves at polarization vector, directed along the normal to the wood fibres, is 2-5 times less, than that at the vector orientation along the fibres. Thus, there is an intensive absorption of waves energy when the polarization vector of a shear wave is directed across the fibres. A similar property - to absorb waves in various ways, called pleochroism (dichroism), - is observed during the propagation of polarized light through some minerals, such as tourmaline, kunzite, cordierite etc. [36].

This property, called an effect of linear acoustic anisotropic absorption of shear waves (LAAA), is observed rather often in textured rocks [42]. In wood LAAA is accompanied, as follows from the shape of VC acoustopolarigrams (Fig. 2b), by an elastic anisotropy. One of the elastic symmetry elements is directed along the axis of the wood ring structure, and another - along the normal to it. Even more considerable manifestation of the linear acoustic anisotropic absorption is observed in a sample of mineral microcline, Fig. 2c. The cubic sample was cut out from microcline in such a manner, that its crystallographic axis [001] coincided with the normal line 1-1' to the side (1), and the axis [010] - with the normal line 2-2' to the side (2). The VC acoustopolarigrams, obtained at crossed vectors of polarization, show that elements of mineral's elastic symmetry are practically perpendicular to the sample sides. The indexes of the linear anisotropic absorption effect for the first and third pairs of sides are very great ($D_1 = 0.90$ and $D_2 = 0.93$ respectively [41]). The most natural explanation of LAAA manifestation in the microcline sample is, that this mineral has perfect cleavage in two directions. The cleavage planes form plane-parallel spatial lattices, at which the waves are absorbed.

Acoustopolarigrams in the direction 1-1' (Fig. 2d) were obtained using a cubic sample of a synthetic quartz monocrystal (trigonal syngony). The rotary axis [0001] of the third order passes in the same direction. Accordingly, on the VC acoustopolarigram, 6 successive minimums with a step of approximately 60° , - two minimums for each symmetry plane are noticeable. The VP acoustopolarigram consists of three petals. Acoustopolarigrams, obtained in the directions 2-2' and 3-3', show the presence of two symmetry elements. Figure 2d shows, that the acoustopolariscopy method can be used to study wave processes in media of low-symmetry systems: triclinic, monoclinic etc.

The stated examples illustrate some singularities of shear waves propagation in composite media. They confirm the presence of all three polarization forms, - linear, elliptic and circular during shear waves propagation in anisotropic media.

The value and direction of vector A_n that describes the medium motion in the wave is expressed by equation:

$$A_n = \frac{ab}{\sqrt{a^2 \sin^2 \omega t + b^2 \cos^2 \omega t}}, \quad (5)$$

where a and b are major and minor axes of the ellipse of the medium's particles shift respectively; ω is a circular vibration frequency; t is time.

If $a = b$, polarization of the shear vibrations will be circular. If $a = 0$ or $b = 0$, polarization of the vibrations will be linear.

Similar phenomena can be observed as light waves propagate. Every photon represents a single wave packet (soliton) of a certain frequency. The direction of the ether particles shift is along the normal to the photon propagation. As the photon passes, it may excite circular,

elliptical or linear shifts in the ether medium. In this case the photon is said to have circular, elliptical or linear polarization. The forms of the ether particles shift during the photon passage are similar to those in Fig. 3.

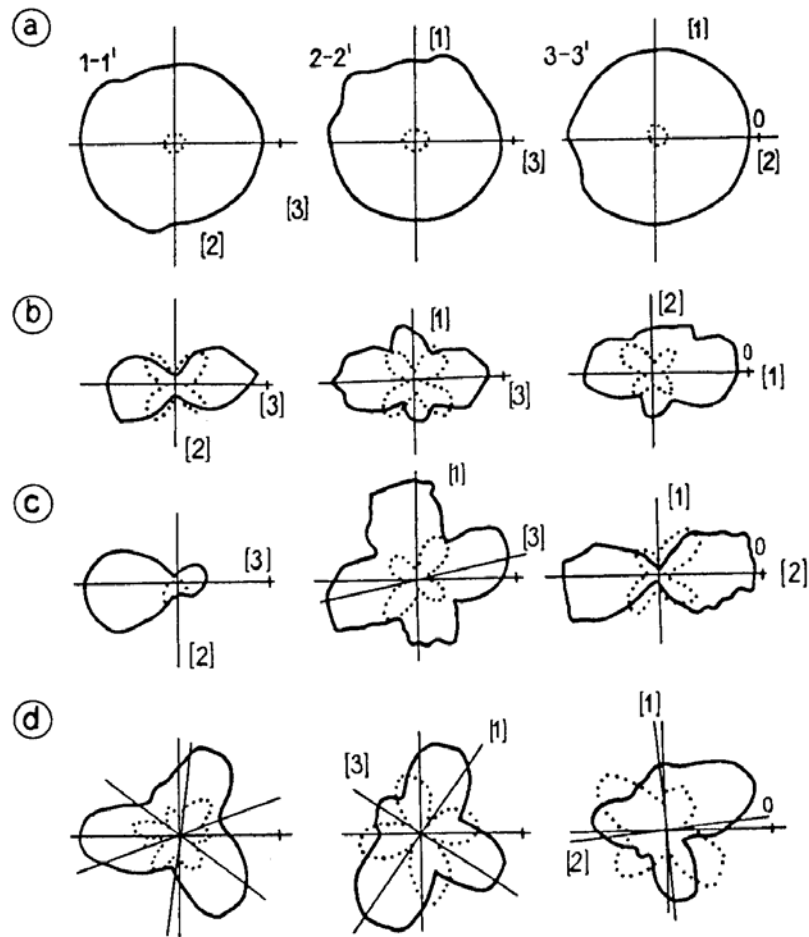


Fig. 2. Acoustopolarigrams of cubic silicate glass samples (a), wood (b), microcline monocrystal (c), synthetic quartz (d) in three mutually perpendicular directions 1-1', 2-2', 3-3'. VP - solid lines; VC - dotted lines.

There are some devices, for instance polarimeters, that enable one to identify one or other polarization type in the total chaotically polarized flux of the sunlight [37]. The ability of electromagnetic waves to take different polarization forms is widely used when investigating properties of various substances, in radio electronics, radiolocation, astronomy etc. [35, 37, 43, 44].

Outcomes of an analysis of a large number of solid media acoustopolarigrams, mainly minerals and rocks, and known data from optical polarization observations practice [35-44], allow one to make a primary classification of common and distinguishing phenomena accompanying the propagation of polarized electromagnetic and acoustic waves. Mathematical description of the following phenomena is adequate for the two types of anisotropic heterogeneous media in which waves propagate:

- A birefringence phenomenon for electromagnetic and a similar phenomenon for acoustic waves;
- Pleochroism phenomena for electromagnetic and linear acoustic anisotropic absorption for acoustic waves;
- Optic activity (electromagnetic waves) and rotating polarization vector in some media (acoustic waves);
- An increase of an ellipticity degree of polarized waves during their propagation in a randomly-heterogeneous medium [35, 45, 46].

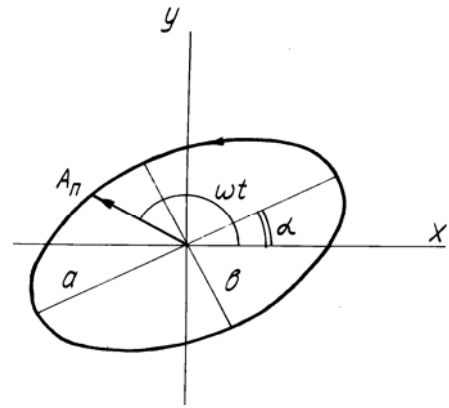


Fig. 3. A mode of medium particles movement in a solid body during propagation of shear waves [39].

However, the following singularities are characteristic of each of these types:

- Electromagnetic waves exhibit dispersion (waves of different length propagate in material media with different velocity), during acoustic waves propagation dispersion is manifested much less [47, 48];
- The properties, for example, dielectric permittivity, defining a wave surface of electromagnetic waves for the most low-symmetric medium, are featured by a second rank tensor (6 components), however the elasticity properties defining an acoustic waves surface of the most low-symmetric medium are described by a fourth rank tensor (21 constants) [43];
- The number and spatial position of symmetry elements of a medium at investigation by waves of both types often do not coincide, the number of elastic symmetry elements, as a rule, is greater;
- There is a class of heterogeneous media (minerals, rocks, textured materials), where the effect of linear acoustic anisotropic absorption is registered very often [39, 41], optical pleochroism (dichroism) in natural media is presented [35, 36] much more seldom;
- There is a class of media, where an optical activity is greatly appeared [47], at acoustic waves propagation an effect of gyration of the polarization vector is fixed only at very high frequency of waves for the time being [49];
- Some liquid media at usual temperatures and pressures are good shear wave conductors at high frequencies (0.5-1.0 MHz and above) [39].

Thus, during the propagation of electromagnetic, light and elastic shear waves many similar and close phenomena, indicating the existence of common elements in the structure of both solid body and vacuum are observed.

The cited enumeration of common and distinguishing phenomena and indications of interaction with media of electromagnetic and acoustic waves is not complete. In addition let us consider the expressions for reflection and transmission factors of a past and reflex flat homogeneous light wave incident on a flat surface, that divides two media, differing in optical properties [47]. For a wave component, which vector of polarization is parallel to the contact plane of the media, the transmission factor is equal to:

$$T_p / A_p = \frac{2n_1 \cos \theta_i}{n_2 \cos \theta_i + n_1 \cos \theta_t}, \quad (6)$$

where T_p is the amplitude of the wave, transmitted into the second medium; A_p is the amplitude of the wave, incident on the media interface; n_1 is the refraction factor in the first medium, $n_1 = C/V_1$; n_2 is the refraction factor in the second medium, $n_2 = C/V_2$; C is the velocity of light propagation in ether; V_1 is the velocity of light propagation in the first medium; V_2 is the velocity of light propagation in the second medium; θ_i is the angle of incidence of the wave ray in the first medium; θ_t is the angle of incidence of the wave ray in the second medium. For the reflected wave the corresponding factor is equal to:

$$T_t / A_p = \frac{n_2 \cos \theta_i - n_1 \cos \theta_t}{n_2 \cos \theta_i + n_1 \cos \theta_t}, \quad (7)$$

where T_t is the reflected wave amplitude.

Now we shall consider the reflection and transmission equations for an acoustic shear homogeneous plane-polarized wave with a flat front, incident also on a flat interface of two solid media, differing in acoustic properties of solid media. According to [50] for a wave with a polarization vector lying in the plane of interface plane (SH-polarization), the transmission and refraction factors look like:

$$K_{SH2} = A_{SH2} / A_{SH} = \frac{2\sqrt{P}\sqrt{1-h}}{P\sqrt{1-h} + H\sqrt{P-h}}, \quad (8)$$

$$K_{SH1} = A_{SH1} / A_{SH} = \frac{P\sqrt{1-h} - H\sqrt{P-h}}{P\sqrt{1-h} + H\sqrt{P-h}}, \quad (9)$$

where A_{SH2} is accordingly the amplitude of the transmitted wave, A_{SH1} is the amplitude of the reflected wave; A_{SH} - is the amplitude of the incident wave; $P = (V_{S12}/V_{S22})^2$ is the ratio of the square velocity of a shear wave propagation in the first medium V_{S1} to the velocity of the same wave propagation in the second medium V_{S2} ; $h = \sin^2 \beta$, where β is the angle of incidence of the shear waves ray in the first medium; $H = \rho_2/\rho_1$ is the ratio of density ρ_2 in the second medium to the density ρ_1 in the first one.

Using the Snellius equation $\sin \theta_i/V_1 = \sin \theta_t/V_2$ and also the expressions $q = \sin^2 \theta_b$, $F = (n_1)^2/(n_2)^2$ the equations (1) and (2) can be brought into the form, similar to the equations form (3), (4):

$$K_p = T_p / A_p = \frac{2\sqrt{F}\sqrt{1-q}}{F\sqrt{1-q} + \sqrt{F-q}}, \quad (10)$$

$$K_t = T_t / A_p = \frac{F\sqrt{1-q} - \sqrt{F-q}}{F\sqrt{1-q} + \sqrt{F-q}}. \quad (11)$$

Analysing jointly the equations (3), (4) and (5), (6) it is possible to note their rather close structure. Except for the parameter $H = \rho_2/\rho_1$ (ρ_1 is a density in the first solid medium, ρ_2 is a density in the second one), these pairs of equations are equivalent. The parameter H in the reflection-transmission equations (5), (6) of light at the interface of optically distinguishing media is absent. This implies the conclusion that ether and optically transparent bodies (gases,

fluids, solid bodies) do not differ in the density parameter, but only in the waves propagation velocity in them for electromagnetic waves. To put it otherwise, ether has neither density nor mass, which physical bodies have. Ether is the basis of electromagnetic waves propagation inside physical media also. As is known, the velocity of light propagation in gases, fluids and solid bodies is lower, than in vacuum [2].

On the basis of that, it is possible to assume, that in physical, perceptible (detected by physical devices) media as photons bend around atomic structures they have to overcome an additional distance, which causes the decrease in the velocity of waves propagation.

Let us also note, that concerning the laws of light reflection-transmission on the media interface the complete balance of energy eliminating the possibility of any additional "longitudinal" light waves is observed [47]. An enumeration of other phenomena and effects including piezo- and thermo-electricity, mutual electro-elastic effects are described in [43, 51, 52]. Summarizing the outcomes set forth the following should be assigned to general properties of ether (vacuum):

- The ability to transfer disturbances only with the displacement vector, directed along the normal to the propagation direction;
- The ability to penetrate into all physical bodies, having at the same time properties of a superfluid medium;
- The ability not to have a density in the sense physical bodies possess it;
- The ability to support waves propagation without their considerable attenuation at least at distances comparable with astronomical ones;
- The ability for orthogonal generation of displacements under dual transformations, for example, of an electric field into magnetic and vice versa;
- The ability to exhibit inertial forces, for example, at transition from electric field to magnetic one and vice versa.

The following model of ether meets to the utmost all enumerated and known properties, the concepts of I. Newton, MacCullagh, J. Maxwell and W. Thomson.

1. Ether called further as ethereal medium, consists of alternate corpuscles of two, opposite in sign, kinds. The alternate corpuscles, opposite in sign, are attracted to each other, forming a homogeneous space, in which, in a non-perturbed state, each of the alternate corpuscles adjoin an alternate corpuscle, opposite in sign. Opposite in sign corpuscles are attracted to each other with great force.

2. Particles opposite in sign composing the ethereal medium move relative to each other completely without friction. The ethereal medium consisting of these particles is a medium of a special type. Linear, circular and other kinds of a motion, shear strains etc. can exist in it indefinitely long. This medium has no density in the ordinary sense. It has definite electromagnetic properties.

3. Any physical substance (matter, molecules, atoms), possessing a mass (density), is permeable to the ethereal medium. Any physical substance can move without friction in the ethereal medium.

4. The inertial forces originate when any physical substance interacts with the ethereal medium only at acceleration or deceleration of motion. A uniform motion of a local physical body deforms the ethereal medium, changing the distance between the oppositely charged, conjunct with great force particles of the ethereal medium, which close up again after the body has transmitted.

5. An acceleration of a local physical body creates inertial perturbations in the ethereal medium. The greater is acceleration of the body, the greater are the perturbations. The greater are the mass and acceleration of a physical body, the greater are the perturbations it induces.

6. The ethereal medium, to some extent, is bound (anchored) by great, on an astronomical scale, physical masses (for example, galaxies), as their presence and movement causes the greatest strain of the ethereal medium.

7. The waves propagating in the ethereal medium represent different kinds of shear strains, in which the displacement of the ethereal medium particles happens in the direction, perpendicular to the propagation direction. The enumerated theses require additional evidence and, at the same time, allow one to develop a physically adequate model of the ethereal medium structure. Below we present the evidence of the formulated theses.

4. Ether consists of two, opposite in charge, particles

The principle of matter separation into opposites is universal. All existing consists of two opposite elements. This philosophical thesis completely concerns ether. With this principle in mind it should be expected that a vacuum, namely the ethereal medium consists of two kinds of particles, charged positively and negatively. It is most probable, that these particles are of an electromagnetic nature. They are attracted to each other with great force. Let us try to construct the model of the ethereal medium, which would meet the phenomenon of a transverse nature when light and electromagnetic waves propagate. A string (filament) stretched in free space along a straight line can be an initial mechanical model for this purpose. The vibration theory for such strings is sufficiently well developed [53]. A flexible string can be presented as a set of unit masses, bound together themselves by rigid links. The rigidity of links is in their unchangeable, constant length. Hinges permitting a free motion of masses and links relative to each other, Fig. 4, connect the links and masses.



Fig. 4. A flexible string consisting of masses, rigid links and hinges.

If a displacement is given to the initial point of the string, the perturbation will begin to propagate along the string. The displacement vector of this perturbation will be perpendicular to the line of string extension, Fig. 5.



Fig. 5. Waves of a flexible string in free space.

It is necessary to note, that such a string in free space can transmit only waves with a displacement in the direction across the line, along which it is stretched. The string cannot transmit oscillations of any other kind.

Note that as early as 1736 Johann Bernoulli Jr. published a work where he compared the waves propagating in the ether with lateral vibrations of a cord in tension which “being slightly pulled aside and then released makes lateral vibrations normal to the cord direction” [8].

If we connect a number of single strings together by transverse rigid links, that hingedly also connect the masses, it is possible to get a plane structure or a lattice consisting of masses and rigid links, Fig. 6.

A plane lattice, as well as the line, Fig. 4, arranged in the manner described, will be capable to transmit only shear waves, Fig. 7.

The transition from the plane lattice to a spatial or volumetric (three-dimensional) one is easy to accomplish by adding the third coordinate to the lattice, Fig. 6, and locating the same rigid links, hinges and masses along this coordinate. Let us pay attention to the fact that in a spatial lattice each mass (particle) contacts six other particles through rigid links. It is quite

obvious that a spatial lattice consisting of the mentioned elements preserves an ability to transmit only shear waves. The direction of the displacement vector of these waves can be arbitrary in a spatial lattice.

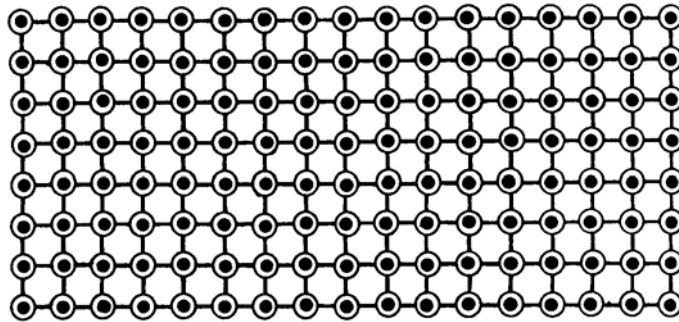


Fig. 6. A plane lattice consisting of unit masses, rigid links and hinges.

Now it is necessary to find a mechanism or some force, which would replace rigid links, retaining the elements of the spatial lattice together. In our opinion, an attractive force of particles of two opposite kinds, situated in a chess order in the points of a regular lattice could be such a force. Conventionally, they can be certain fundamental particles with a positive and negative charges, Fig. 8.

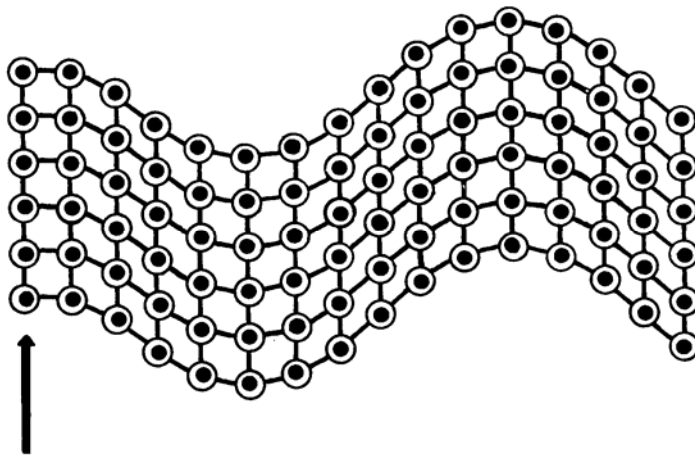


Fig. 7. A plane lattice transmitting shear waves.

In the figure, particles of two kinds, positive and negative, are represented as geometrically identical spheres tightly contacting each other. As will be shown below, the nature of their charges is electrical. It is doubtless, that for a spatial lattice formation, these fundamental particles should be attracted to each other with a great force.

The model consisting of particles of two kinds, opposite in sign that are attracted with a great force, explains many of the ethereal medium's properties. For example, it logically explains the exclusive homogeneity of vacuum, correctly noticed by J.C. Maxwell [13]. Really, a major attractive force among the particles will make a particle to come nearer to an analogue of an opposite kind. A process of attractive interaction and compensation of particles charges of an opposite kind will last till each particle of a particular sign is enclosed by six particles of the opposite sign. Thus, the structure of the ethereal medium will be strictly ranked and arranged as a regular spatial lattice. Dislocations, originating in free ether for some reasons, will propagate from the place of their origin at the velocity of light C . As it was

already shown above by the example of the most ancient Earth's rocks and meteorites [34], fundamental particles (electrons on its orbits et al.) can move through the ethereal medium extremely long and completely without friction. Accordingly, particles of this medium themselves can move relative to each other also without friction.

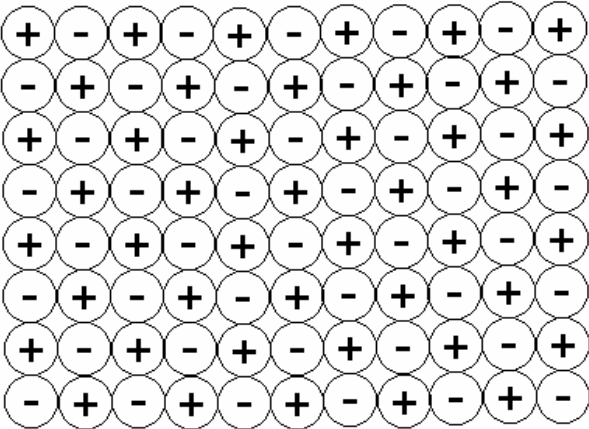


Fig. 8. The structure of the ethereal medium consisting of particles of two kinds, opposite in charge (projection to a plane).

The most visual idea of the ethereal perturbed medium is given by a magnetic field around a conductor with current or in the neighbourhood of a permanent magnet. Usually, a visualization of magnetic force lines is carried out with iron dust, Fig. 9.

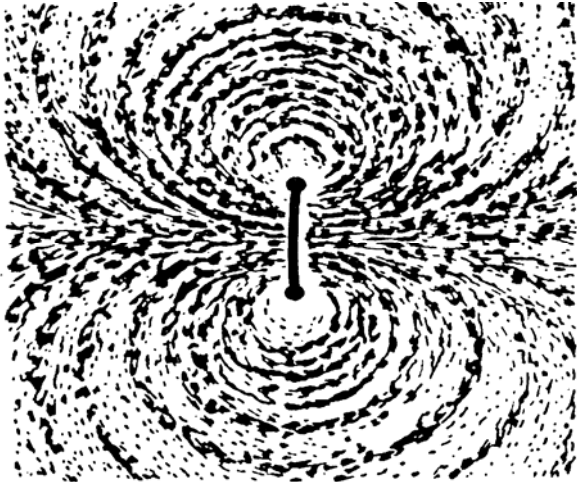


Fig. 9. Force lines of a magnetic field of circular current, traced through an iron dust.

The representation of a magnetic field as a shear strain of the ethereal medium is most logical. It eliminates a great number of contradictions. It is strictly proved that magnetic force lines are always close-mouthed. Equipotential lines of elastic shear strains are always close-mouthed too [54]. The so-called space continuity condition in this case is met. It should be supposed, that the space continuity condition is valid for the ethereal medium too. At the same time the concept explaining the nature of a magnetic field by the presence of a vortex motion (for example, some particles) along ring or other close-mouthed trajectories, requires a resolution of several contradictions.

First, an existence of unit material carriers of a magnetic field, which would be capable to move only along close-mouthed trajectories, should be assumed. However, individual carriers of a magnetic field, for example, Dirac monopole, have not been detected experimentally [25].

Second, individual field carriers, naturally, can move not only along close-mouthed trajectories. If such carriers of a magnetic field existed, they could accumulate on poles, similarly to electrical charges and were of a static nature. In such a case, they could easily be detected by experimental methods.

Third, in a vortical formation (population of enclosed into each other particles moving along close-mouthed trajectories of medium particles) a movement, depending on the distance to the centre of rotation should happen with different velocity. The velocity of particle movement is lower at the vortex periphery it rises in the direction to the centre. However by observations of the propagation of a magnetic component of radio waves with different frequency in an interplanetary space, it was determined that its velocity is close to a constant, namely to the velocity of light propagation C [44].

From the mechanics of moving media it is also known, that a vortex cannot be formed from particles moving with identical velocity, as for each of the rings, enclosed in the vortex, the laws of equality of moments of momentum and continuity of medium should be observed. Besides, it is extremely difficult to imagine and mathematically model closed streams of such particles without formation of local vortexes, instabilities, different shapes of laminar, turbulent and other kinds of motion. As is known, just the instability of motion is typically of streams of actual fluids, including especially superfluid ones.

It would be possible to conceive magnetic monopoles as waves moving around a conductor with current. However in this case, too, a contradiction arises: only the light velocity C is the allowed velocity of waves propagation in ether, and it is close, as is known, to a constant. Thus, a magnetic wave, which circulates around a conductor with current with a different, depending on the distance to the conductor, velocity cannot exist around the conductor.

An exposition of the magnetic field near a permanent magnet by a static shear, torsional strain of the ethereal medium is much closer to the nature of observable phenomenon. Thus, a model of vacuum composed of geometrically equal particles with opposite charges represents a continuous medium, in which only shear, torsional strains and shear, torsional waves are possible. The mathematical concept of a similar medium was developed as early as the century before last.

5. Mathematical model of quasielastic ether.

As early as 1839 on the basis of the usual theory of elasticity MacCullagh developed concepts of the ethereal medium, which appeared to be in agreement with the theory of electromagnetic and optical phenomena by J.C. Maxwell (1864). Below the equations of MacCullagh are given mainly in Arnold Sommerfeld's presentation [12]. In the theory of continuum, displacements, gyrations and strains are usually considered. An elastic body reacts to a strain by the rise of a tensor of elastic forces, the strains are also described by a tensor. Now let us imagine a "quasi-elastic" body, which is unreceptive to compression-tensile strains, but reacts to torsional strain relative to absolute space. A mathematical description of such shear strains can be given by an antisymmetric tensor. We can represent the strains applied to unit cube sides as antisymmetric tensor:

$$\begin{pmatrix} 0 & \sigma_{xy} & \sigma_{xz} \\ \sigma_{yx} & 0 & \sigma_{yz} \\ \sigma_{zx} & \sigma_{zy} & 0 \end{pmatrix}, \quad (12)$$

where $\sigma_{ik} = -\sigma_{ki}$.

The relation between a rotation and strains are shown in Fig. 10. The elementary volume $\Delta\tau$ is turned by an angle of φ_z (an arrow around the positive direction of the z -axis, according to the rule of right-handed screw).

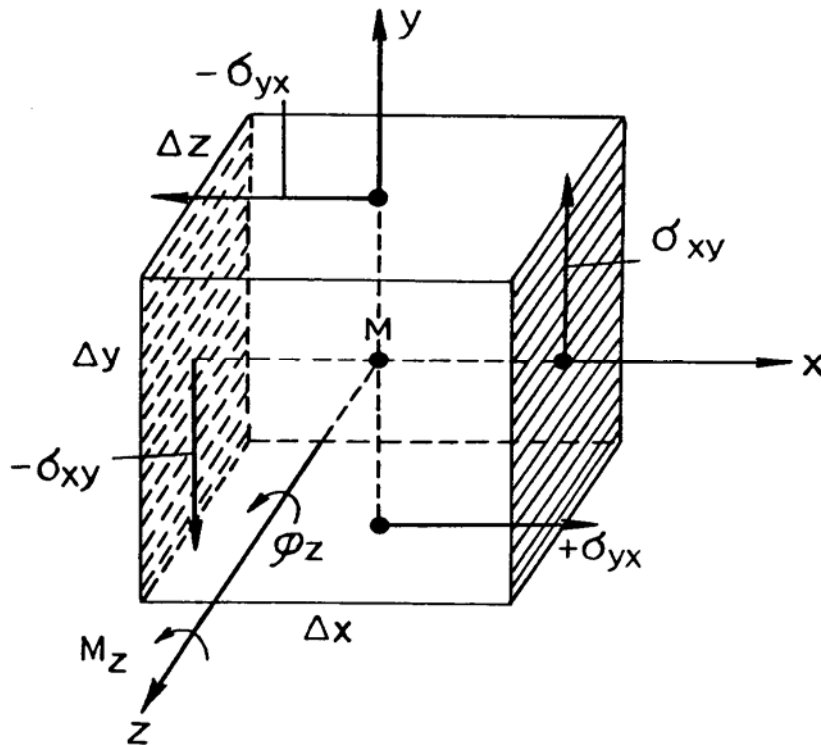


Fig. 10. Relation between strains and twisting moment in a quasi-elastic body.

To realize such torsion it is necessary to apply a moment of force around the z -axis:

$$M_z = k\varphi_z \Delta\tau, \quad (13)$$

where k is the "torsion modulus" of a quasi-elastic body. Two shearing forces σ_{xy} and σ_{yx} designated in the figure, in the x - and y -planes, plotted on the axes x and y in positive directions and antiparallel forces in the relevant planes along the axes in negative directions, correspond to this moment of force. To observe a correspondence between (12) and (13) we should get

$$\sigma_{xy} = -\sigma_{yx} = (k/2)\varphi_z. \quad (14)$$

As a result we obtain the moment operating in both x -planes:

$$2\sigma_{xy}\Delta y\Delta z(\Delta x/2) = (k/2)\varphi_z\Delta\tau$$

and the moment operating in two y -planes

$$-2\sigma_{yx}\Delta x\Delta z(\Delta y/2) = (k/2)\varphi_z\Delta\tau,$$

as well as the moment from equation (13).

The cyclical substitution from (14) explicitly leads to the following expressions:

$$\sigma_{yz} = -\sigma_{zy} = (k/2)\varphi_x, \quad \sigma_{zx} = -\sigma_{xz} = (k/2)\varphi_y. \quad (14a)$$

The action of forces, given in Fig. 10, can be represented schematically as those applied to an infinitesimal material point, situated inside a certain body.

It is possible to write down the motion equations of this quasi-elastic body by analogy with the known motion equations from the theory of elasticity [54]. Compiling them, we should take into account inertia (δ - is the mass of a unit volume) and consider only conventionally slow motions. Besides, we should abandon exterior forces ($P = 0$). Then, taking into account (14) and (14a), we shall get

$$\delta \frac{\partial u}{\partial t} = \frac{\partial \sigma_{yx}}{\partial y} + \frac{\partial \sigma_{zx}}{\partial z} = -\frac{k}{2} \left(\frac{\partial \varphi_z}{\partial y} - \frac{\partial \varphi_y}{\partial z} \right).$$

The latter, cyclically converted and vectorial written, represents an equation of motion

$$\delta \frac{\partial \vec{S}}{\partial t} = -\frac{k}{2} \text{rot } \vec{\varphi}. \quad (15)$$

This equation can be represented in another way, using the ratio between \vec{S} and the angular velocity $\vec{\omega}$. It will happen, if here we exchange $d\varphi/dt$ for $\partial\varphi/\partial$ too

$$\delta \frac{\partial \vec{\varphi}}{\partial t} = \frac{1}{2} \text{rot } \vec{S}. \quad (16)$$

Based on assumptions of medium incompressibility, for the value of $\vec{\varphi}$, - i.e. the angle of rotation of the displacement vector, we shall add the following condition:

$$\text{div } \vec{S} = 0, \text{div } \vec{\varphi} = 0. \quad (17)$$

According to A. Sommerfeld [12], the set of equations (15), (16) and (17) demonstrates a convincing simplicity and symmetry. It has the same shape, as equations of J.C. Maxwell for vacuum.

For more detailed investigation we shall introduce an electric field strength \vec{F} , a magnetic intensity \vec{G} , the constants of proportionality α, β , whose dimensions will depend on a choice of a physical quantities system, in which \vec{F} and \vec{G} are expressed and also on the sign before the magnetic field charge and force:

$$\text{a) } \vec{S} = \pm\alpha\vec{F}, \quad \vec{\varphi} = \pm\beta\vec{G},$$

or

$$\text{b) } \vec{S} = \pm\alpha\vec{G}, \quad \vec{\varphi} = \pm\beta\vec{F}.$$

Then identically to equations (15), (16) and (17) we shall receive the following twice:

$$\begin{aligned} \varepsilon_0 \frac{\partial \vec{F}}{\partial t} &= \text{rot} \vec{G}, & \text{div} \vec{F} &= 0, \\ \mu_0 \frac{\partial \vec{G}}{\partial t} &= -\text{rot} \vec{F}, & \text{div} \vec{G} &= 0. \end{aligned} \tag{18}$$

The abbreviations introduced here ε_0, μ_0 are termed dielectric and magnetic permeability of vacuum. In the system of our designations they will be given via:

$$\varepsilon_0 = \frac{\delta}{k} \frac{2\alpha}{\beta}, \quad \mu_0 = \frac{2\beta}{\alpha}, \tag{18a}$$

$$\mu_0 = \frac{\delta}{k} \frac{2\alpha}{\beta}, \quad \varepsilon_0 = \frac{2\beta}{\alpha}. \tag{18b}$$

Their product is irrespective of the choice of a system of units (the coefficients α, β). In both cases, this product will be equal to:

$$\varepsilon_0 \mu_0 = \frac{4\delta}{k} = \frac{1}{C^2}. \tag{19}$$

Thus, the particular value of C means the velocity of propagation in vacuum. Let us take note, that just as the Newtonian definition of velocity is bound up with the concept of elasticity, so C is bound with the torsion modulus k .

In a ponderable dielectric the same basic equations (18), as in vacuum, operate only with the changed values of ε, μ , instead of ε_0, μ_0 . However, both conditions of divergence will vary essentially. Instead of $\text{div} \vec{G} = 0$ there should be

$$\text{div} \mathbf{B} = 0, \text{ where } \mathbf{B} = \mu \vec{G} \text{ is magnet induction.} \tag{20}$$

This implies that a torsional deformation $\vec{\varphi}$ of a medium will be determined not by the value of \vec{G} , but by the value of \mathbf{B} creating no difficulties. On the other hand, the condition $\vec{F} = 0$ will transform into

$$\operatorname{div} \mathbf{D} = \delta_e, \quad \text{where } \mathbf{D} = \varepsilon \vec{F} \text{ is electrical strength,} \quad (21)$$

where δ_e is spatial density of an operating electrical charge.

Since not \vec{F} , but \vec{G} determines now the current velocity \vec{S} and the constants ε , μ , are bound with k , δ , α and β , J.C. Maxwell's equations can be valid here too, in a ponderable dielectric. In the work [12] A. Sommerfeld writes, that he is far from attaching any physical sense to this "model of ether". At the same time, the inclusion of the part about a model of quasi-solid ether into his fundamental work "Mechanics of deformable media", which latest edition was issued in 1978, is rather significant.

The strain of the ethereal medium arising around the conductor with current, Fig. 9, most clearly demonstrates the validity and adequacy of MacCullagh's concept. Torsional strain forms a number of nested concentric surfaces. Each of these surfaces is equipotential within which a magnetic field intensity is a constant.

Our proposition (see p.6 of section 3) that the ethereal medium, to some extent, is bound by great (according to astronomic scales) physical masses, corresponds to MacCullagh's earlier concept. In our opinion, the strains in the ethereal medium can be described by all tensor types in which diagonal terms, as in (12) are zero. It means that in the ethereal medium strains of shape-changes, i.e. torsion, twisting and shear may exist.

6. Density of the ethereal medium in a vacuum and in physical media.

On the basis, of the equation (19) from the previous section we can state, that the ethereal medium possesses some density δ of an electromagnetic nature. Owing to the very high homogeneity of this medium (except for the areas close to physical bodies), the density, as well as the velocity of light C , is rather constant. This medium is in a sense an analogue of an omnipresent (distributed) fluid with constant density. But, it is necessary to consider such a medium or vacuum a material body, as it actively exhibits itself in electrical and magnetic fields and is the basis, in which electromagnetic waves propagate. Therefore, it is necessary to term the ethereal medium, Fig. 8, a distributed material body. Physical bodies of the higher-level organization (electrons, atoms, molecules etc.) are not distributed uniformly in space, as the ethereal medium. They are geometrically concentrated and represent clots of a material medium in particular points of space. It is necessary to term them concentrated material or physical bodies. This definition has also the sense, that physical bodies can be detected by physical devices. Of course, the properties of the ethereal medium can be determined by wave excitation in it, for example. However, the characteristics of an unexcited ethereal medium cannot be defined, because any physical device will change its state on measuring.

The density of the ethereal medium, as well as the density of a physical one, is one of the parameters defining the velocity of waves propagation in it. From the equation (19), given in the previous section, it is possible to find out, that the velocity of electromagnetic waves propagation in a vacuum is equal to

$$C = \sqrt{\frac{1}{\epsilon_0 \mu_0}} = \sqrt{\frac{\kappa}{4\delta}}, \quad (22)$$

or

$$C = \sqrt{\frac{\kappa}{4\delta}}. \quad (23)$$

As follows from this equation, the torsion elasticity k , equivalent to the square of the light velocity should be very great. It could be determined, if the electromagnetic density of a vacuum δ was known. The assessment of the density δ can be made using the wave impedance equation for vacuum. As is known, the wave impedance of continuous media is defined by the formula:

$$R = \delta C, \quad (24)$$

whence

$$\delta = R/C. \quad (25)$$

The value of the vacuum wave impedance is precisely known [3],

$$R = \sqrt{\frac{\mu_0}{\epsilon_0}}, \quad (26)$$

where μ_0 is magnetic permeability, ϵ_0 is the dielectric constant of vacuum. The velocity of light C can also be expressed as μ_0 and ϵ_0 :

$$C = \sqrt{\frac{1}{\mu_0 \varepsilon_0}}. \quad (27)$$

Substituting the expressions for R and C into the formula (25), we shall obtain

$$\delta = \mu_0 = 1.25664 \cdot 10^{-6}, m \text{ kg} \cdot s^{-2} a^{-2}, \quad (28)$$

where the density dimension is given in the SI system units.

Thus, the magnetic permeability μ_0 plays the role of density (inertial mass) in the ethereal medium. Now we shall use A. Sommerfeld's formula (19) to determine the value of torsion modulus

$$\kappa = 4/\varepsilon_0 = 4.51763 \cdot 10^{11}, m^3 \text{ kg} \cdot s^{-4} a^{-2}. \quad (29)$$

We mentioned in Sec. 2 that MacCullagh identified dielectric permeability ε with the reciprocal of elasticity [11].

So, it uniquely follows from the definitions of δ and k that the ethereal medium (vacuum) is of an electromagnetic nature. The exponents of these values give an idea of the value δ as a very small one, and of the torsion modulus k as an extremely high one. The classical mechanics and the mathematical oscillation theory show with obviousness that wavelike processes can exist only given some distributed masses and elastic forces uniting the masses into an unbroken continuum. It is necessary to take into account, that for solid isotropic bodies there is a formula linking the values of the velocity V , mass and elastic modulus of a substance [53]:

$$V = \sqrt{E / \rho}, \quad (30)$$

where E - is the elastic modulus, ρ is the substance density.

A comparison of the formulas (23) and (30) shows, that they are similar. In the formula (30) the elastic modulus E reflects the elasticity of links between particles in a solid body. The substance density ρ reflects the mass of these material points. As follows from the form of the formula (30), the velocity V in a solid (and not only in solid) body is higher in those substances, in which the links between material points (atoms, molecules) have greater force, the velocity is less in those, whose atoms and molecules are less massive. Many substances, in particular, diamond and lead, can exemplify this concept. As is known [56], diamond is noted for its great hardness and elasticity. For example, the value of the velocity of shear waves propagation in it is $V_s = 12.32 \text{ km/s}$, with the density $\rho = 3.51 \text{ g/cm}^3$. At the same time in lead the velocity $V_s = 0.86 \text{ km/s}$ and the density is $\rho = 11.6 \text{ g/cm}^3$. A proportional dependence between the velocity V_s and the value $1/\rho$, the inverse of the density, is well expressed for alkaline metals. Besides, simple mechanical models demonstrate the rule – the greater is the mass of unit cells in oscillating systems, the lower is the oscillation frequency and v.v. Accordingly, the greater is the elasticity of joints in the elementary cell, the higher is the oscillation frequency in the oscillation system and v.v. Adverting to the expression (29) we see, that the shear elasticity of the ethereal medium k is really very great. The comparison of the velocity of the shear wave propagation in elastic solid bodies with the velocity of light C indicates it. For example, the velocity of propagation of shear waves in the most elastic solid substance - diamond - is only $4.1 \cdot 10^{-5}$ of the C value. Accordingly, the vacuum density should be very low, as follows from the C value (28). It is natural, that the electromagnetic values of

δ and k cannot be strictly compared with the relevant characteristics of solid bodies by virtue of their distinguishing physical nature.

7. The attractive forces mechanism of physical bodies in the ethereal medium

As is known, sizes of atoms, including their electron shells are fractions and units of the unit of angstrom, $\text{\AA} = 1 \cdot 10^{-10} \text{ m}$. The nuclei have the sizes close to 10^{-15} m . At the same time, the wavelength, for example of a visible light, is $(4-7) \cdot 10^{-7} \text{ m}$ [57]. There are many experimental data about the propagation of light in gaseous, fluid and solid media.

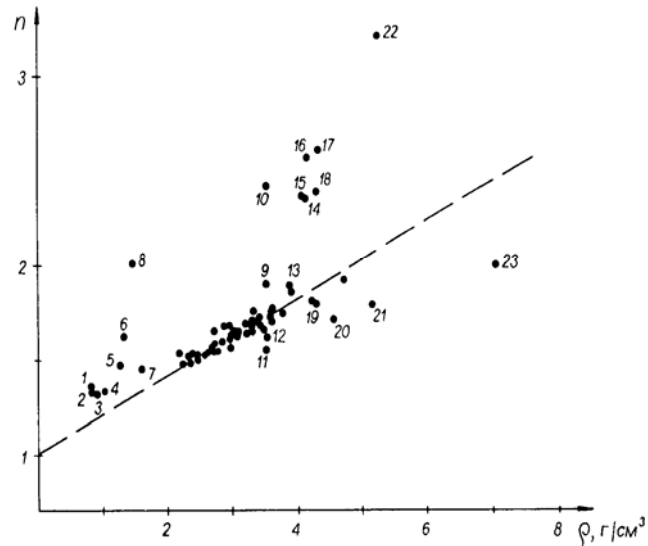


Fig. 11. The relationship between the refraction coefficient n and the density ρ of some liquid and solid substances, minerals (based on the data [56, 58]). 1 - ice, 2 - acetone, 3 - alcohol, 4 - water, 5 - glycerine, 6 - carbon bisulphide, 7 - carbon tetrachloride, 8 - sulphur, 9 - titanite, 10 - diamond, 11 - grothite, 12 - topaz, 13 - siderite, 14 - wurtzite, 15 - sphalerite, 16 - brookite, 17 - rutile, 18 - goethite, 19 - xenotime, 20 - barite, 21 - monazite, 22 - hematite, 23 - cassiterite.

The refraction coefficient, which can be measured to a high accuracy in transparent media, is the parameter, closely related to the propagation velocity of a light wave. Let us consider a relationship between the refractive coefficient n and the density ρ of some substances (Fig. 11).

Parameters of the majority of substances (anhydrite, apatite, baddeleyite, beryl, boracite, galena, halite, gypsum, disthene, dolomite, calcite, quartz, cordierite, corundum, leucite, microcline, muscovite, nepheline, orthoclase, periclase, rhodonite, sillimanite, staurolite, zircon, eudialyte and lot of others) are subject to the relationship:

$$n = 1 + 0.2 \rho. \quad (31)$$

This relationship has been reflected by a dotted line in Fig. 11. In the figure the substances, whose relations ρ and n are outside the general relation, are numbered. For example, the ratios for diamond, sulphur, iron, titanium and some of their compounds on the plot are above the line of the general relation. The relations for some compounds of fluorine, barium, phosphorous, tin, etc. are below this line.

As a whole, transparent substances, including gases, fluids and solid substances have the refraction coefficient n more than unity [2]. It means that the light waves (photons) velocity in physical media is always lower, than in vacuum. It is natural to assume, that the deceleration of the velocity of light propagation in physical media happens due to the effect of bending around some, impenetrable for photons, areas. The photons of low energies have to bend the areas of space occupied by electron shells and atom nuclei. High-energy photons penetrate into the areas that are closer to a nucleus. X-ray waves interact directly with the area of an atomic nucleus. The deceleration of the light velocity of in physical media is contributed by the effects of photons re-emission, recombination and luminescence, to a greater degree. However, the basis, in which light waves propagate, is the ethereal medium. Thus, it is logical to assume, that the ethereal medium, being displaced by nuclear forces, is absent both close to an atomic nucleus and inside it.

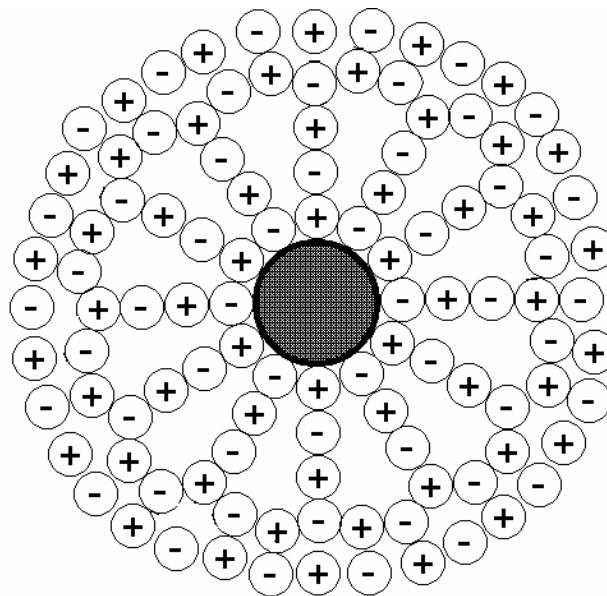


Fig. 12. A simplified scheme of the spatial network structure of ether in the vicinity of a unit spherical mass.

In Figure 12 the structure of the ethereal medium near to a conditional atomic nucleus is represented as a unit spherical mass in simplified form. The given primitive scheme displays, that the spatial netlike structure of ether has been distorted by the spherical mass. Near to the spherical mass this structure is appreciably loosened. As the structure moves away from the spherical mass, the loosening degree will diminish. It is natural, that the sizes of such a mass, for example, an electron and a particle of the ethereal medium, are incomparable in sizes. The relation of their sizes is much greater than it is shown in Fig. 12.

A comparison of Fig. 8 and 12 shows that the structure, near to which there are no physical masses, has the greatest density. The structure distorted by mass presence, has a less density. A spatial netlike structure formed by unlike particles attracted to each other, develops great pressure on their contacts as was shown above.

The same or less pressure will be exerted on the spherical mass as well, Fig. 12. This pressure will be developed due to breaking contacts of unlike particles immediately contiguous to the spherical mass. The pressure on the spherical mass will be strengthened due to distortions of the second, third, fourth etc. line of the structural lattice, situated, accordingly, in the second, third, fourth etc. line from the spherical mass. This pressure is

caused by a quest of particles situated in the second, third etc. line to be as close as possible to each other and to restore the non-deformation structure, Fig. 8.

At some greater distance from the centre of the spherical mass, the general view of the structural medium can be conventionally represented as concentric spheres inserted one into another, Fig. 13.

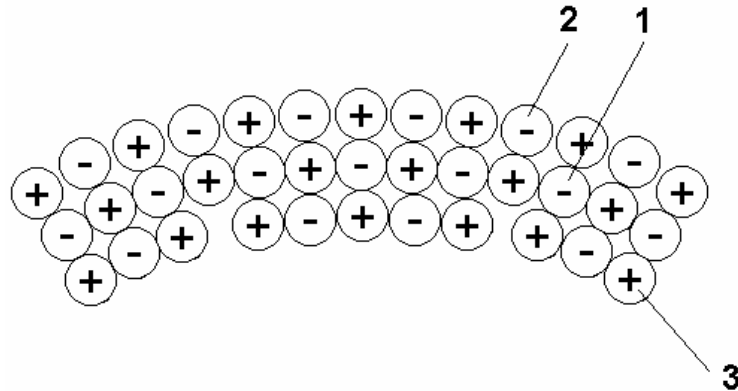


Fig. 13. A fragment of the structure of the ethereal medium at some distance from a physical mass.

Conventionally, we shall consider, that in a medial concentric sphere (1, Fig. 13) all particles of the opposite kind contact with each other directly, without intervals. Then in the concentric sphere located further from the mass (2, Fig. 13), since the number of the opposite particles should correspond to each other, intervals will appear between them. In the concentric sphere located closer to a physical mass (3, Fig. 13), the package of particles will also be less dense, because it is impossible to dispose the same number of particles here, as in the medial sphere. Some of the particles from the near sphere will be forced out, and empty space will occupy their places.

The comparison of the diagrams, introduced in Fig. 8 and 13 enables to conclude that the ethereal medium in an environment of a physical mass is less dense and "looser", than in a medium without physical masses. It is easy to imagine that, as we move away from a physical mass, the density of the ethereal medium will increase, and its "loosening" will diminish proportionally to the distance from this mass.

If we imagine some physical test mass and place it inside a non-perturbed ethereal medium, Fig. 8, this test mass will distort the structure of the ethereal medium as it is shown in Fig. 12. The test mass will experience the greatest pressure, equal from all directions. Now let us move the test mass to the medium that has already been distorted by the presence of some physical mass, Fig. 13. In this case, the pressure on the test mass will not be identical from all directions. The test mass will be under pressure of a great many concentric layers of different curvature, depending on the distance to the physical mass. The concentric layers of lower curvature will exert the greater pressure on the trial mass. The pressure exerted by the layers with greater curvature that are closer to the physical mass, will be lower. Thus, the ethereal medium in the field of influence of a physical mass appears to be gradient. The vector of this gradient is directed to a physical body. The force pushing this body to a physical mass will be applied to the test body. This is just the fundamental basis for gravitational forces in the ethereal medium consisting of equal, opposite in sign particles.

Thus, a loose ethereal medium represents space, to which free masses from the area of space, with denser ethereal medium are displaced. If the lattice is curved, for example, due to the presence of some mass inside the lattice, it is less dense. In such a curved lattice, a free

mass will move in the direction the lowering the gradient of the lattice density (or otherwise, in the direction of greater "loosening").

The law of gravitation is rather easily deduced from the above concepts. Let us assume, that along the circumference L_1 , of the concentric layer 1, Fig. 14, formed around of the heavy mass M_1 , the precise number n_1 of particles of opposite signs with diameter d , or $L_1 = n_1d$, are stacked.

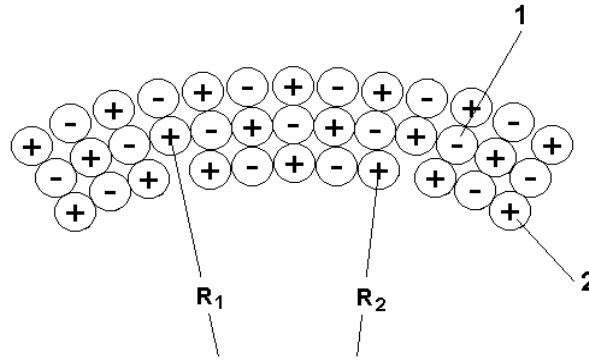


Fig.14. The schema for quantity calculation of particles in concentric layers in the ethereal medium around a physical mass.

Let us consider, that $L_1 \gg d$. The radius of such a circle will be equal to $R_1 = n_1d/2$, and the quantity of particles $n_1 = 2\pi R_1/d$. As follows from our model the next concentric layer that is closer to the heavy mass with the circumference L_2 , will have the radius R_2 , smaller just by the magnitude of the particle d size than the first one, $R_2 = R_1 - d$. The circumference of layer 2 will be equal to $L_2 = 2\pi R_2 = d(n_1 - 2\pi)$, and the number of particles $n_2 = 2\pi(R_1 - d)/d$. Otherwise, $n_2 = n_1 - 2$. Accordingly, in layer 2 the number of particles will be by 2π less than along the circumference L_1 . On the other hand, each particle of the circle L_1 must be corresponded by another, opposite in sign, particle L_2 . Then due to the $n - 2\pi$ number of particles in the second concentric layer 7 particles of the first layer will not be compensated. Therefore particles of layer 2 will be at slightly greater distance from each other, than the particles of the first layer. Thus, in the limits of concentric layer 2 some loosening of the ethereal medium occurs.

In some k -layer that is closer to the centre by the value kd , along the circumference the number of particles $n_k = n_1 - 2k\pi$ will be stacked. The value of the ethereal medium loosening in the k -layer in relation to the first layer can be expressed by the coefficient, showing the ratio of the number of particles in each layer to their circles:

$$\Delta_k = (n_1 - 2k\pi)/n_1 = 1 - 2k\pi/n_1. \quad (32)$$

The formula (32) in fact, at great numbers n , expresses a modification of the diameter (radius) or curvature of concentric layers, in the limits of which, ideally, the particles of ether are disposed.

It is easy to show, that with distance from the centre, the curvature (for spherical surfaces) diminishes proportionally to the square of the radius of the sphere. Accordingly, the degree of the vacuum medium "loosening" will decrease as much as the distance from the mass disturbing vacuum, will increase.

Let us imagine a presence of a point mass M_1 in the homogeneous, non-perturbed vacuum. As was already shown, with distance from the point mass M_1 , the degree of vacuum "loosening" will diminish proportionally to the first power of the distance R to the centre of

the mass that is M_1/R . Now we shall introduce the second mass M_2 into the point located at the distance R from the first mass. The mass M_2 will cause "loosening" of the vacuum equal to M_2/R at the area of the mass M_1 . Thus, the mutual attraction of the two masses M_1 and M_2 will be proportional to the product of two foregoing expressions,

$$T = -\frac{M_1 \cdot M_2}{R^2}. \quad (33)$$

As is known, the law of gravitation is stated as follows: two material points possessing masses M_1 and M_2 are attracted to each other with the force F :

$$F = -g \frac{M_1 \cdot M_2}{R^2}, \quad (34)$$

where R is the distance between the points, and g is the gravitation constant equal to $6.67 \cdot 10^{-11}$, $n \cdot m^2/kg^2$ [57].

From this example it is clear, that the law of gravitation is directly deduced from the offered model of the ethereal medium. When analysing the formulas (33) and (34) one should take into consideration that ethereal particles are extremely small.

Thus, the presence of unit masses shown in Fig. 12, or their accumulation distorts the configuration of the spatial- netlike structure of the ethereal medium. As the unit masses concentrated mainly in nuclei are bound with each other by particular forces, forming solid, liquid and gaseous bodies, deformations introduced into the spatial-netlike structure, are partially summarized from each unit mass. In the end, it leads to loosening, lowering the specific density of the ethereal medium. The more is the total mass of a physical body, the greater is the loosening. It is great in the vicinity of planets. It is even greater in the vicinity of a massive star. Loosening of the ethereal medium created by galaxies, stretches for astronomical distances. The potential theory [59] allows one, from the given mass distribution, to determine mutual gravitational forces in planetary and more complicated systems.

The explanation of the nature of a mutual attraction of physical bodies, in our opinion is one of the most important results of the non-empty ether concept. As mentioned above, earlier I. Newton, MacGullagh, W. Thomson, et al. pointed to the presence of quasi-solid ether deformed by physical bodies [11, 12, 15, 32, 33]. There are experimental data confirming such a strain. For example, the light propagating in the environs of a massive body propagates with lower velocity than when it is far from it. During radiolocation of Mercury and Venus, as they moved behind the disk of the Sun, an additional signal delay stipulated by the gravitational field of our star, was about $2 \cdot 10^{-4}$ s [60]. Thus, lowering of the rigidity, "loosening" and deformation of the ethereal medium near to physical bodies have been confirmed.

The proposed concept of the ethereal medium structure explains the nature of inertial forces, and the reason for identical acceleration of bodies of different mass in a gravitation field. Each physical body at rest occupies certain space in the ethereal medium, displacing a part of the netlike ether and distorting its structure, as it is shown in Fig. 12-14. Without the influence of gravitation masses, the ethereal medium will exert an equilateral pressure on this physical body. If a physical body moves uniformly, it will be flowed around by the ethereal medium. In the direction of the body's motion, in front of it, some mass of the ethereal medium will disconnect. Behind the body, the same mass, with the same velocity, as in front of the body, will close. Moment of momentum of masses located along the line of motion in

front of the body and behind it will be equal. As the ethereal medium has no ability to absorb, disperse energy, uniform motion of a physical body can continue indefinitely long.

Another situation will be observed during acceleration of a physical body motion. In this case moment of momentum of the ethereal medium mass located in front of the body and behind it will differ. To cause an acceleration of a physical body it is necessary, according to the second Newton's law, to apply force to it. To cause an acceleration of a heavier body, it is necessary to disconnect a much greater number of particles of the ethereal medium proportional to the mass of this body along the line of its motion. Thus, the acceleration of a light and heavy body, for example, in the gravitation field of the Earth, will be identical. The absence of ether, as a medium, actively interacting with an accelerated mass, contradicts the third Newton's law of action and reaction.

It is the interaction of the accelerating charge with the ether medium that enabled J.J. Larmor [61] to propose the following hypothesis: since atoms consist of electron systems, it may be proved that the inertia of ordinary weighty matter can be explained by the excitation of self-inductance currents during acceleration of the weighty body. Every electron, as it accelerates together with the body, excites convection self-inductance currents around itself. In this case, according to the energy conservation law, some work should be done to produce these currents (local magnetic field of self-inductance) and to set the electron in motion.

But this hypothesis was not supported by physicists at that time. To our mind, the idea of J.J. Larmor is fruitful and it is necessary to return to its development.

A physical body moving uniformly in the ether medium does not meet resistance. Even D'Alambere pointed to the possibility of a body to maintain a strait-line uniform motion meeting no resistance in an ideal liquid. Thus, the ether medium resembles an ideal liquid by its properties, but at the same time it has some distinctions of a specific solid body.

8. Strain of the ether medium in electric and magnetic fields

The influence of an electric current on the magnetic needle behaviour was first found by Oersted in 1820 [62]. Faraday observed the electroinduction phenomenon [63]. Later it was shown that equipotential lines of the magnetic field round a conductor with current are concentric circles. Here is how Pointing described the rise of lines of force round a conductor with current: "When the strength of the electric current that flows in a direct conductor increases gradually from zero, the ambient space is being filled with magnetic lines of force that have a shape of circles arranged around the conductor's axis. "... These lines of force get to their places moving outside from the conductor in such a way that the magnetic field grows since the conductor constantly emits lines of force which expand and travel just as ripples caused by a stone thrown in still water". [64].

Then an electromotive force (EMF) of self-induction was found. According to Lenz's law [57], inductive currents are always directed in such a way that their proper field counteracts the changes of the field that cause them. EMF of self-induction appears when turning off an electric circuit. Since the magnetic field around the conductor with current disappears when turning off the circuit, one may presume that the EMF of self-induction is formed due to transformation of magnetic field energy into electric current.

According to our concept, the self-induction mechanism is the following. At the initial stage of switching on an electric circuit the electric current cannot reach its maximum value at once, since part of its energy is spent on formation of a magnetic field in the ether medium around the conductor (here we consider the conductor placed in the evacuated space). The magnetic field cannot rise instantly, since electromagnetic disturbances in the vacuum propagate with the final velocity - velocity of light C . In principle, the magnetic field of the conductor with current extends over indefinitely great distances.

The magnetic field is maintained all the time while the current flows in the conductor, Fig. 9 and 15. When turning off an electric circuit the magnetic field energy stored in the ether medium is given back to the conductor as a self-induction current. Quite apparently, during switching on a circuit, part of the electric energy is elastically stored as a magnetic field around the conductor. During switching off it elastically comes back to the circuit as EMF self-induction. Some part of the energy is irreversibly spent for electromagnetic radiation both during switching the current on and off.

Thus, the ether medium or vacuum around the conductor plays the role of an elastic element storing energy. Around the conductor with current a torsion strain (a kind of a shearing strain) described by MacCullagh's tensor appears (12).

It is rather difficult to think up other mechanisms that might adequately explain both the phenomenon of self-induction and other effects observed in experiments. Theoretically, one may assume the existence of single material carriers of a magnetic field that are able to move only along closed trajectories. P. Dirac made attempts to provide theoretical grounds to the

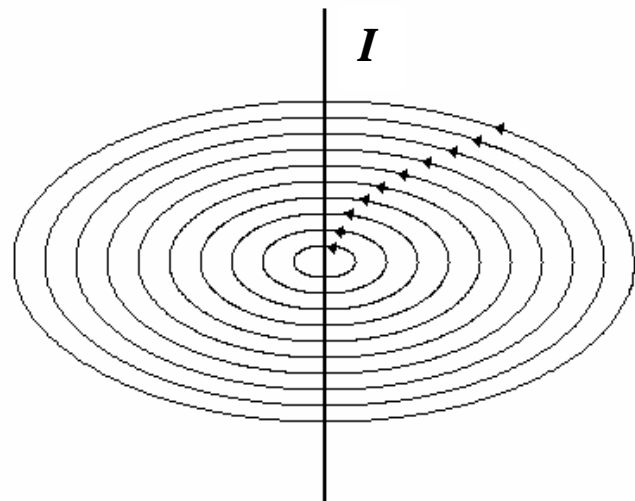


Fig. 15. Equipotential lines of a magnetic field in the ether medium (vacuum) around a linear conductor with current I .

presence of individual carriers that were called monopoles [55, 60]. Naturally, such monopoles can move not only along closed trajectories. If the single carriers of a magnetic field had existed they might be accumulated at the poles similar to electric charges and would have been of a static nature. In this case they would have been easily detected experimentally.

One might imagine magnetic monopoles as waves moving around a conductor with current. But in this case also a contradiction arises, i.e. the allowed velocity of electromagnetic waves in the ether is only the velocity of light C that is close, as is known, to a constant. Thus, the magnetic wave that moves around a conductor with current with various velocities depending on the distance to the conductor, cannot exist around this conductor. Previously Yu.K. Sakharov [65] noted that the law of conservation of energy forbids the existence of a magnetic monopole.

A substantiation of a possible existence of gaseous or liquid ether encounters more principle contradictions than its quasi-solid model. It is extremely difficult to imagine and mathematically simulate closed streams of gas or liquid particles without formation of local swirls, instabilities, different forms of laminar, turbulent and other kinds of movement. The behaviour of real gases follows the laws of thermodynamics. As is known, it is just the motion instability that is typical of the flows of real liquids including superfluid ones. Observations on the magnet component of radio waves of various frequency in the interplanetary space showed that its velocity as well as the velocity of light C is near to constant [44]. This suggests a substantial homogeneity of the ether medium and points to a low probability of dynamic instability of various types existing in this medium.



Fig. 16. The velocity profile in an atmospheric typhoon registered in Manila on 20 October, 1882.

A movement in a vortex formation (a set of medium particles embedded into each other and moving along circular paths) should be with a different velocity in relation to the distance to the centre of rotation. The laws of equality of angular momentum and medium continuity should be followed for every ring embedded in the vortex. On the vortex periphery the particle circular velocity is lower, as the particles move to the centre, the velocity increases. As observations show, at some distance from the centre, the circular velocity acquires the maximum value. Farther to the vortex centre the circular velocity of particles decreases. This phenomenon can be explained by weakening of the centrifugal force action on inertial particles (i.e. massive particles). The velocity decrease in the centre of the whirl is most conspicuous during atmospheric cyclones, hurricane, typhoon, tornado etc. Fig. 16 gives the profile of the air speed in an atmospheric typhoon that corroborates this phenomenon. The velocity profile of this natural phenomenon was registered in Manila on 20 October, 1882 [66]. The total time of the typhoon passage through the town was about 12 hours. During 5 hours the wind speed V reached 60 m/s . Then it fell sharply virtually to zero in the tornado centre. After passing the centre, the wind speed again reached its maximum.

Experiments show that around a conductor with current, the gradient of decrease in the magnetic field stress is directed away from the conductor and its function is monotonous [57, 67]. In this case, as is shown above, the ether medium has a specific mass (see Sect. 6) and the processes of magnetic field formation around the conductor with current are inertial. If the magnetic field had been really vortex then we would have observed a rather weak magnetic field near the surface of the conductor with direct current. At some distance it would have acquired the maximum value. Then, as the magnetic field moved away from the conductor, it would have decreased monotonously. Thus, the known Maxwell's equation $B = \text{rot} \vec{e}$ (\vec{e} is

elastic displacement) cannot be brought into correlation with the vortex motion of an inertial medium. The above Maxwell's equation suggests a monotonous decrease of the magnetic flux from the linear current along the normal to this current.

As shown above, the distribution of velocity and power in the vortex motion of particles possessing inertia (mass) differs radically from that described by the Maxwell's equation. In fact, a monotonous decrease of the magnetic field value around the conductor with direct current begins directly at the conductor surface. These observations count in favour of MacCullag's hypothesis of quasisolid ether (see Sect. 5).

We should also notice that an imagination of a magnetic field as a vortex near, for instance, a permanent magnet suggests an availability of a dynamic motion. But the field of a permanent magnet is really constant. It does not reveal itself if there is no other magnet or moving conductor. After W. Thomson (see Sect. 2), a dynamic movement formed by the flow of hypothetical magnet particles near a cylindrical solenoid with current, would really draw the particles inside the solenoid. But then the flow of particles forming the magnet field would push those particles out of the solenoid. Carrying the particles out of the solenoid would occur, if for no other reason than the sluggishness (inertness) of their movement. Experiments show that ferromagnetic particles drawn into the solenoid remain in it. They remain in the area of the maximum stress of the magnetic field, i.e. where the maximum strain of the ether medium is observed.

From the above, it is most logical to imagine a magnetic field as a torsion (shear) strain of the ether medium. It has been strictly proved that magnetic lines of force are always closed. Equipotential lines of elastic shear strains are also always closed [54]. In this case the so called medium continuity condition is met. It should be believed that the medium continuity condition is valid for ether as well.

Particles in the ether medium are rigidly bound, so they can move there only relative to each other forming strains of this medium. Rotary motions of one particles relative to others do not occur in the medium. If ether particles could spin, then the light passing through the field of a strong magnet would be polarized.

As shown above, in the ether medium only torsional and shearing strains, i.e. strains of a form are possible. Accordingly, in the strained ether medium, magnetic fields of different forms can exist. They reflect the strain form of the medium. Potential power in the ether medium is stored as a magnetic field and an electric charge field. Both these fields reflect different strains of the ether medium. Dynamic effects occurring in the ether medium will manifest themselves as displacement currents.

A torsion strain can be expressed by the equation describing a linearly decreasing strain with the increase in the distance from the linear conductor. As shown by W. Thomson and A. Sommerfeld, it can be fully described by the Maxwell's equation $B = rot\vec{e}$ (see Sect. 5).

Imagine simple models of the ether medium strain in accordance with the concept of the quasi-solid ether. As shown above, when an electric and (or) magnetic field are superimposed, the ether medium particles will shift from their equilibrium position that they would occupy in the space-netlike structure in the unperturbed state. Consider a displacement pattern in the ether medium at the superposition of an electrostatic field on the medium, for instance, between the plates of a charged vacuum-processed capacitor. In this case the ether medium, Fig. 8, will undergo strain in the way shown in Fig. 17. In this case the ether medium's particle with the positive charge will move away from the positively charged plate. On the contrary, a negatively charged particle of the ether medium will be in contact with the positively charged plate.

Naturally, the diagram in Fig.17 (plane section) is greatly simplified since the charges, for instance, electrons will take places in the capacitor plate in accordance with the electron gas laws and the picture, on the whole, will be more complicated. Note that the displacement

between the positive and negative particles of the ether medium in the capacitor field will be of some value ζ .

The capacitance C of the vacuum-processed capacitor can be calculated by formula [57]:

$$C = \frac{\epsilon_0 S}{h}, \quad (35)$$

where ϵ_0 is the vacuum inductivity, S is the area of the capacitor plates, h is the distance between its parallel surfaces.

As follows from formula (35), the capacitance of the vacuum-processed plane capacitor is independent of the thickness of its plates and their conductivity, of the kind of material they have been made of etc. The value S/h involved in the formula refers only to the volume of the ether medium that is between the capacitor plates. If we deliver charge to the plates of a plane capacitor, Fig. 17, then in the $S \cdot h$ volume a strain of the ether medium (vacuum) will appear. The larger is the area of the capacitor plates, the greater is the volume of the strained vacuum. With the same charge at the capacitor plates, the shorter is the distance h , the greater is the electric intensity between the plates. Great electric intensity causes a great degree of the vacuum strain. Thus, it is

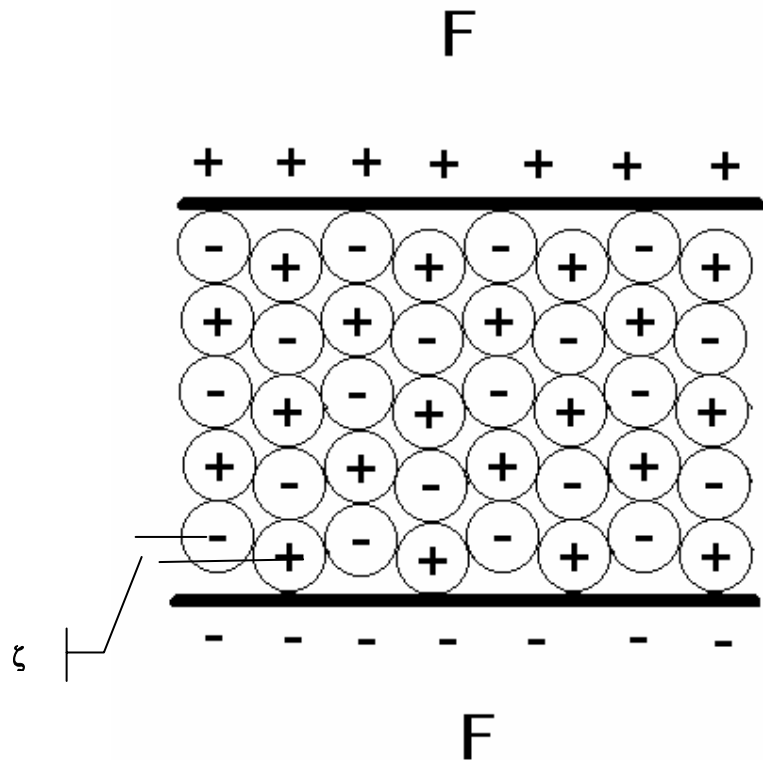


Fig.17. Ether medium strain in the electric field of the charged plane capacitor.

exactly the ability of the ether medium to be strained that is responsible for the capacitance of a flat (as well as of all the other types of) capacitor.

Let us imagine how the strain of the ether medium occurs in a magnetic field. According to the above grounds, the ether medium in the magnetic field is strained by shear forces, every subsequent row of the medium being shifted from the preceding one in one and the same direction. Figure 18 gives a plane section of such a shear strain of the ether medium in a homogeneous magnetic field that will be observed at one side of the central part of a very long (quasi-infinite) solenoid. Note that in a homogeneous magnetic field every row is shifted from the preceding one by some value of strain ξ .

As is known [67], inductance L of a cylindrical solenoid (inductance coil) depends on the magnetic permeability of the medium μ , its length l , the area of the cross section S and a number of coils N . For the solenoid that is in the vacuum, with the relation of the length l to the diameter of its coils d , $l/d > 10$, the value

$$L = \mu_0 n^2 V, \quad (36)$$

where μ_0 is magnetic permeability of the vacuum, $n = N/l$ is a number of coils per unit length, $V = Sl$ is the solenoid volume.

As for a capacitor, the inductance of a solenoid is independent of the conductivity and type of the conductor material. In formula (36), attention is drawn to the peculiarity that the solenoid inductance is determined, besides other factors, by the volume V and the properties of the vacuum μ_0 which is inside its coils. It is quite clear that if the volume V is equal to zero, the solenoid inductance will be also equal to zero. The increase in the number of coils n or in the number of currents per unit length of the solenoid, greatly increases the vacuum strain degree.

Experiments with solenoids allow one to demonstrate clearly such an important vacuum feature as its sluggishness. For instance, when the source of electromotive force (EMF) in the circuit with inductance L and resistance R is switched off, the current I will change according to the law [67]:

$$I = I_0 e^{-\frac{R}{L}t}, \quad (37)$$

where I_0 is the current initial value before the circuit is switched off, t is time.

From formula (37) it follows that the greater is the inductance L and, accordingly, the greater space (vacuum) is occupied by the solenoid internal volume, the slower is the current decrease from the initial value in the circuit. On the one hand, when a circuit with current is switched off, the magnetic field in the solenoid and around it decreases and disappears. On the other hand, the decrease of the magnetic field occurs by the exponential law. It means that theoretically the field changing continues infinitely long. Since the velocity of electromagnetic disturbances in the ether medium the velocity of light, one may believe that when switching an electric circuit off (on), the change in the magnetic field covers indefinably great space with time. Accordingly, in this case the sluggishness of the ether medium is formed by the availability of physical, i.e. magnetic field and the final velocity of disturbances in the medium. Similarly, as inertial properties of the vacuum are displayed, discharging or charging of the capacitor, including a vacuum-processed one, takes place [67]. Thus, sluggishness is an integral and essential feature of the vacuum (ether medium).

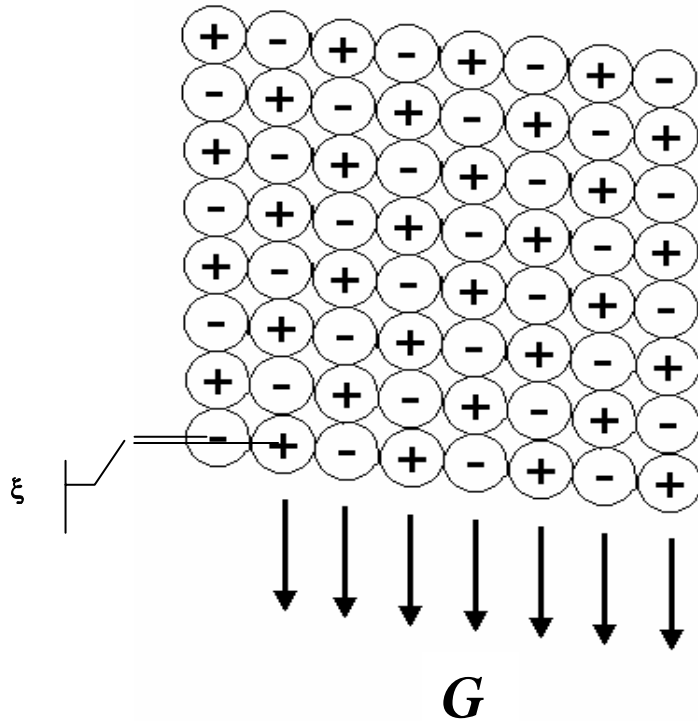


Fig. 18. Homogenous strain of the ether medium near a strong magnet or solenoid with current. It is an example of a constant gradient of a field strength in the direction transversal to the force lines. Such a gradient can be observed in the central part of a very long solenoid (magnet).

An analysis of Figs. 17 and 18 allows one to understand why there is a great difference in magnetic and electric forces acting on various materials. For instance, the attraction of two electrified bodies is rather small as compared with the force of attraction of a piece of iron to a magnet. Really, when the ether medium is strained by an electric field, Fig. 17, the second row of charges shifts from the first row by ζ . Such a shift occurs in every other row. The overall shift U_e of the neighbouring rows of the ether medium elements will be no more than ζ .

Another situation will be observed if we consider the total shift of the rows of the ether medium elements U_m in a magnetic field, Fig. 18. Here the second row will shift from the first row by the value ξ . Every subsequent row will shift in the same direction and by the same

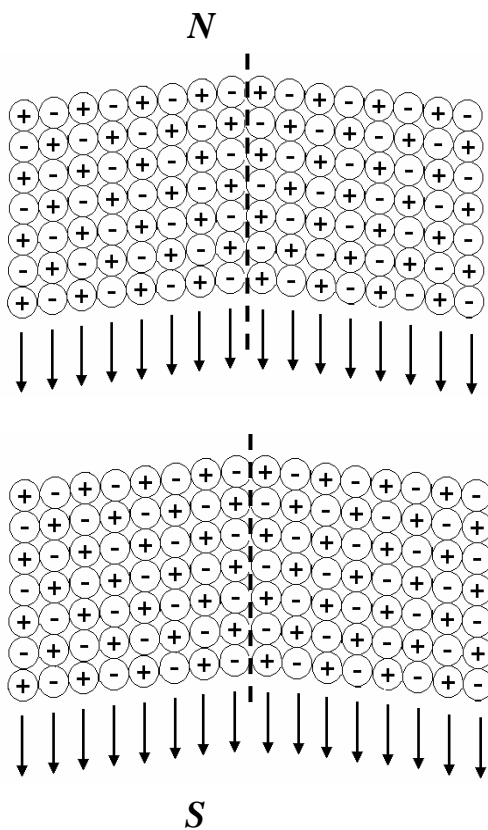


Fig. 19. Homogeneous magnetic field, established by two magnets (circulating currents) in the ether medium. Unlike poles of the magnets face each other.

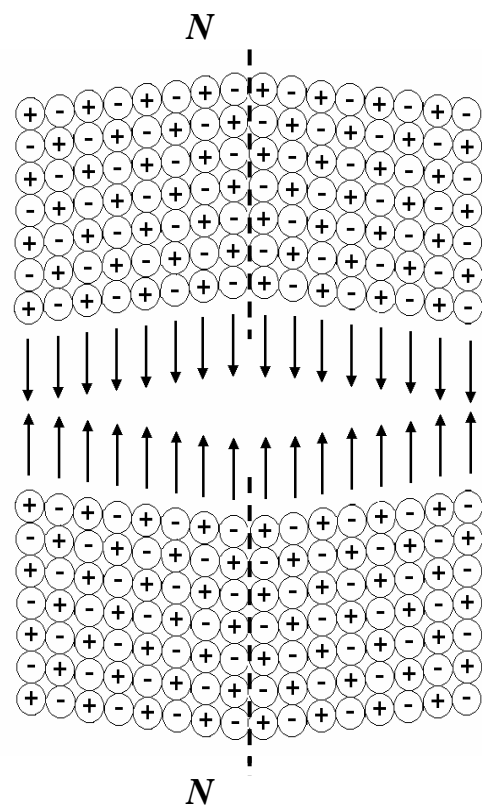


Fig. 20. Homogeneous magnetic field excited by two magnets (circulating currents) in the ether medium. Like poles of the magnets face each other.

value ξ . The overall strain of the ether medium for a number of rows n will be $U_m = \xi n$ and will be proportional to the value of the magnetic field section under consideration. A comparison of U_m and U_e shows that the magnetic force is n times greater than the electric one, all other things being equal. Accordingly, magnetic fields demonstrate much greater forces than electrostatic ones. Practice, including that in technical applications, corroborates that. This practice has been embodied in power electric motors, electromagnets and many other applications. Due to the fundamental difference in the action on the ether medium, electric fields cannot develop considerable forces. That is why up to now electrostatic power machinery has not found such a wide application as electromagnetic one.

The diagram in Fig. 19 allows explaining the interaction mechanism of two circulating currents (magnets) and strains of the ether medium produced by them. The Figure gives a part

of a homogeneous magnetic field excited by two magnets (circulating currents). Such a magnetic field can be excited inside an infinitely long solenoid. This field represents the strained ether medium with an axial symmetry and a circular section. By convention the North magnetic pole N is directed to the convex part of the equipotential lines of this field, while the South pole S - to the concave lines. The arrows in the diagram point to the direction in which the ether medium particles will shift when the current is switched off in the solenoid. If we move the field of the upper solenoid closer to the field of the lower one, Fig. 19, they will undergo attraction due to the same direction of the strains of the solenoid fields.

Quite another picture will be observed if the like poles of the magnet fields face each other, Fig. 20. In this case due to the fact that the ether medium strains from each solenoid will have opposite directions, considerable repulsive forces will appear.

Observations show that when two magnetic cores approach each other, their unlike poles close up and form a unified magnet. When the like poles of magnets approach each other, a certain effort is required to keep them closed up. If this effort disappears, they will disconnect. In this case the position of one magnetic core relative to the other becomes unstable. The magnets will tend to occupy such a position at which they will create the ether medium strain with the same direction.

The suggested concept eliminates the magnetic field paradox that, up to now, has been called vortex everywhere in reference books and text-books [57, 67, 68]. In our opinion, that is wrong.

Thus, an electric and magnetic fields are different forms of shear (torsional) strains of the ether medium composed of particles with opposite charges. The ether model we have proposed complies with the principles of I. Newton, J. MacCullagh, J. Maxwell and W. Thomson's theories [69].

The concept of the ether medium presented above allows one to understand why moving electric and magnetic fields (as well a stationary one) in O. Lodge's experiments did not have a noticeable impact on the light velocity (see Sect. 2). The point is that electric and magnetic fields do not change the ether medium density, they only strain it (Fig. 17 and 18). The strains induced by a massive physical body decompact the ether medium (Fig. 12 and 13). A deviation and change of the light velocity near massive bodies (for instance, the sun) is a well established physical factor [60].

9. Propagation of electromagnetic waves in the ether medium

A motion in the ether medium may occur as a travel of physical bodies in it and transfer (propagation) of energy. The transfer of disturbances (energy) occurs as electromagnetic oscillations (waves). Types of these oscillations have long been known. They are light, electromagnetic, X-ray etc. types of oscillations that have common electromagnetic nature. The basis for propagation of such oscillations is the ether medium. The wave velocity is equal to the light velocity C [2].

An analysis of propagation of an electromagnetic wave front from a moving point source is rather interesting. Imagine the most common case when a source radiates a spherical wave. Let us consider that the space (ether) in which the wave is radiated is free from physical bodies (solid, gaseous, plasma etc.) and electromagnetic fields. In this case the space has isotropic properties. The wave amplitude at the front from the source will be the same in all directions and the wave front will be ball-shaped, $F = 4\pi r^2$, where r – is the ball's radius. Consider that the source moves along the straight line. In this case, theoretically, three versions of the relation between the source movement velocity V and the light velocity C may appear.

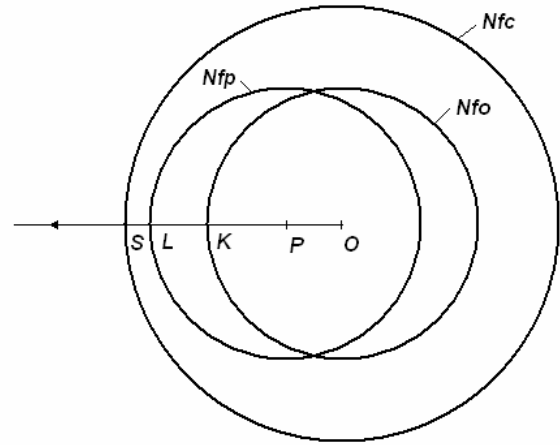


Fig. 21. Formation of the electromagnetic wave front from the source moving with the velocity V that is less than the light velocity C .

1. The source velocity V is less than the light velocity C , $V < C$. In this case, the wave radiated at some initial moment and all the subsequent moments, forms a spherical front. This spherical front will propagate with the velocity C that is larger than V . The subsequent fronts arising at the points which the source passes through will lag behind the spherical front formed at the initial moment of radiation. Thus, the initial front of an electromagnetic wave from the source moving with the velocity that is less than the velocity of light will always be the spherical front from the initial moment of the source radiation. This can be easily demonstrated with the diagram in Fig. 21. We consider that at the moment t_0 the source was at the point O and the front of its wave occupied the Nfo position. The source moved to the point P over the distance PO with the velocity $V < C$ for the time t_1 and its front occupied the position Nfp . The front will travel $LK = PO = V \cdot t_1$ in the direction of the source movement. The front Nfo will travel the distance $SK = C \cdot t_1$ and occupy the position Nfc for the same time t_1 . Division of SK by PO yields $SK/PO = C/V > 1$. This means that the fronts arising from the source position that differs from the initial one, will always be within the front propagating from the point at which the source was at the initial moment.

Figure 21 allows one to note that the energy density A_f (a number of spherical fronts from various positions of the source per the length unit) in the direction of the source movement will be higher than in other directions. It is easy to show that the change in this energy will be proportional to

$$A_f = f[(\pi - \alpha)C/(C - V)\pi + C\alpha/(C + V)\pi]^2, \quad (38)$$

where α is the angle between the direction of the source movement and direction in which the energy flow is assessed at the wave front.

2. Consider the type of the light wave front with the source moving with the velocity equal to the light velocity $V = C$. As the source moves it will create spherical fronts, Fig. 22. For instance, when it is at the point k it will produce the front Nfk . At the point n the front Nfn will be formed. In the movement direction the source travels with the velocity C . In the same direction (as in all others) the fronts Nfk and Nfn expand also with the velocity C . Thus, the source will always be at the wave front created by the front. The wave front created at all the preceding points of the source presence along the line of its propagation, will pass through the point S where the source is at the moment, Fig. 22. Since we consider that the radiating source moves infinitely long along the strait line, the wave front created infinitely long ago will also move through the point S . The crookedness of the spherical front with the indefinitely large radius of the sphere is equal to zero. Hence, the general front Nfc of the light or electromagnetic wave in the direction of the radiating source movement, with $V = C$, will be a plane perpendicular to the movement line and extensively propagating into infinity from the source.

This conclusion can suggest that this source should possess infinitely great energy, so that the area of its front will be infinitely large. This conclusion is corroborated when analysing the expression (38), since with $V = C$, the first item of this expression turns into infinity. But this conclusion will be invalid if the source does not move infinitely long.

Note that at point S , all the amplitudes of the whole set of fronts that, accordingly, had arisen at all points of time before the source reached point S , will be summed up.

3. Theoretically, one can imagine a source that will move faster than light, i.e. $V > C$. In this case the source will be at the top of the bodily cone that will form the wave front Nfc , Fig. 23. The front Nfc will be formed by the sequence of the spherical fronts of every preceding position of the source. For instance, the front Nfo is formed by the source at point O . During the same time t , the source will move from point O to point N and the spherical front Nfo of the wave will reach point K with the light velocity C .

Let us determine angle α between the front Nfc and the symmetry axis of this front cone. Since the triangle formed by points NOK has a right angle, by the Pythagorean theorem, we can write down $(NO)^2 = (NK)^2 + (KO)^2$. Angle α lying opposite the side KO will be equal

$$\alpha = \arccos(NK/NO) = \arccos \frac{\sqrt{NO^2 - KO^2}}{NO}. \quad (39)$$

The distance NO will be travelled with the V velocity for the time t and the distance KO with the C velocity for the same time t . Accordingly, $NO = Vt$, $KO = Ct$. Putting these equalities in Eq. (39) we get

$$\alpha = \arccos \sqrt{1 - \frac{C^2}{V^2}}. \quad (40)$$

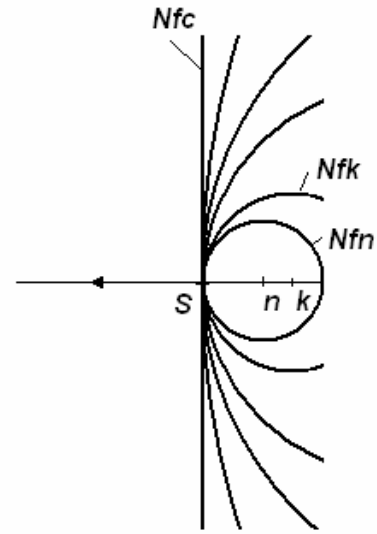


Fig. 22. Formation of the electromagnetic wave front from the source moving with the velocity V equal to the light velocity C .

The wave amplitude on the movement line at point N will be equal to the amplitude of the source. At other points, for instance at point K , it will be inversely proportional to the squared distance KO . Note that by formula (39) the greater is the velocity of the source in relation to the light velocity, the less is the angle α . The last-mentioned formula also corroborates the following feature of the wave front: if the source moves with the light velocity, $V = C$, then the front will be flat and extend at infinity.

On the whole, the possibility of some physical bodies to propagate faster than the light should be considered to be only a hypothetical one, since no movements exceeding the light velocity are known with assurance so far, at least when observing the processes of microinteractions.

Note that since the electromagnetic wave velocity in the free space is determined only by the characteristics of the ether medium, it is equal to the light velocity in spite of the velocity of the source movement.

Now it is necessary to consider the effects arising in the motion of the observer or device (receiver) that will move and register the waves (radiation) from the source. The velocity of the receiver movement is also restricted by the light velocity. Thus, the extreme mutual velocity (V_{SR}) of the source (S) and receiver (R) approach may be thought of as being always less than the double light velocity, $V_{SR} < 2C$.

Oscillation frequency in the source located in the free (from physical bodies and electromagnetic fields) space is determined by the oscillatory process in the source. If the source is immovable, the receivers located motionlessly at some distance and in any directions will register the same frequency of the electromagnetic waves as in the source. But if the source moves, then, according to the Doppler effect, immovable receivers located along the trajectory and in the moving direction will register the frequency increased over the wave frequency in the source. Immovable receivers located along the trajectory but in the direction opposite to the moving direction of the source, will register the decrease in the wave frequency proportional to the source movement velocity.

Such changes will be observed as the wave receiver (observer) moves relative to the immovable source. If the receiver moves in the source direction, then it will register an increased wave frequency over the frequency in the source. The receiver moving away from the source registers a decrease in the wave frequency proportional to the velocity of the source motion. The manifestation of the Doppler effect prevents distinguishing whether the receiver moves relative to the source or, vice versa, the source moves relative to the receiver.

The presence of the ether medium allows returning to the tenets stated by H. Lorentz. For instance, one may find an explanation why the mass of an accelerated particle (physical body) increases by the law [70]:

$$m = \frac{m_0}{\sqrt{1 - \frac{V^2}{C^2}}} \quad (41)$$

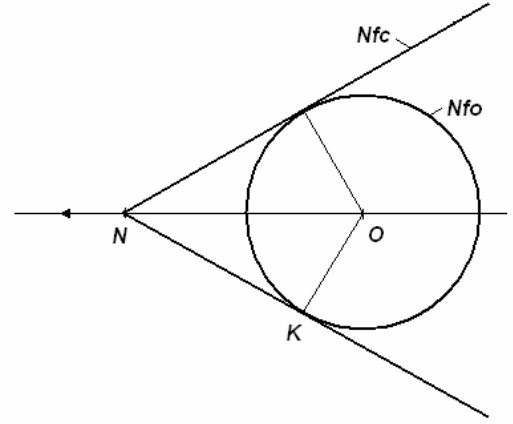


Fig. 23. Formation of the electromagnetic wave front from the source moving with the velocity V that exceeds the light velocity C .

where m_0 is the particle mass at rest, m is the particle mass in motion relative to the ether medium, V is the particle velocity, C is the light velocity.

This law shows that as the particle velocity approaches the light velocity, phenomena similar to those observed as the body velocity approaches the sound velocity in gases occur. But there is a fundamental difference between these phenomena. When a body moves in gas, the gas flows around it. As a body moves in the ether medium, as is shown by H. Fizeau's experiments and some other ones, the ether medium moves through the physical body. In this case the ether medium directly interacts with every elementary particle composing the physical body and possessing a mass - with electrons, protons, neutrons etc.

Formulas (38) and (41) show that the motion in relation to the ether medium is possible with any small difference between V and C , since in the case $V = C$ the energy and mass of the particle will be infinitely great. The laws of conservation of mass and energy impose a ban on infinitely great masses of any bodies. Thus, physical bodies cannot move through the ether medium with the light velocity.

The last conclusion has an interesting consequence - photons, light quanta, that always propagate with the C velocity, cannot have a mass and therefore they are waves that disturb the ether medium and propagate in it. As is known, photons (quanta) have a large spectrum of different frequencies from a thermal range to X-rays. An infinite number of photons (quanta) of different frequency propagate in the ether in all directions and are received by devices as electromagnetic waves, light and X-radiation.

On the basis of the accepted concept, below is given an interpretation of the known experiment of H. Fizeau. To our mind, this experiment allowed determining an interaction of the ether medium with the substance on the Earth's surface.

10. On Fizeau's experiment and its interpretation

In 1851 a French physicist H. Fizeau published the work "On hypotheses regarding the light ether and on one experiment which is likely to prove that a motion of bodies changes the light velocity inside these bodies" [10]. Using the extracts from this work we shall find the interpretation of this experiment results on the basis of the suggested theory.

At that time there were three hypotheses on interrelation between the light ether and ponderable matter.

1. The ether is rigidly bound with the body molecules and hence participates in the motions that can be given to the body.
2. The ether is free and independent and is not dragged by bodies during their motion.
3. Only part of the ether is free, while the other part is tied with the body molecules and it is just this part that participates in their movement (the third hypothesis takes into account the first and the second ones).

Fizeau writes that the third hypothesis was suggested by Fresnel in order to satisfy the phenomenon of aberration and famous Arago's experiment. Arago has proved that the motion of the Earth does not influence the refraction of the star light as the light passes through a prism.

Fizeau designed a device of two glass tubes of $L = 1.487 \text{ m}$ length and diameter 5.3 mm . The tubes were filled with water. Parallel beams of light were sent into the tubes through faces. One beam passed through both tubes towards the water flow, the second beam passed through both tubes in the flow direction. After the tubes both beams were sent to one and the same glass plate by means of mirrors. On the plate one could observe a shift of the interference bands from the light beams that had passed through the water in the parallel tubes. Then the water in the parallel tubes was set in the opposite motion with the $V = 7.069 \text{ m/s}$ velocity. The index of refraction for water was $n=1.333$ and the wave length in the light beam was $\lambda = 526 \cdot 10^{-9} \text{ m}$.

The band shift caused by the water, that was initially at rest and then set to motion, was called an ordinary one by Fizeau. The shift caused by the water, that reversed its direction, was called a double shift by him. Nineteen well-agreed observations resulted in the shift equal to 0.23 of the interference band for the unidirectional water flow and 0.46 for the double one when the flows reverse their direction.

Then Fizeau performed an experiment with moving air. The air was pumped through tubes at 25 m/s . As the air was pumped, no virtual shift of the interference bands was registered.

Let us set up the calculated equation that would meet the hypothesis of fully carried-away ether. Fizeau used this equation when analysing the results of his experiments. Let us define the refraction index of the body, $n = C/C_T$, where C is the light velocity in the free space, C_T is the light velocity in a physical body. According to this, for the conditions of Fizeau's experiment, the passage time t_1 for the bundle of rays first through one tube of L length and then through the other of the same length in the water flow direction with V velocity will be:

$$t_1 = \frac{2L}{C_T + V} = \frac{2L}{\frac{C}{n} + V}. \quad (42)$$

For the light beam moving along both tubes in the opposite direction in relation to the flow

$$t_2 = \frac{2L}{\frac{C}{n} - V}. \quad (43)$$

The difference $\Delta t = t_2 - t_1$ will be:

$$\Delta t = \frac{4LV}{\frac{C^2}{n^2} - V^2}. \quad (44)$$

The last mentioned formula fully coincides with the formula presented by U.I. Frakfurt [70].

In relative wave lengths of the registered light, the difference Δ_G , deduced from formula (44) will be

$$\Delta_G = \frac{4LCV}{\lambda \left[\left(\frac{C}{n} \right)^2 - V^2 \right]}. \quad (45)$$

Substituting all numerical values $L = 1.487 \text{ m}$, $C = 2.9979 \cdot 10^8 \text{ m/s}$, $V = 7.069 \text{ m/s}$, $\lambda = 526 \cdot 10^{-9} \text{ m}$, $n = 1.333$ in formula (45) we obtain $\Delta_F = 0.473$.

For the experiment with air pumping ($n = 1.000292$) through the same tubes ($L = 1.487 \text{ m}$, $C = 2.9979 \cdot 10^8 \text{ m/s}$, $\lambda = 526 \cdot 10^{-9} \text{ m}$) with $V = 25 \text{ m/s}$, formula (45) allows obtaining $\Delta_A = 0.942$. As mentioned above, when pumping the air, no shift of the interference bands was observed. Thus, formula (45) yields the value that does not comply with the result of Fizeau's experiment.

According to Fresnel's theory (see point 2), the absolute light velocity in a moving body is

$$U = cI + [(\mu^2 - 1)/(\mu^2)]\omega,$$

or in the above accepted notation:

$$U = C/n + (1-1/n^2)V. \quad (46)$$

A relative shift of the wave length calculated by Fresnel's formula will be

$$\Delta_R = \frac{4LV}{\lambda C} (n^2 - 1) \quad (47)$$

In numerical expression, after substitution of the data for the liquid moving in Fizeau's experiment ($L = 1.487 \text{ m}$, $C = 2.9979 \cdot 10^8 \text{ m/s}$, $V = 7.069 \text{ m/s}$, $\lambda = 526 \cdot 10^{-9} \text{ m}$, $n = 1.333$) $\Delta_R = 0.207$. For air calculations by formula (45) allow obtaining $\Delta_R = 5.51 \cdot 10^{-4}$.

In 1851 I. Fizeau performed such calculations and concluded that the experiment results comply with Fresnel's theory. A partial drag of the ether is executed by the physical matter that causes an additional part of the refraction index to the unity.

Fresnel's theory suggests "thickening", increasing the density of the ether medium in physical bodies. But after L.B. Boldyreva and N.B. Sotina [71], the development of Fresnel's formula can be carried out on the assumption of photons dynamic interaction with the atoms

of a physical body. In this case the light movement in the matter slows down without the ether "thickening" in it. Below we present an outline of Fresnel's formula development from [71].

First they consider the case with a transparent medium being at rest in relation to the observer connected with the earth. The time $t_0 = L/C$ is designated as the duration of the light pass of the distance L in the vacuum (in the same frame of reference but out of the medium). The duration of the light pass of the same distance inside the transparent medium is defined as:

$$t_0 + \Delta T = L/C_1, \quad (48)$$

where C_1 is the average velocity of light in the transparent medium at rest, $C_1 = C/n$, and ΔT is the total time of the photon delay at the L length due to the interaction of the photon with the atoms (molecules) of the matter.

Another case was considered with a transparent medium moving with the V velocity relative to the earth (the motion of the medium from the source corresponds to the positive V value). In the system related to the moving medium the photon velocity is equal to $C-V$, and the duration of the photon pass over the length L in the vacuum

$$T_0 = L/(C - V). \quad (49)$$

The duration of the light pass over the same distance will be:

$$T_0 + \Delta T = L/C^*, \quad (50)$$

where C^* - is the average light velocity in the system related to the moving medium.

It is known from the experiments that the refraction index depends only slightly on frequency. From the viewpoint of the proposed model it means that the mean duration of the light delay at the length unit $\Delta T/L$ to a first approximation by $\beta = V/C$ may be considered to be independent of the source relative velocity. With this assumption from formulae (48)-(50) we obtain:

$$L/C^* = L/(C - V) + L/C_1 - L/C. \quad (51)$$

Hence in [71] for the light velocity U in relation to the immovable observer, after all the necessary substitutions and expansion the result into a series we obtain:

$$\begin{aligned} U &= C^* + V = C_1 C (C - V) / [C_1 V + C(C - V) + V] = \\ &= (C_1 C^2 - C_1 C V + C_1 V^2 + C^2 V - V^2 C) / [C_1 V + C(C - V)] \approx \\ &\approx C/n + (1 - 1/n^2)V. \end{aligned} \quad (52)$$

According to the authors of this conclusion, Fresnel's formula describing Fizeau's experiment can be obtained within the model of the three-dimensional Euclidean space and independent time as a result of interaction of photons with the medium atoms.

This explanation is most logic among others including the one suggested by Fresnel. The concept of the ether "thickening" inside material bodies cannot be accepted with the understanding that the ether existence is denied by the special theory of relativity. We think that the ether medium providing a basis for the light propagation is displaced near atomic nuclei in physical bodies (Fig. 12). Deceleration of the light velocity in physical bodies occurs due to the effect of bending around the areas near the atomic nuclei. We believe that the light in a physical body propagates in the ether medium with the velocity equal to that in the free space C . But the distance of electromagnetic waves transmission in a body is greater than the

length of this body due to the processes of bending around the areas where the ether medium is displaced by nuclear forces. Elongation of this distance is proportional to the refraction factor of the body.

Thus, the real light velocity as the ratio of duration of the wave pass to the body length, is equal to some value $C_T = L/t = C/n$, that is less than C . Recall that as follows from the light refraction formulae, no jump in the ether density occurs on the boundary of a transparent body (see Sect. 3), only the “apparent” light velocity changes. This “apparent” velocity is a result of elongation of the photon distance in a physical body. Every photon of the visible light diffracts on an obstacle that is, for instance, an electron or atomic nucleus, since the wave length of the visible light is much greater than the size of such an obstacle. If the wave length approaches the nucleus size, the phenomenon of beam diffusion and reflection is observed. These phenomena are used during X-ray diffraction analysis of substances.

The acoustic signal velocity decelerates in the medium saturated with inclusions which size is much less than the length of propagating waves. This phenomenon is well known in acoustics [72]. The carrier of the light electromagnetic oscillations in physical bodies is all-penetrating ether. In physical bodies the refraction factor can, to some extent, vary due to manifestation of the effects of photon re-emission, recombination and luminescence.

Thus, Fizeau’s experiment is not evidence of the ether partial entrainment by a physical body. This experiment should be explained by the fact that the light velocity is less decelerated (or accelerated) in a moving body than in a body at rest. In this case the ether medium remains immobile.

Massive physical bodies that greatly deform the ether medium supposedly “fasten” the shell from the ether medium in their environment. A recent discovery of the dark mass filling the universe [73] provides a basis for the conclusion that the Earth as a massive body has its own “atmosphere” of the ether medium that is entrained in the movement together with our planet. It is believed that the influence of this “atmosphere” supposedly extends to the Lagrange point, where the gravitation fields’ influence of the Earth and the Moon is divided.

11. Moving charges and Galileo principle

Phenomena arising when electrically charged physical bodies move in the ether medium are more complicated than those that are typical of uncharged bodies or an immobile charge. In the undisturbed ether, particle charges balance each other and such ether manifests itself as electrically- and magnetically neutral. A single immobile charge sets up an electrical field around itself which, in fact, is a result of the ether medium deformation. A moving charge also establishes an electrical field, but as it moves, a magnetic field is set up as well. A moving charge can be detected only with another charge (magnet). Thus, it turns out that a motionless (in relation to the ether) charge and a charge that is moving straight and uniformly are not equivalent. On the other hand, the charge that is moving straight and uniformly neither emits nor loses energy. At the same time its energy is less than that of the immobile charge, since part of the energy was spent on establishing the magnetic field in the surrounding ether medium at the instant of transition from rest to movement.

Let us explain this phenomenon in terms of an example. Assume the availability of two charges known to be identical and immobile. They can be located at such a great distance from each other that their fields (the ether medium deformations) will not virtually interact. Let us leave one charge immobile in relation to the ether medium and start moving the other. To set an immobile charge in motion it must be given acceleration. The acceleration of the charge will establish an alternating magnetic field around the charge route. Part of this field energy will be spent on electromagnetic radiation as electromagnetic waves. This part of the energy will be radiated into the infinity and will not come back to the charge as EMF of self-induction if the charge stops its movement. The other part of the charge energy will be spent on establishing a constant magnetic field (if the charge moves with a constant velocity). This part of energy will be the energy of deformation of the ether surrounding the charge. During uniform straight movement the magnetic field (or the ether deformation) will preserve a constant value. Comparing the state of the two charges – motionless and moving at this moment, note that the energy (electric potential) of the moving charge is less than that of the motionless one. There is no magnetic field around the motionless charge, but it is present around the moving charge. The moving charge spent part of the energy in radiating electromagnetic waves as it accelerated from the stationary state.

As follows from the above, the state and energy of the immovable (in relation to the ether medium) and moving charges are greatly different. The motionless charge is surrounded by an electrical field, the moving charge – by an electrical and magnetic fields. The energy and electrical potential of the moving charge are less than those of the motionless charge.

Compare the differences in the state of motionless and moving charges with the state of uncharged motionless and moving physical bodies. In accordance with the quite objective Galileo principle, the behaviour of an electrically neutral physical body that is in the straight uniform motion is indistinguishable from that of the body that is at rest in relation to the Earth. Thus, one can state that there are certain differences between the states of electrically neutral and charged physical bodies at rest and in motion. Due to the presence of the ether medium Galileo principle of relativity cannot be applied to immovable and moving in relation to the ether charged bodies.

There are a lot of works dedicated to the theory of fields around moving charges. For instance, O. Heaviside [74] received a solution showing that the electrical vector created by a moving point charge is radial everywhere. Magnetic lines of force created by a moving point charge are circles whose centres are located along the line of movement. Later G.F.C. Searle solved the problem on distribution of a charge over a moving sphere [75]. The moving sphere that establishes the same field as a moving point charge is not a sphere but a compressed

spheroid which polar axis is located in the motion direction. Then U.B. Morton showed [76] that in the case with a moving electrified sphere, the surface density does not change as the sphere moves, but the force lines no longer leave the surface at the right angle.

The energy of the field surrounding a charged sphere was demonstrated to be greater when the sphere moves than when it is at rest, since along with the electric field around the sphere, a magnetic field arises as well. Accordingly, the work that should be done to bring the sphere to a given velocity is greater when the sphere is charged than when it is uncharged. The effective mass of the sphere increases due to the charge presence. According to the authors, the reason for this is self-induction of the convection current that is generated when the charge starts moving. Thus, the well-known works also corroborate inefficiency of Galileo principle for charged bodies.

The inapplicability of Galileo principle for moving charged bodies and those at rest offers an explanation to the fact that A. Einstein did not find a place for the ether in STR. The recognition of the ether medium presence immediately breaks the equivalence principle for independent inertial systems that provides a basis for STR.

12. Ether medium and substance balance in the universe

Recently the discovered experimental corroboration of the essential vacuum (ether medium) contribution in the total balance of the universe masses has been actively discussed in cosmology. Following A.D. Chernin [73], vacuum is dominating in the universe. The vacuum surpasses all “ordinary” forms of the cosmic substance taken together in energy density. According to the mass balance given in the paper, the relative vacuum density is 0.7 ± 0.1 of the total mass equated to the unity. Other forms of the cosmic substance are a dark substance, a luminous substance of stars and galaxies and radiation. The dark substance has a relative density of some 0.3 ± 0.1 . The luminous substance of the stars and galaxies occupies about 0.02 ± 0.01 . The energy concentrated in radiation (converted to mass) is about $(1-30) \cdot 10^{-5}$ of the relative fractions. As follows from the mass balance, the vacuum density exceeds the total density of all the rest types of the cosmic energy. Thus, the vacuum or, put otherwise, the ether medium is rehabilitated in physics as an actual substance.

The known experimental facts set one acknowledge that the ether medium surrounding our planet Earth is virtually immovable in relation to the Earth. A comparatively simple observation convinces us of that. If the ether medium were involved in any noticeable movement in relation to the Earth, then a magnetic field would be detected near the charge that was immovable in relation to our planet, as a result of the ether medium deformation. But the experiments of F.T. Trouton and H.R. Noble with the charged condenser located at the Earth surface at some point and moving with the Earth, showed that the ether medium is motionless in relation to this surface [77]. The experiments of A. Michelson and E. Morley also demonstrated immobility of the ether medium in relation to the planet Earth [70].

On the other hand, the presence of the cosmic vacuum as a mass [see expression (28)] actively participating in the universe mass balance suggests that the planet Earth has “a shell” consisting of a vacuum (ether medium). This shell can extend to the place where the Earth’s gravitation force, decreasing with the distance from its centre, becomes comparable with that of the Moon or the Sun. The calculations given in [78] indicate that. Following L.I. Katurina and Yu.A. Fedorin, the calculated summary tidal deceleration of the Earth rotation is $3.5 \cdot 10^{-3}$ s per 100 years. Astronomic observations point to the elongation of the twenty-four-hour period by $2 \cdot 10^{-3}$ s per 100 years on the average. The $1.5 \cdot 10^{-3}$ s per 100 years difference is attributable to the dissipative action of the hidden mass distributed in the Earth’s vicinity. The calculations presented showed the validity of the assumption of the hidden mass influence on the deceleration nature of our planet rotation. The ether medium mass, as the ether shell held by the Earth in its vicinity, acts as this hidden mass.

Thus, recognizing the presence of the ether as a substance possessing certain physical properties, we should recognize the presence of the space as a container of the whole universe. The ether uniformly fills all the space known to us. The energy as electromagnetic fields and waves (light and X-ray ones) reflects the disturbed state of the ether. A condensed physical matter (for instance, in the form of atoms, molecules, physical bodies etc.) is in the ether and is permeable for it. In this universe pattern we obtain a unity of nested categories.

The space covers all known limits of the matter existence. It possesses geometric properties. The presence of the ether filling the space provides a basis for the presence of certain physical properties, including electromagnetic ones, in the space and explains a possibility of existence of electric and magnetic fields. As mentioned above, these fields are the forms of disturbance of the ether medium and bringing it to the nonequilibrium state. To establish an electric or magnetic field in the ether medium, one must expend energy. When removing an electromagnetic field, the ether medium gives back the energy accumulated in it. Another type of the energy transfer into the ether medium is exciting electromagnetic waves in it. Physical bodies (see Sect. 7) introduce distortions in the lattice of unlike charges

arrangement in the ether medium. These distortions cause the ether to exert a decreased pressure on the physical body that happened to be in the distorted field (Figs. 12 and 13). For this reason the attraction of one body to another arises. The dynamic processes in the ether medium in the micro- and macrocosm of physical bodies proceed in time.

Thus, let us define space as an object that has purely geometric properties, ether as a medium filling the space with homogenous, uniformly distributed matter and time as a sequence of events occurring with material (localized) physical bodies. Earlier a variety and properties of physical bodies received sufficient attention and, on the whole, no consideration has been given to them in this work.

13. Foundations of the universe structure

The grounds and recognition of the ether presence as a medium, more or less uniformly filling the space, generate a need for revision of the present dominant notions of the space-time relations in the universe.

As is known, the notion that time and space are a unified physical essence, dominated recently. It was suggested by H. Minkovsky in 1905. Minkovsky's unified space-time is characterized by three space coordinates, for instance, x , y , z , and time t . The space-time metric in the theory of relativity is written [79]:

$$ds^2 = c^2 dt^2 - dx^2 - dy^2 - dz^2, \quad (53)$$

where ds is displacement.

In this equation, the space-time dimension is expressed by a combination of a meter and second (or their equivalents). At the same time, it is known that the vacuum or the ether medium possesses dielectric and magnetic permeability and wave resistance. For instance, the dimension of the vacuum dielectric permeability ϵ_0 in the SI units is expressed in $m^{-3}kg^{-1}s^4a^2$, magnetic permeability of the vacuum μ_0 - in $m kg s^{-2}a^{-2}$ and its wave resistance - in $m^2 kg^{-3}a^{-2}$ [57].

As follows from the above, besides the size and time categories these dimensions include the current strength value a - ampere and the mass value (kg). Thus, electrical, magnetic and other vacuum properties are determined by the categories of extension (m), time (s), mass (kg) and current strength (a). Physical properties of the vacuum cannot be expressed only as measures of length, time or movement velocity. Their dimension also contains the units of current strength and mass.

As shown above, the displacement currents in the vacuum between the plates of the charged capacitor determine its charge. The value of the magnetic field around the current conductor is determined by the value of this current. The value of self-inductance current arising at the current conductor disconnection is determined by the value of the stored magnetic field energy in the vacuum around the conductor. By now, not a single reliable experiment exists that would show a possibility to denude the vacuum of its magnetic properties. On the contrary, simple actions, for instance, with a magnet and a piece of iron, indicate the inherence of the electromagnetic properties of the vacuum or the ether medium. The electromagnetic properties of the vacuum are of vital importance in micro interactions. However, in the astrospace, too, there are very strong magnetic fields, as has been established by astronomers.

On the other side, on the basis of philosophical, theoretical and physical analyses of the aspects related to the proof of four-dimensionality of space-time, the following conclusion was drawn in [79]: "The issue of theoretical justification of (3+1) dimensional nature of space-time is still enigmatic. It should be acknowledged that up to now we do not know what causes four-dimensionality of the real world. Information available on this subject represents only the first attempts to move forward in the desired direction".

Thus, considering Eq. (53) on the whole, we should acknowledge that it was a result of some agreement. It is suitable for description of moving material bodies. But space is also the essence independent of material bodies, since it may exist void (of physical bodies). At the same time, the state of the void (for a material body) space can be changed establishing, for instance, a magnetic field in it. This state of the space cannot be described by physical values constituting only Eq. (53). From this it follows that Eq. (53) is really the result of the agreement and does not reflect the real essence of the universe. As is known, an agreement

may be useful at some stage of the theory development, but it cannot be used as the basis for a physical law that reflects real interactions of material bodies.

Thus, Minkovsky's concept of space-time as the basis for the general and special theories of relativity is not a complete one, since it does not take into account electromagnetic properties of the vacuum. It does not reflect the real vacuum (that we call the ether medium) features properly and fully. Space-time is some mathematical abstraction that may be applied for consideration of only some particular processes.

As follows from the principle constants of the vacuum (ether medium), the main components of cosmos are space, time, mass and an electric charge (current). Accordingly, the universe includes the following categories:

I. Space. Space is admitted to be an objective essence enclosing visible and invisible (i.e. beyond our perception) universe. The space is determined by a measure of length (distance).

II. Ether medium (vacuum). The ether medium uniformly fills the visible space. It possesses a spatial-netlike structure and physical properties. This structure consists of two equal but opposite in sign charges. The ether medium is determined by measures of length, time, mass and electrical charge (current).

III. Mass. The ether and physical media possess mass. The mass value is determined by its inertness (sluggishness), i.e. by the ability to acquire one or another value of acceleration or deceleration under force. As evidenced by the experiments on charging a vacuum capacitor and observations of the phenomenon of self-inductance electromotive force in the conductor with current varying in value, the ether medium possesses mass. The dimensions of the ether and physical masses differ. The mass of a physical body is determined by Newton's law: the body acceleration under force is proportional to this force value and inversely proportional to the body mass.

IV. Time. The changing succession of the state, properties and position of a physical object can serve as a time measure. The time corresponds to this object. The count of vibrating (periodic) deformations of the ether medium can also serve as a time measure. The movement of a physical body in relation to some coordinate system can be fixed in time determined, for instance, by a vibrating (periodic) process occurring on the object that has no relation to the physical body.

V. Electric charge (current). The electric charge (current) value determines the rate of deformation of the ether medium by an immovable (moving) electric charge. The electric charge (current) value is measured, for instance, by coulomb (ampere).

On the whole, the hierarchy of categories constituting the universe shows up as follows. The space embraces everything. It is rigid, Euclidean and three-dimensional. The space is filled by the ether medium. The ether medium can be deformed under the effect of external physical bodies and electromagnetic fields and its density can be different at various points.

It can experience static and dynamic, shear and torsion deformations. The ether medium is the basis for electromagnetic wave propagation and transmission of gravitational influence of physical bodies upon each other. Physical bodies (elementary particles, gases, liquids, solid bodies, plasma etc.) are placed in the space and ether medium. The gravitational influence of one physical body on another is performed by the ether medium. Dynamic processes in the ether medium and movements of physical bodies can be fixed in time.

Below the categories of space and time are analysed in greater detail due to their great importance in the universe physical pattern.

14. Space as all-inclusive category

A lot of mathematical and physical proof found in the ancient time and at present bears witness to the three-dimensionality of the continued space. Aristotle gave the clearest statement of the space three-dimensionality. He asserted that a line has one dimension. If we add one more dimension to the line, we can get a plane. If we add one more dimension to the plane, we can get a volume. This volume will possess a length, a width and a height, i.e. three dimensions.

This conclusion is corroborated by the following obvious within Euclidean geometry definitions. The position of a point on a strait line is determined by one number – by one coordinate. To define the position of the point on a plane you will need two coordinates, in space (volume) – three numbers or three coordinates. The other conclusion corroborating the space three-dimensionality and also resulting from Euclidean geometry: space has three dimensions since one can draw three and only three mutually perpendicular lines at one point.

Assuming three-dimensionality of the space, we thereby recognize that the position of any point in the space can be determined by three coordinates. However, the coordinates of any system (Cartesian, polar, elliptic, curvilinear etc.) are peculiar kinds of “forests” and are of a subjective nature. They are introduced for analysis of the geometric or physical continuum. If the continuum has no breaks, the position of the point can always be determined within the Cartesian or other coordinate system.

Recent investigations showed that the physical state cannot be sufficiently described using four spatial coordinates that have a dimension of length. In this case the causality principles would be violated. For the four-dimensional (as well as for the 4+1-dimensional) space, the Huygence principle, providing the basis for optics, would be broken [79].

Using the results of physical observations the philosopher Immanuel Kant concluded that the three-dimensionality of space is proved by the fact that the acting force is inversely proportional to the distance squared from the point source in the space. As is well known, within gravitational and electric fields the acting forces decrease proportionally to the distance squared. Elliptical orbits of planets that circle the Sun are stable only because the physical space is three-dimensional. However this statement is arguable.

The visible space of the universe is filled with the ether medium. Due to the influence of the astronomic masses (black holes, Galaxies, stars, planets, dark substance etc.) and powerful magnetic and electrical fields, the ether medium including that in the interstellar space is deformed. Gravitation of physical (astronomic) bodies is a consequence of the ether medium deformity. Great deformations of this medium near very massive bodies cause a formation of the so-called gravitational lenses. Rays of light would not propagate along a strait line in the deformed ether medium. This has been proved many times, for instance, during the earth observations of the passing of the far stars' rays near the solar disk [60, 70].

To analyse the universe geometry astronomers can use only the objects radiating light and take observations on the trajectories of electromagnetic and light waves. The observations on the so-called gravitational lenses gave rise to the notion that space is subject to the geometry of Riman or Lobachevsky. However the geometry of space is Euclidean. At the same time the ether medium in which electromagnetic radiation (including visible light) propagates can possess geometry that differs from the Euclidean one.

S.A. Tochelnikova-Murri suggested the following definition of the visible (within the attainability of observations taken by astronomical instruments) space [80]: “Since the distances to farther objects defined by other methods depend on the values of trigonometric parallaxes of stars, one may state that the universe space is Euclidean, but it would be more precise (from the gnoseology point of view) to put it in other words: the Euclidean geometry,

elaborated on the basis of the movement studies in the terrestrial conditions and in the near-earth space, serves as a theoretical foundation during determining distances in the universe.

Riman's or Lobachevsky's geometry can under certain conditions be applied only to the ether medium filling the space.

15. Time as a measure of movement and changes in local physical objects.

Let us cite some most capacious statements of philosophers about time translated into Russian by P.S. Taranov [4]. “Time is eternity that beholds with its own eyes its realizations” (Plato). “Time is a measure of movement. All things are in time and are measured by time” (Aristotle). “Time does not exist by itself, but things themselves lead to perception of what happened centuries ago” (Lucretius Carus).

The most developed conception of time was elaborated by Augustine Aurelius in the first millennium of our Era. “What is time? How should one understand “duration” or “compactness” of time, where does it exist? In the past, but it does not exist now. In future, but it does not exist yet. Then it exists at present time. But if we take a quantum of the present time of any duration – a hundred years, a year, a month, a day, an hour etc., we will see that it consists of quasi-three intervals. One of them is in the past, another – in the future and the third, the shortest one that is indivisible into the smallest parts, is a moment that constitutes the proper present time. It is so short that has no duration. If it lasted, one could separate the past from the future in it; the present does not continue. Then how can we measure time, compare spaces of time etc.? Where is this elusive time?”...”Where there is no creature, through changing movements of which times generate, there can be no time at all” (Cited as translated into Russian by P.S Taranov [4]).

Classical physics holds that it is possible to describe the position of every material point of the space without attracting the time coordinate if this point is in the static state, at rest. But this description is possible only for micro-objects, i.e. such objects that greatly surpass the volumes of elementary particles, since according to modern notions, elementary particles (electrons etc.) are in a constant mutual movement. The stable state of micro-objects, their fixed mutual arrangement can last long. For instance, the established age of some earth rocks and meteorites is $(3.8-4.7) \cdot 10^9$ years [34]. Thus, the mutual arrangement of atoms and molecules in these rocks and meteorites remained unchanged during all that time. If we bring the beginning of coordinates and position of the space axes into coincidence with the position of the three material points, we can make sure that the position of these and other material points in such a body remains unchanged during billion years.

At the same time it is impossible to build some single temporal domain without spatially arranged objects. If we fix the position of some material object at the instant of time t_0 at the point M_0 , this can be done only with some coordinates x_0, y_0, z_0 , representing a measure of space of some volume (area). If the object under observation at the instant of time t_1 occupies a new position, suppose at the point M_1 that is fixed by coordinates x_1, y_1, z_1 , we can correlate the measure of time $t = t_1 - t_0$ with the distance between the points M_0 and M_1 . Thus, the distance between these points provides information on the quantity of the past time that is needed for moving the material object between the points M_0 and M_1 . If the material object remains at the same point M_0 , we cannot define how much time has passed. It may be both $t = 0$ and $t = \infty$. Thus, a motionless point lacks the category of time and, accordingly, a temporal domain cannot exist separately from the spatial domain.

Physical events occurring with some object, for instance, the change in its position can be numbered in such a way that those numbers form a linear sequence. They can be put in a line and due to the used external facilities – clocks they can be given a certain place on this line-time. Thus, real time is one-dimensional. Clocks are such facilities in which equal spaces of time are counted successively. The equality of these spaces is most often ensured by some cyclic, repeated infinitely many times, process. It may be cycles of movement of the planet (Earth) round the Sun, of mechanical pendulum, of electrons round an atom, cycles of current variation in the loop etc.

How many clocks can there be? For instance, these may be an atomic caesium clock [81], electron, 24-hour clock when time is counted by the cycle of day and night changing. A yearly cycle serves to count centuries and millennia. So-called light year is used in astronomy – the distance that light travels with the C velocity during a year. One may also speak about life time of some organism as about the cycle of time account etc.

Since cyclic processes define intervals that provide a basis for time calculation, it is useful to reveal the factors that influence the recurrence of these cycles. The comparison of life cycles of organisms shows that the cycle of one organism can end while the cycle of another one, whose life cycle began simultaneously with the first one, is actively going on. As precise measurements show, the Sun activity greatly influences the duration of the earth year. This activity also influences the orbits of other planets. The cycle of the 24-hour Earth's rotation is under the influence of magnetic disturbances in the ionosphere. The movement cyclicity of a mechanical pendulum is under the effect of the ambient temperature, barometric pressure, humidity etc. The fluctuation cyclicity of the loop in an electronic clock can change under the effect of magnetic or electric fields. The process cyclicity inside the electron shells of atoms and inside their nuclei is more stable. But the cyclicity of these processes can change, for instance, during radioactive decay or fusion.

Now let us focus our attention on the mechanisms that define the process cyclicity in one clock or another. The cycles of those processes are determined by inner reasons. For an atomic clock, this reason is the relation between the electron mass and the field of intranuclear forces within which the electron orbit is. In an electronic clock, the inner reason for the rise of the fluctuation cycle is in the presence and relation between the capacity and inductance of the loop. In a pendulum clock, a cycle arises due to the presence of the pendulum's mechanical mass and acceleration force of the free fall in the Earth's field of gravitation. In another type of mechanical clock, the mechanical mass and the recurrent force of the spring are used. The rotation of the Earth's great mass around its axis is the reason of the earth day cycle. The revolution of the Earth in an orbit around the Sun is a year cycle.

The question arises of whether an external cause that triggers all those cycles and can synchronize those cycles, can exist. Does the worldwide time subject to whatever mechanism that is common to the whole universe, exist? It was shown above that time in every process is given by internal causes of different kind that are determined by atomic, electronic, mechanical, cosmic (including galactic), biological etc. mechanisms of cycle formation. The start-up and slowdown of every temporal process is determined by external or internal causes that are often of statistic nature. The start-up of all cyclic or other processes from one worldwide centre, on the one hand, would require an all-penetrating medium that enables transmitting the start-up pulses in all areas of the universe. This medium, in principle, is conceivable. On the other hand, considering the infinity of the universe (at the moment there is no evidence of its finiteness) and three-dimensionality of the space, the source of such strobe pulses should have infinite energy and transmit those pulses with infinitely great velocity.

The principle of matter and energy conservation prevents the processes with infinitely great energy and infinitely great velocity of perturbation propagation. Thus, it should be acknowledged that the world course of time does not exist. As shown above, this conclusion is corroborated by the variability of the process cyclicity under the influence of different environmental conditions. Thereby, the worldwide cosmic basis for synchronization of all existing natural cycles does not exist.

We can use the most stable cycles occurring in physical bodies applying them for the time scales and extend those scales to other events that have different cyclicity. But as was shown, the worldwide, space wide time does not exist. Time is determined by inner cycles of the processes that are physically isolated in the general case.

Time is a one-dimensional physical quantity. It is characterized by unidirectionality – from past to future. If a body, a material point can be mechanically sent back to the position it occupied t_r time ago in the coordinate system, then additional time t_1 should be spent for this and the sum of these spaces of time will be $t_r + t_1 > t_r$, i.e. it will always be greater than the time t_r . Thus a material body can be in one and the same place at different time. But the same body cannot be at different places at the same time.

In the material world there are billions and billions of material bodies (from atoms to galactic formations) moving in relation to billions and billions of other material bodies, every one of which can be taken as the beginning of the time reference system or spatial coordinates [82].

Thus, time is local, i.e. it refers only to the object that is moving (somehow changes its position, quality, properties etc.). It is irreversible (for cyclic processes as well), since to maintain those processes or to count cycles, power supply is necessary. Time is one-dimensional and unidirectional. This feature of time is very important, since one-dimensionality and unidirectionality of time (within one process) ensure following the causality principle. Since time passes from past through present to future, the reverse motion of time would break the direction of cause-and-effect relations in the world. But it is time that determines the causal link of events.

One-dimensionality of macrotime is a reliable physical fact [79]. A short event can be placed on the time axis to a very high accuracy. At present the most precise physical devices allow the time to be measured with an accuracy better than $1 \cdot 10^{-12}$ [83]. For instance, we can say that a given event occurred at the point of time t . This time can be determined by the velocity of the process run (inner clock). In this case the time t can be determined taking some inner event as the reference point. The time t can be determined independently of the process, by the "external" clock.

So, our understanding of space and time is close to the understanding of these categories formulated by G. Leibnitz. According to his concept, space is an order of mutual arrangement of individual bodies and time is an order of alternating phenomena or body states [84].

Many-dimensional space ($n > 3$) and time ($n > 2$), a possibility of time reversibility are widely used in abstract mathematical constructions and described in popular scientific and other literature. Naturally, this attracts mathematicians and physicists, since it expands the scope for imagination and complexity of mathematical and physical abstractions. Considering a great body of the available information on physical phenomena known for a long time, many-dimensional worlds attract modern scientists as a field for investigations where they can obtain new results. But in our opinion, all the results should be correlated with real three-dimensionality of space and one-dimensional and unidirectional time that is independent of the space for every specific process.

16. Principles acting in the universe

Based on the above tenets about space, ether medium, time and known recognized physical postulates that have been experimentally checked many times, one can formulate the following basic principles acting in the universe:

1. Space is all-inclusive. It is rigid, Euclidean and three-dimensional. Space is linear and continuous.
2. The visible space is filled with the ether medium composed of particles of two types opposite in sign. Those particles form a spatial-netlike structure. The spatial-netlike structure of the ether medium becomes deformed under the action of electromagnetic fields (waves) and physical bodies. The ether medium has a specific mass and elastic properties. It is discrete (in micro scales) and exhibits itself as a continuous medium in macro scales.
3. Matter (substance) as well as energy do not appear and does not disappear (Lavoisier, Lomonosov).
4. The energy of any process, as well as the amount of the matter participating in the process, cannot be infinitely great. Accordingly, the transmission velocity of the energy including that of any signals cannot be infinitely great.
Time is local, irreversible, one-dimensional and one-directional – from past to future. The time locality lies in the fact that it determines the variation of a specific object. The movement, change in location, properties and quality of an object can be an abstract measure of time, but in fact time determines the processes only of a specific local object.
5. Time as a mechanism whose movement might control processes all over the universe does not exist since ensuring such a movement would require infinitely great energy.
6. Due to one-directionality of time the impulsive cause and effect are separated by a space of time. This space of time may be very short but it is never equal to zero. Any process exchanging the power with the unlimited environment is irreversible in time.
7. But a physical body acts on another physical body without a direct contact between these bodies, through physical matter that possesses certain physical properties. This matter transmits the action from one of its points to another, from one body to another. All known physical fields (mechanical, electric, magnetic, gravitational etc.) have a material physical carrier.

To date it is known from astronomers' investigations that a number of processes in the universe and the volume (mass) of the matter participating in the processes are uncountable. From the principle of indestructibility of matter and energy it follows that the universe always existed and will exist for ever.

The above principles have obtained reliable experimental corroborations during observations on macro objects, such as physical media (solid bodies, fluids, gases etc.). Astronomers' observations during the whole lifetime of astronomy allowed obtaining new and new facts that corroborate the reality of some mentioned statements. Let us note that besides determined events one can observe accidental events in physical media and micro objects.

17. Conclusion

Nature does not like emptiness. Virtually all recent concepts of physical vacuum are based on this postulate [26-33, 85]. The universe is filled with a specific medium – ether. The one who just once approached a strong magnet to a piece of iron cannot deny the presence of this specific medium. Only the acceptance of the fact of the ether medium existence allows retaining the material basis for the propagation of light and electromagnetic waves [8]. This medium is a transmitter of gravitational interactions of gravitating bodies. Otherwise, one should accept a possibility of a gravitating body to mystically recognize the presence of another body and then to tend to it.

The second fruitful postulate is – every existing thing consists of two principles that are opposite in sign. It was proposed in the middle of the 1st millennium BC by Chinese philosophers [5, 86]. The opposite principles – in' and yan – are not only philosophy categories expressing the idea of the world dualism, but they are also the basis of the universe arrangement. In the traditional cosmogony, the appearance of the in' and yan categories signifies the first step from chaotic unity of the primeval pneuma (tsi) to the variety of the entire “host of things” (“Tao Te Ching”). Each of these principles contains the potentiality of the other one. The examples of separation into two opposite principles can be found in all forms of the matter existence, in different degrees of its manifestation, especially when analyzing physical phenomena. We know that only two types of electric charges exist – positive and negative. To date there is an experimental proof of the presence of both matter and antimatter. Neutrino and antineutrino have been predicted and registered [87]. The outlined foundations of the ether theory demonstrate clearly the first step of the matter self-organization. The following steps lead to formation of more complicated forms of the matter up to producing biological living types of its existence.

The proposed concept of the ether medium solves a few problems that recently seemed to be unsolved [88]. It explains “transverseness” of light and electromagnetic waves. It allows understanding the difference between the mass of a physical body and electromagnetic mass of the ether medium. It explains the observed forms of the laws of light reflection and refraction. It corroborates the principle of arrangement of any medium that is able to transmit oscillatory perturbations – this medium should possess elasticity and mass. The obtained physical values of the ether medium elasticity and mass confirm this. The presented concept fully agrees with D. Maxwell’s fundamental equations and, accordingly, with theories of electrostatics and electrodynamics. It explains great homogeneity of the vacuum and why at collision of high-energy particles in experiments, pairs of new particles with opposite charges arise – they are borne by the ether medium containing these charges [89].

The suggested concept removes the paradox of a magnetic field which is mistakenly called vortex in reference and training literature [57, 67, 68, and 90]. In our work it is shown that a magnetic field is various forms of shear deformation of the quasi-solid ether medium. The “vortex”, gaseous, liquid theory of a magnetic field as well as of the ether medium cannot be substantiated without breaking a number of physical principles.

One of the most important consequences of the suggested theory is an explanation of the nature of the mutual attraction and inertia of physical bodies. Establishing a gradient of the ether elastic pressure by a physical body in the vicinity of another physical body that creates a gradient of the ether elastic pressure in the vicinity of the first one, results in the rise of a force making these bodies approach each other. This is the reason for gravitation. The interaction of a physical body with the ether medium is the basis for manifestation of inertia forces.

To our mind, an interpretation of Fizeau’s experiment cannot be based on the assumption of the ether “thickening” in physical media. As shown above, light (electromagnetic waves) propagates in physical bodies as in media with dislocations. These dislocations are atom

nuclei (their field), electrons etc. The denoted dislocations lead to a deceleration of the electromagnetic wave velocity in physical bodies.

The presence of the ether medium means inapplicability of Galileo's principle of relativity to electrically charged bodies. Accordingly, the recognition of the ether medium presence breaks the principles on which the general and special theories of relativity are based. The recent discovery of the universe's hidden matter by astronomers lends the cosmological support to the ether.

The universe is composed of the following categories (essentialities). The space embraces everything. It is rigid, Euclidean and three-dimensional. The space is filled with the ether medium. The ether medium can be deformed under the influence of the external physical bodies and electromagnetic fields and its density may be different at different points. The ether medium can experience static and dynamic, shear and torsion deformations. It is the basis for propagating electromagnetic waves and transmitting gravitational influences of physical bodies upon each other. The physical bodies (elementary particles, gases, liquids, solid bodies, plasma etc.) are located in the space and ether medium. The gravitational influence of one physical body upon another is carried out via the ether medium. Dynamic processes in the ether medium and the movement of physical bodies can be fixed in time. Time is local, irreversible, one-dimensional and one-directional – from past to future.

The suggested concept of the ether medium [69, 91] allows predicting most elementary perturbations (particles) that may arise in it. It was shown above that the ether medium is a regular spatial lattice composed of two particles that are equal in size but opposite in sign. Their mutual attraction will make these particles occupy a strict and exact position relative to each other. Thus, the spatial lattice of the ether medium will be rather homogeneous in the end. However, we can imagine initiation of dislocations or heterogeneities in the vacuum spatial structure due to some reasons. For instance, as discussed earlier, heterogeneities arise in the vacuum in the presence of atoms, ions, electrons, i.e. bodies possessing a physical mass. However, to our mind, in some cases heterogeneities may arise in the absence of a physical body. Imagine the simplest types of such heterogeneities. For instance, one can imagine the presence of an excess particle with a positive sign located in the middle of a homogeneous lattice. That will be the example of the simplest heterogeneity that may be called the heterogeneity "with the positive excess". One can also imagine an excess negative particle in the middle of the lattice. This heterogeneity may be called the heterogeneity "with the negative excess". Two other types of heterogeneity can exist. One of them is represented by the absence of the positive charge in the middle of the lattice. Let us call this type the heterogeneity "with the positive deficit". The opposite type will be called "with the negative deficit". Thus, there can be four types of the simplest heterogeneities. Interestingly, combining heterogeneities "with the positive excess" and "with the positive deficit" will result in their mutual annihilation, elimination. A similar situation holds when combining heterogeneities "with negative excess" and "with negative deficit". Such heterogeneities (mini-particles) will not possess the mass that is typical of a physical body. But these "excess" and "deficient" mini-particles must have some charge (lack of charge) and electromagnetic mass (lack of this mass). They must be the smallest and most elementary of all possible. The heterogeneities "with positive deficit" and "negative deficit" are kinds of holes in the ether medium. Note that D. Willer [92] presents a diagram in which antineutrinos play the role of holes.

The ether medium or vacuum is really a shoreless ocean, as Paul Dirac wrote. This ocean is filled with electromagnetic matter. Now it is difficult to say how this energy can be released and used. But enormous quantities of energy can be undoubtedly transferred without any loss through the ether medium, free cosmos by means of electromagnetic waves of great intensity.

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