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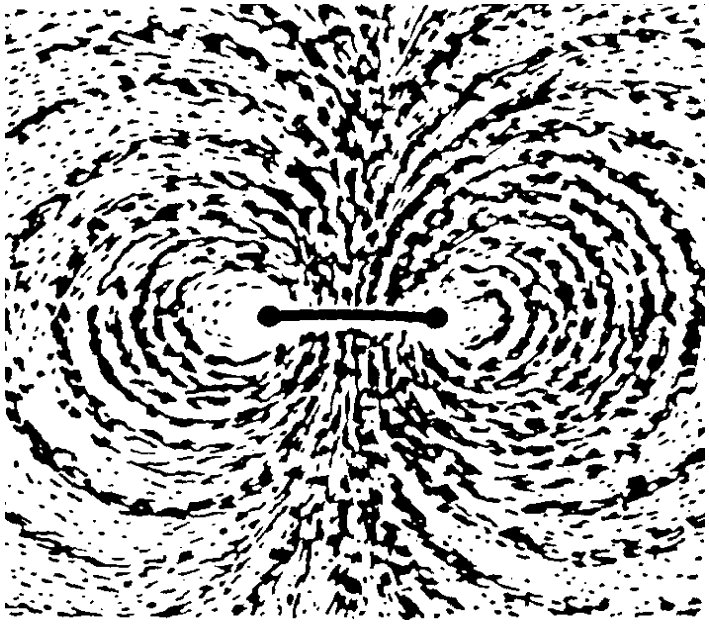
THE FUNDAMENTALS OF NON-EMPTY ETHER (VACUUM) THEORY



APATITY

2001

Gorbatsevich F.F.

THE FUNDAMENTALS OF NON-EMPTY ETHER (VACUUM) THEORY

Annotation
The fundamentals of a physical model of the ethereal medium (vacuum) consisting of particles of two kinds, equal, but opposite in sign are stated. The model contains elements of the vacuum structure offered by W. Thomson, of MacGullagh continuum and conforms to the theory of electromagnetism by D. Maxwell. A uniform physical basis for an explanation of observed electromagnetic phenomena, inertia and gravitation is given.

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The author will be grateful for any remarks and comments to the presented work.
My address is:
F.F.Gorbatsevich Geological Institute KSC RAS, 14, Fersman Str., Apatity, Murmansk region, Russia.
Tel. +7 81555 79626 (of.), +7 81555 24475 (h).
E-mail: gorich@geoksc.apatity.ru

F.F. Gorbatsevich. The fundamentals of non-empty ether theory

The concepts of space, time and matter provide the basis for scientific notions of the universe. An assumption of the postulates of both special theory of relativity and general theory of relativity has not allowed one to get a non-contradictory physical model of the universe. The physical model of a vacuum (ethereal medium), suggested in the book, conforms with the known phenomena, appearing when light and electromagnetic waves propagate, and explains the nature of inertia and gravitation as well. According to the model, the ethereal medium consists of two geometrically similar, but opposite in sign, particles. The particles are strongly attracted together forming homogeneous space. Being opposite in sign the particles move without friction relative to each other. 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 a shear deformation of the ethereal medium. The ethereal medium has certain electromagnetic density and elasticity. Any physical substance, possessing a mass (density), is permeable to the ethereal medium. Any physical substance may move without friction in the ethereal medium. A uniform motion of a local physical body deforms the ethereal medium, changing a distance between the ethereal medium particles of unlike charges, that are strongly stuck together and that close again after the body has passed. The greater is the acceleration of a local physical body, the greater is the inertial perturbation in the ethereal medium caused by this body. The greater is the mass of a physical body, the greater is the inertial perturbation caused by it. One of the most important results of the suggested theory is an explanation of the nature of physical bodies mutual attraction. A physical body creates a gradient of the ether's elastic pressure in the vicinity of another physical body that also creates ether's elastic pressure gradient in the vicinity of the first one. This gives rise to the strength that makes these bodies draw close together. And this causes gravitation.

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, M. V.F. Mitkevich, 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 sputnics 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 m/sec [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 feminity, 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 dealt with the problems of universe and cosmogony in detail. They determined ether as all-generating imperceptible to the touch, not subject to our sensations matter. It seems to us, that the most consistent model of ether was offered by Demokrite [5]. He stated that ameres - verily indivisible, devoid of parts - underlie all elementary particles. The ameres, being parts of atoms, have properties, which are vastly different from atoms' properties. If gravity is peculiar to atoms, ameres are completely devoid of this property. All totality of the ameres, moving in the emptiness (vacuum), according to Anaximandr, is a common global medium, ether or apeiron. Creators of bases of modern mathematics and physics considered ether as a substantial medium. For example, R. Descartes considered the space to be entirely filled with matter. The formation of visual matter, planets, by R. Descartes, happens from vortexes of ether. At the end of his life, Isaac Newton explained the presence of the gravitational force by pressure of the ethereal medium on a material body. According to his last view, the density gradient of ether is necessary to rush bodies from denser areas of ether to less dense ones. However, in order the gravitation appeared in the way it is observed by us, ether, according to Newton, has to possess great elasticity.

The first serious attempt to give mathematical description of ether was made by MacGullagh in 1839. According to MacGullagh, ether is a medium rigidly anchored in the global space. This medium renders elastic resistance to a turning strain and is characterized by an antisymmetric tensor of the second rank, which main diagonal terms are equal to zero. Posterior scientists have shown, that MacGullagh's ether is characterized by Maxwell's equations for empty space [6].

Of the classics of natural sciences the most complete definition of ether was given by James Clark Maxwell [7]. He wrote that ether is distinct from ordinary matter. When the light goes through the air, it is obvious, that the medium, in which the light propagates, is not the

air, because, first, the air cannot transmit shear oscillations; and the longitudinal oscillations, transmitted by it, propagate almost a million times more slowly than the light.

It is impossible to suppose, that the structure of ether is similar to the gas structure, in which molecules are in the state of a random motion, because in such a medium a shear oscillation during a wavelength attenuates to the quantity, less, than 1/500 of the initial amplitude. However, it is known that a magnetic force in some area around a magnet is maintained while the steel retains its magnetism. Since we do not have reasons for the assumption that a magnet can lose all its magnetism as times goes by, we conclude, that molecular vortexes do not require a constant expenditure of work to maintain their motion. Whatever difficulties we encountered during our attempts to work out a well-grounded notion of ether structure, it is doubtless, that interplanetary and cosmic space is not empty, it is occupied by a material substance or body, the most extensive and, very likely, the most homogeneous we have ever known.

One of the creators of classical physics W. Thomson in the XIX century also developed a concept of an incompressible ethereal medium consisting of "atoms, conventionally, red and blue", bound to each other by rigid bindings and located at Bravai's lattice points [8]. His concept suggests that ether is quasi-rigid and absolutely resists any rotational displacements (gyration). W. Thomson's ether can be subject to shear strains. In order the ethereal model met the conditions of absolute resistance to a rotational displacement, W. Thomson arranged gyratory gyroscopes on rigid bindings. The gyroscopes can be represented as vortexes of an incompressible fluid. The angular velocity of the motion in each of the gyroscopes can be indefinitely high. On this assumption, a spatial net of differently orientated gyroscopes will render infinitely great resistance to a rotational displacement of the ethereal medium around any axis. The model of ether, constructed like that, according to W. Thomson's concept, is capable to transmit oscillations just as natural ether does.

Undoubtedly, W. Thomson's model does not virtually conform to modern concepts. It is very complicated. It is difficult to conceive gyroscopes with an indefinitely great angular velocity. Comparatively simple reasoning leads to the conclusion, that an indefinitely great velocity requires indefinitely great energy. It is not absolutely clear how the gyroscopes' areas, in which the gyration happens around reciprocally perpendicular axes, mate. W. Thomson does not explain, what physical mechanism realizes rigid bindings. At the same time, in our opinion, the concept of the ethereal medium consisting of "atoms" of a double sort, joint by strong connections and located at the particular lattice points has a rational base.

An essential revolution regarding conceptions of ether among physicists took place after the publication of principles of the theory of relativity by A. Einstein [9]. For example, in 1905 A. Einstein writes that introduction of "light-bearing ether" will appear thus redundant (Zur Elektrodynamik der bevegter Körper. Ann. Phys., 1905, **17**, pp.891-921). In another work, in 1915 he writes that it is necessary to give up the introduction of the concept of ether that has turned into a useless makeweight to the theory (Die Relativitättheorie. In: Die Physik. T.3, Abt.3, Bd.1, Leipzig, Teubner, 1915, pp.703-713). In 1920 he writes that the hypothesis of the ether existence does not contradict the special theory of relativity (Ather and Relativitätstheorie. Verlag von Julius Springer. Berlin, 1920). In 1954 A. Einstein gives a final verdict: “The special theory of relativity demonstrates inconsistency of the ether hypothesis existence…” (Relativität und Raumproblem. Supplement V, 1954).

One of the eminent physicists P. Dirac has described his understanding of vacuum this way [10]. According to these new notions, vacuum is not a hollow, which has nothing in it. It is filled with an enormous quantity of electrons, which energy is negative and which can be viewed as a certain ocean. This ocean is filled with electrons without a limit for the quantity of the negative energy, and therefore there is nothing similar to bottom in this electronic ocean. The phenomena we are interested in are the phenomena happening at the surface of

this ocean and what happens at a depth is unobservable and is not of any interest. As long as the ocean is completely homogeneous, while its surface is flat, it is unobservable. But if we take a handful of water out of the ocean and lift it, the resulting disruption of homogeneity will be observed as electrons represented in this situation as the lifted part of water and the hole, remaining in its place, i.e. positrons (translated from Russian).

Another eminent scientist L. Brillouin has made a deduction: ..."General Theory of Relativity - is a brilliant example of a magnificent mathematical theory constructed on sand and leading to an increasing pile of mathematics in cosmology (a typical example of science fiction)" [1]. In the book "Relativity reexamined" he writes, that the theory of relativity, as well as the quantum theory, have arisen in the beginning of the 20-th century. Then fast development of quantum mechanics began. Spin, the Pauli exclusion principle, associated waves, the Schroedinger equation and many other things were discovered. Experiments supplemented the theory, the improved theory allowed one to predict new phenomena. The development of quantum mechanics has shown a remarkable symbiosis of theory and experiment, which leads to an unlimited growth of knowledge.

The theory of relativity (GTR and STR) is quite another matter. Subjected only to several experimental checkouts, it remains logically inconsistent. It has not caused that violent quantity of new scientific directions, which could be given by a fruitful theory. Hard fights with logical and physical inconsistencies in the theory are still going in its field.

Let us note that the aforecited argued assertions of world-renowned scientists cannot be ignored. The latest scientific achievements, especially in the field of radio-waves propagation, including that in outer space, motivate one to return to the solution of the ether problem.

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 D. 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 $3.8\text{-}4.7 \cdot 10^9$ years [11]. 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 **E** and magnetic **H** fields. The intensity vectors **E** and **H** vary synchronously and perpendicularly to the wave propagation direction. Perpendicularity of the vectors **E**, **H** and propagation direction causes "shear nature" of an electro-magnetic wave. The vectors E and 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 [12]. In the first two cases it is possible to determine the orientation of the vectors **E** and **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) [13, 14]. 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 [15]. 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 **E** and **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 [16]. 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 [17]. Acoustopolarization measurements are carried out by a specially designed device, named acoustopolariscope, Fig. 1 [16]. 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 [18]. 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.

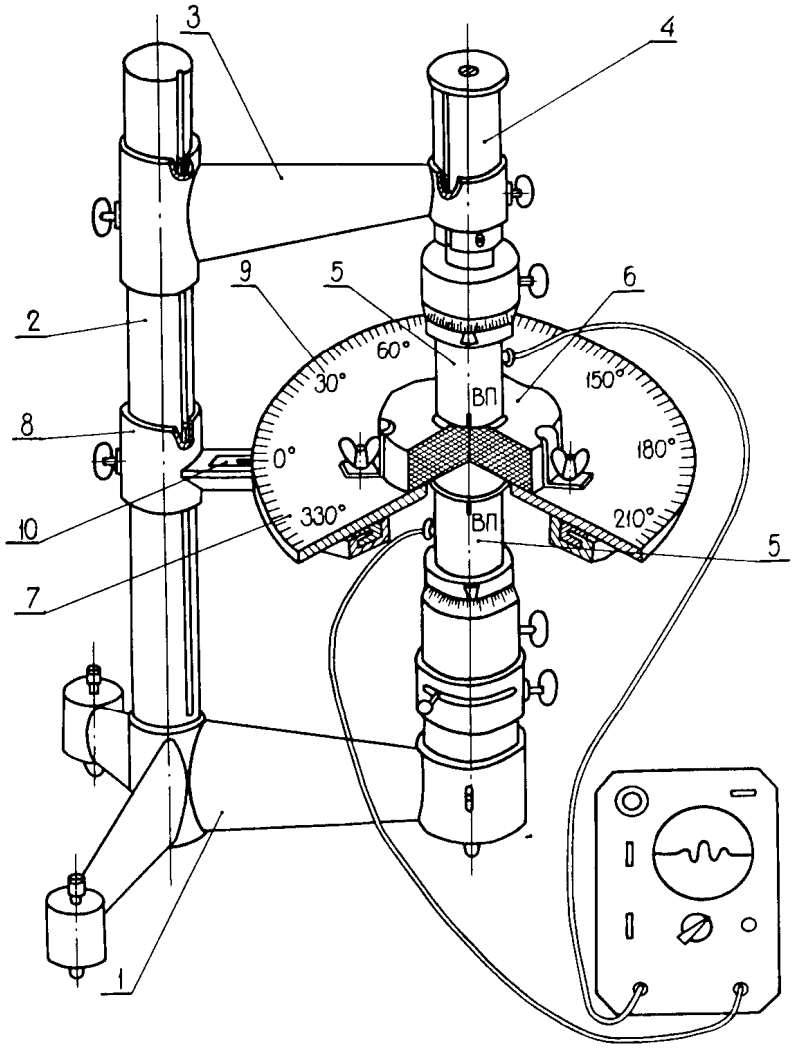

Fig. 1. Design of acoustopolariscope with the rotating platform (Pat. No. 1281993, USSR). 1 - base; 2 - pole; 3 - bracket; 4 - travelling rod; 5 - transducers; 6 - sample; 7 - rotating platform; 8 - additional bracket; 9 - angle scale; 10 - mark.

The 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 [18]. 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 [16].

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 [18]. 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/sec). 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. [13].

This property, called an effect of linear acoustic anisotropic absorption of shear waves (LAAA), is observed rather often in textured rocks [16]. 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). 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.

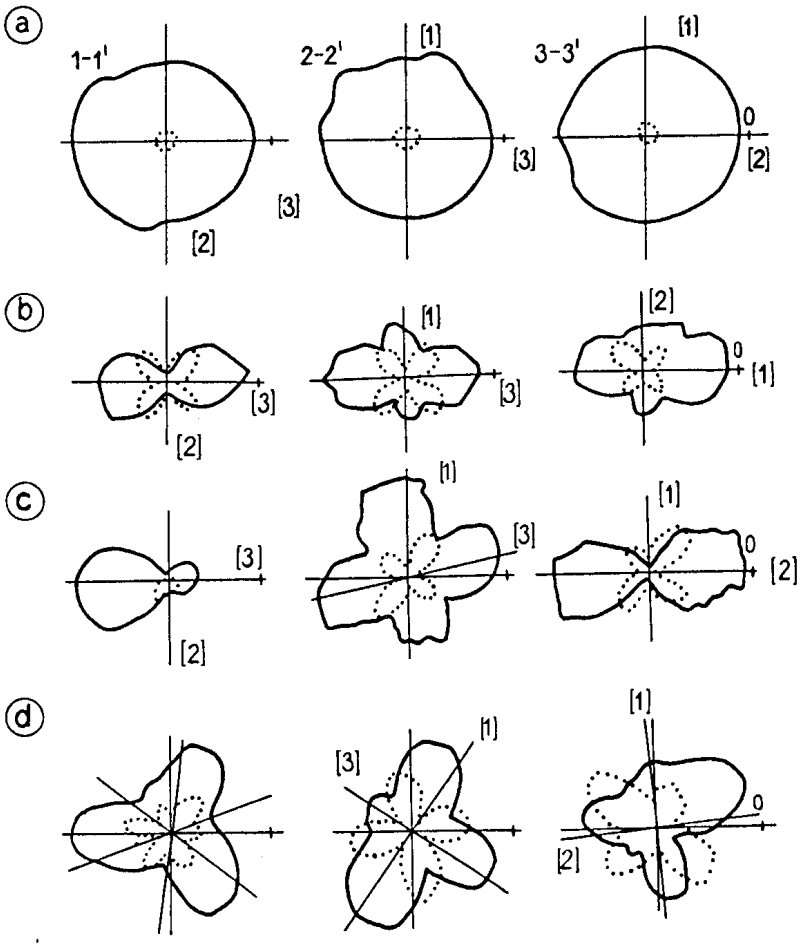

Fig. 2. Acoustopolarigrams of cubic silicate glass samples (a), wood (b), microcline monocrystal (c), synthetic quartz (d) in three mutually perpendicular directions 1-1', 2-2', 3-3'. VP - solid lines; VC - dotted lines.

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 60^0, - 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. Outcomes of an analysis of a large number of solid media acoustopolarigrams, mainly minerals and rocks, and known data from optical polarization observations practice [12-19], 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;

- Pleochroizm 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 [12, 19].

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 [20, 21];
- 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) [22];
- 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 [16], optical pleochroism (dichroism) in natural media is presented [13] much more seldom;
- There is a class of media, where an optical activity is greatly appeared [20], 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 [23];
- Some liquid media at usual temperatures and pressures are good shear wave conductors at high frequencies (0.5-1.0 MHz and above) [16].

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 [20]. For a wave component, which vector of polarization is parallel to the contact plane of the media, the transmission factor is equal to:

$$T_p / A_p = \frac{2n_1 \cos\theta_i}{n_2 \cos\theta_i + n_1 \cos\theta_t}, \quad (1)$$

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:

$$T_t / A_p = \frac{n_2 \cos\theta_i - n_1 \cos\theta_t}{n_2 \cos\theta_i + n_1 \cos\theta_t}, \tag{2}$$

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 [24] for a wave with a polarization vector lying in the plane of interface plane (SH-polarization), the transmission and refraction factors look like:

$$K_{SH2} = A_{SH2} / A_{SH} = \frac{2\sqrt{P}\sqrt{1-h}}{P\sqrt{1-h} + H\sqrt{P-h}}, \tag{3}$$

$$K_{SH1} = A_{SH1} / A_{SH} = \frac{P\sqrt{1-h} - H\sqrt{P-h}}{P\sqrt{1-h} + H\sqrt{P-h}}, \tag{4}$$

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 $q = \sin^2\theta_t$, $F = (n_1)^2/(n_2)^2$ the equations (1) and (2) can be brought into the form, similar to the equations form (3), (4):

$$K_p = T_p / A_p = \frac{2\sqrt{F}\sqrt{1-q}}{F\sqrt{1-q} + \sqrt{F-q}}, \tag{5}$$

$$K_t = T_t / A_p = \frac{F\sqrt{1-q} - \sqrt{F-q}}{F\sqrt{1-q} + \sqrt{F-q}}. \tag{6}$$

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 always 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 [20]. An enumeration of other phenomena and effects including piezo- and thermo-electricity, mutual electro-elastic effects are described in [22, 25, 26]. 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, MacGullagh, D. 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 are the perturbations, the greater is acceleration of the body. 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 [2]. 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. 3, connect the links and masses.

Fig. 3. 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. 4.

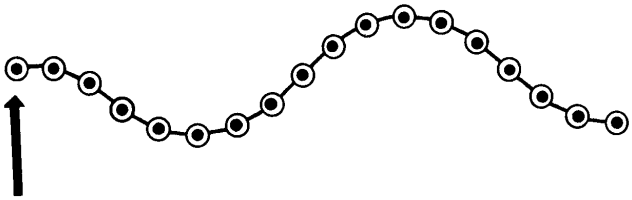

Fig. 4. Waves of a flexible string in free space.

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.

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. 5.

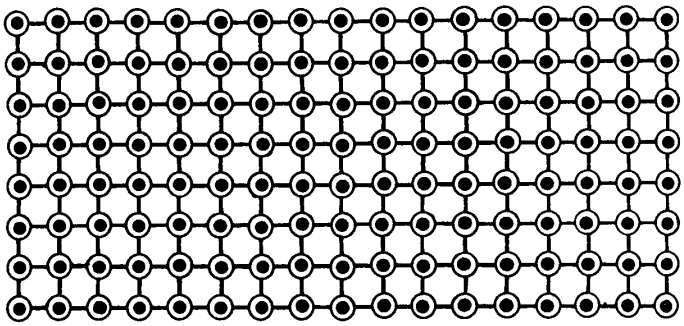

Fig. 5. A plane lattice consisting of unit masses, rigid links and hinges.

A plane lattice, as well as the line, Fig. 3, arranged in the manner described, will be capable to transmit only shear waves, Fig. 6.

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. 5, 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.

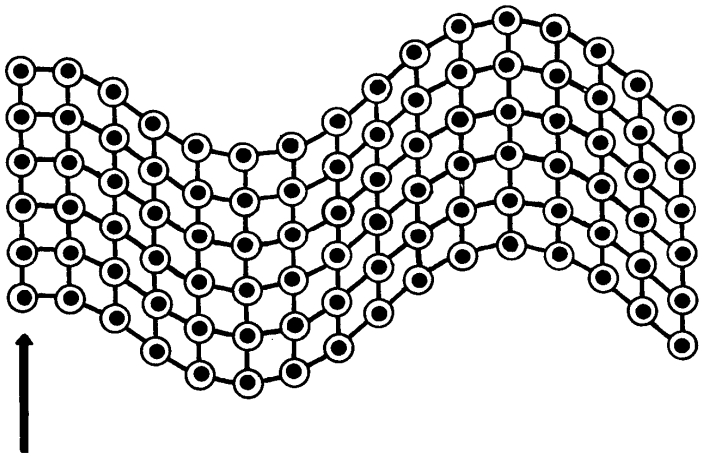

Fig. 6. A plane lattice transmitting shear waves.

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. 7.

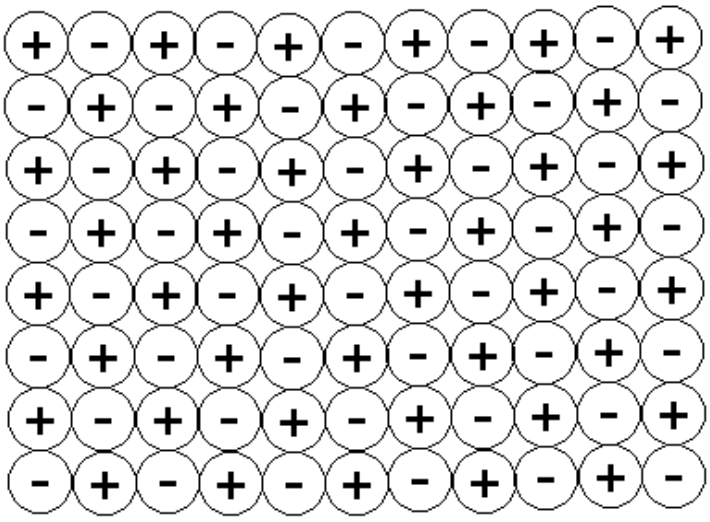

Fig. 7. The structure of the ethereal medium consisting of particles of two kinds, opposite in charge (projection to a plane).

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 D. Maxwell [7]. 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 [11], 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.

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. 8.

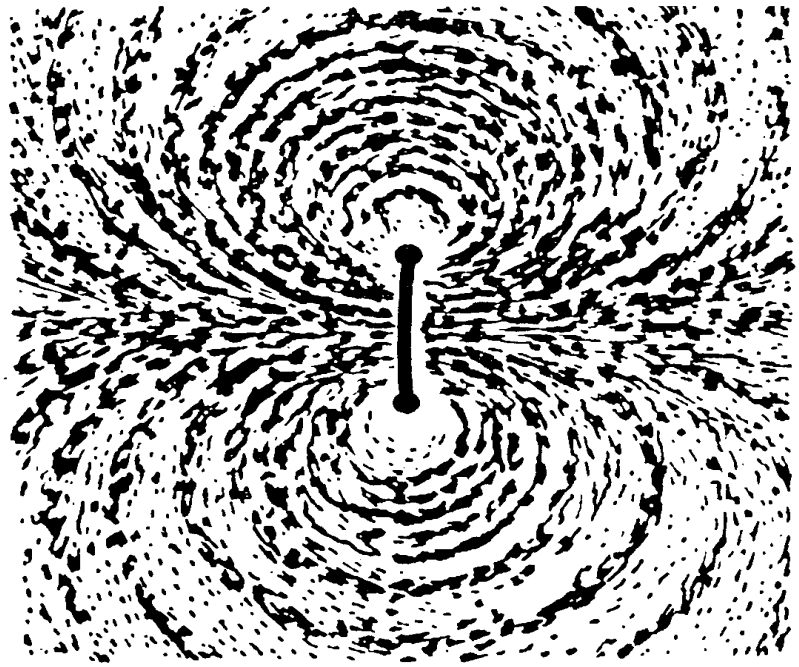

Fig. 8. Force lines of a magnetic field of circular current, traced through an iron dust.

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 [28]. 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 [29].

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 [30].

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 super fluid 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. On the other hand Yu.K. Sakharov [31] affirms that the energy conservation law forbids an existence of magnetic a monopole. Based on the schemes given, cited in Fig. 8 and 9, the most consistent is the explanation that around a conductor with current there is a torsional, shear strain in the ethereal medium. This assertion is convincing substantiated at the analysis of a self-induction mechanism in a conductor with current.

At connection of a voltage source the current in the conductor arises not at once. It increases by the exponential law, reaching a fixed value in some time, determinates by inductance of the conductor. At that moment, when the connection of the conductor with the source is interrupted, in the conductor there is a current of self-induction, which energy is exactly equal to the energy accumulated during the connection of the conductor to the source. There is a reasonable assumption, that at the moment of connection, the energy was elastically accumulated. At the moment of interruption this elastic energy was realised at making of self-inductance electromotive force. And, this energy is reserved in space (ether), enclosing a conductor, as numerous experiences with conductors, solenoids with current, etc., show.

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 MacGullagh developed concepts of the ethereal medium, which appeared to be in agreement with the theory of

electromagnetic and optical phenomena by D. Maxwell (1864). Below the equations of MacGullagh are given mainly in Arnold Sommerfeld's presentation [6]. 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. Since such torsion exhibits antisymmetric tensor characteristics we can represent the strains applied to unit cube sides as antisymmetric tensor:

$$\begin{pmatrix} 0 & \sigma_{xy} & \sigma_{xz} \\ \sigma_{yx} & 0 & \sigma_{yz} \\ \sigma_{zx} & \sigma_{zy} & 0 \end{pmatrix}, \tag{7}$$

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

The relation between a rotation and strains are shown in Fig. 9. 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).

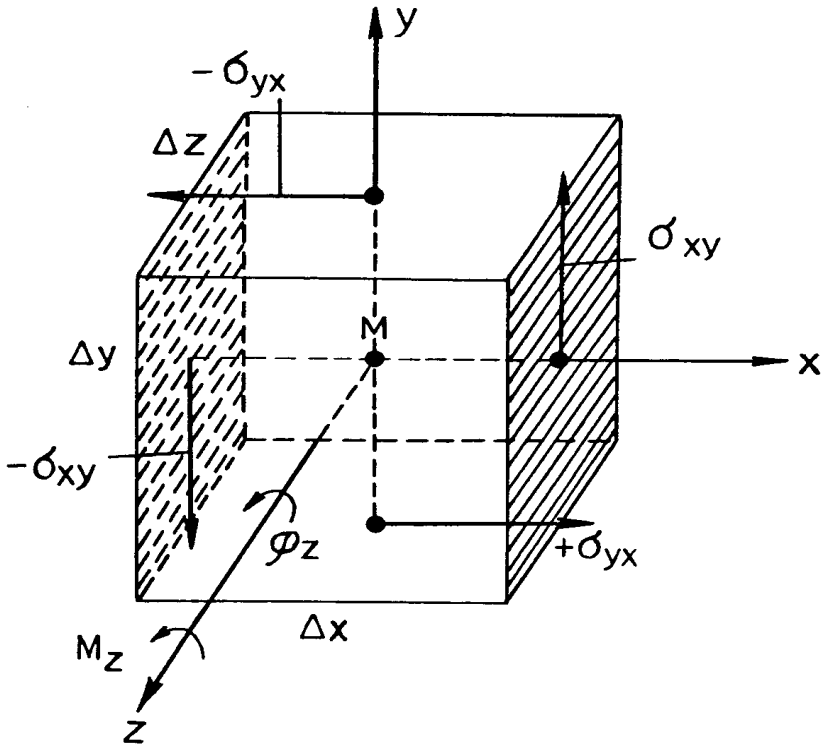

Fig. 9. Relation between strains and twisting moment in a quasi-elastic body.

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

$$M_z = k\varphi_z \Delta\tau, \tag{8}$$

where k is the "torsion modulus" of a quasi-elastic body. Two shearing forces σ_{xy} and σ_{xy} 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 (7) and (8) we should get

$$\sigma_{xy} = -\sigma_{yx} = (k/2)\varphi_z. \tag{9}$$

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 (8).
The cyclical substitution from (9) explicitly leads to the following expressions:

$$\sigma_{yz} = -\sigma_{zy} = (k/2)\varphi_x, \qquad \sigma_{zx} = -\sigma_{xz} = (k/2)\varphi_y\,. \tag{9a}$$

The action of forces, given in Fig. 9, 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 [28]. 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 (9) and (9a), 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 vectorially written, represents an equation of motion

$$\delta\frac{\partial\vec{S}}{\partial t} = -\frac{k}{2}\,rot\,\vec{\varphi}. \tag{10}$$

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

$$\delta\frac{\partial\vec{\varphi}}{\partial t} = \frac{1}{2}\,rot\,\vec{S}. \tag{11}$$

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:

$$div\,\vec{S} = 0,\ div\,\vec{\varphi} = 0. \tag{12}$$

According to A. Sommerfeld [6], the set of equations (10), (11) and (12) demonstrates a convincing simplicity and symmetry. It has the same shape, as equations of D. Maxwell for void.

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:

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

or

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

Then identically to equations (10), (11) and (12) we shall receive the following twice:

$$\varepsilon_0 \frac{\partial\vec{F}}{\partial t} = rot\vec{G}, \qquad div\,\vec{F} = 0,$$
$$\mu_0 \frac{\partial\vec{G}}{\partial t} = -rot\vec{F}, \qquad div\,\vec{G} = 0. \tag{13}$$

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:

$$\varepsilon_0 = \frac{\delta}{k}\frac{2\alpha}{\beta}, \quad \mu_0 = \frac{2\beta}{\alpha}, \tag{13a}$$

$$\mu_0 = \frac{\delta}{k}\frac{2\alpha}{\beta}, \quad \varepsilon_0 = \frac{2\beta}{\alpha}. \tag{13b}$$

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:

$$\varepsilon_0\mu_0 = \frac{4\delta}{k} = \frac{1}{C^2}. \tag{14}$$

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 (13), 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 $div\,\vec{G} = 0$ there should be

$$div\,\boldsymbol{B} = 0, \text{ where } \boldsymbol{B} = \mu\vec{G} \text{ is magnet induction.} \tag{15}$$

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 $\boldsymbol{B}$ creating no difficulties. On the other hand, the condition $\vec{F} = 0$ will transform into

$$div\, \boldsymbol{D} = \delta_e, \quad \text{where } \boldsymbol{D} = \varepsilon \vec{F} \text{ is electrical strength,} \tag{16}$$

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, D. Maxwell's equations can be valid here too, in a ponderable dielectric. In the work [6] 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. 8, most clearly demonstrates the validity and adequacy of MacGullagh'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 MacGullagh'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 (7) 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 (14) 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. By virtue of this the medium could be neglected. 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. 7, 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 (14), given in the previous section, it is possible to find out, that the velocity of electromagnetic waves propagation in a vacuum is equal to

$$C = \sqrt{\frac{1}{\varepsilon_0 \mu_0}} = \sqrt{\frac{\kappa}{4\delta}} \ . \tag{17}$$

As follows from this equation, the shear 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:

$$R = \delta C, \tag{18}$$

whence

$$\delta = R/C. \tag{19}$$

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

$$R = \sqrt{\frac{\mu_0}{\varepsilon_0}}, \tag{20}$$

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:

$$C = \sqrt{\frac{1}{\mu_0 \varepsilon_0}}. \tag{21}$$

Substituting the expressions for R and C into the formula (19), we shall obtain

$$\delta = \mu_0 = 1.25664 \cdot 10^{-6},\ m\ kg \cdot s^{-2} a^{-2}, \tag{22}$$

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 (14) to determine the value of torsion modulus

$$\kappa = 4/\varepsilon_0 = 4.51763 \cdot 10^{11},\ m^3\ kg \cdot s^{-4} a^{-2}. \tag{23}$$

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 [27]:

$$V = \sqrt{E / \rho}, \tag{24}$$

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

A comparison of the formulas (17) and (24) shows, that they are similar. In the formula (24) 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 (24), 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 [32], diamond is noted for its great hardness and elasticity. For example, the value of the velocity of shear waves propagation in it is Vs = 12.32 km/s, with the density ρ = 3.51 g/cm^3. At the same time in lead the velocity Vs = 0.86 km/s and the density is ρ = 11.6 g/cm^3. A proportional dependence between the velocity Vs 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 (23) 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 (22). 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, $\mathring{A} = 1 \cdot 10^{-10}$ m. The nuclei have the sizes close to 10^{-15} m. At the same time, the wavelength, for example of a visible light, is $(4\text{-}7) \cdot 10^{-7}$ m [33]. There are many experimental data about the propagation of light in gaseous, fluid and solid media.

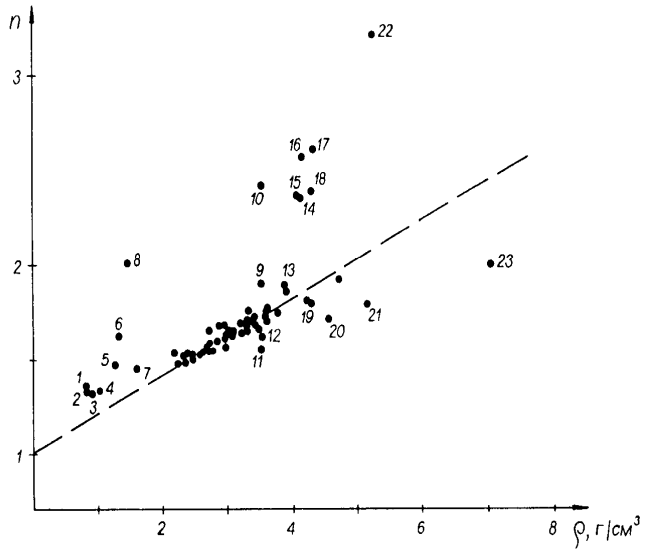

Fig. 10. The relationship between the refraction coefficient n and the density ρ_ of some liquid and solid substances, minerals (based on the data [32, 34]). 1 - ice, 2 - acetone, 3 - alcohol, 4 - water, 5 - glycerine, 6 - carbon bisulphide, 7 - carbon tetrachloride, 8 - sulphur, 9 - titanite, 10 - diamond, 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. 10).

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:

$$n = 1 + 0.2\,\rho\,. \tag{25}$$

This relationship has been reflected by a dotted line in Fig. 10. 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, all 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.

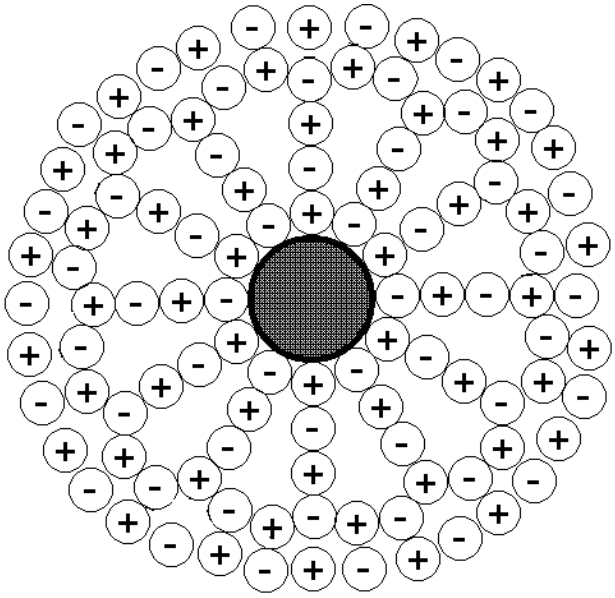

Fig. 11. A simplified scheme of the spatial network structure of ether in the vicinity of a unit spherical mass.

In Figure 11 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. 11.

A comparison of Fig. 7 and 11 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. 11. 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. 7.

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. 12.

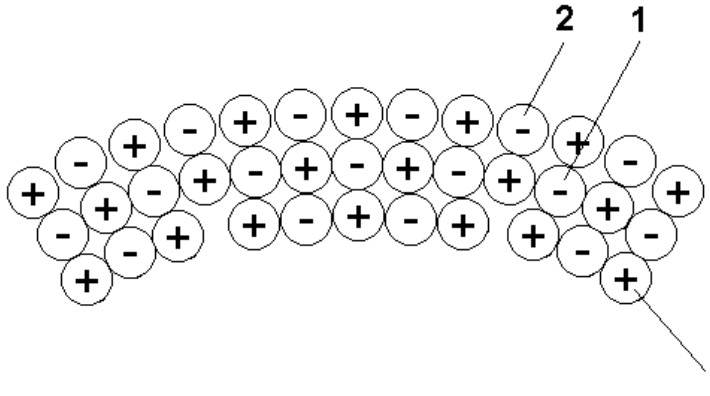

Fig. 12. A fragment of the structure of the ethereal medium at some distance from a physical mass.

Conventionally, we shall consider, that in a medial concentric sphere (1, Fig. 12) 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. 12), 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. 12), 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. 7 and 12 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. 7, this test mass will distort the structure of the ethereal medium as it is shown in Fig. 11. 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. 12. In this case, the pressure on the trial 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. 13, formed around of the heavy mass M_1, the precise number n_1 of particles of opposite signs with diameter d, or $L_1 = n_1 d$, are stacked.

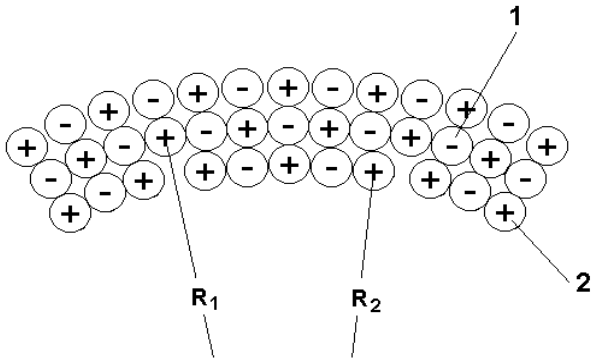

Fig.13. The schema for quantity calculation of particles in concentric layers in the ethereal medium around a physical mass.

Let us consider, that $L_1 >> d$. The radius of such a circle will be equal to $R_1 = n_1 d/2$, 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:

$$\Delta_k = (n_1 - 2\kappa\pi)/n_1 = 1 - 2\kappa\pi/n_1. \quad (26)$$

The formula (27) 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 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,

$$T = -\frac{M_1 \cdot M_2}{R^2}. \quad (27)$$

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*:

$$F = -g\frac{M_1 \cdot M_2}{R^2}, \quad (28)$$

where *R* is the distance between the points, and *g* is the gravitation constant equal to $6.67 \cdot 10^{-11}$, $n \cdot m^2/kg^2$ [33].

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 (27) and (28) one should take into consideration that ethereal particles are extremely small. Thus, the presence of unit masses shown in Fig. 11, 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 [35] 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 [6, 8, 36, 37]. 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 $2 \cdot 10^{-4}$ c [38]. 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. 11-13. 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.

A similar concept - overcoming inertia is overcoming the resistance of ether - was earlier developed in the work of V.A. Lebedev [39]. A physical body uniformly moving in such an ethereal medium does not experience any resistance. D'Alambere pointed to the possibility of a body to preserve rectilinear and uniform motion in an ideal fluid, not experiencing resistance at all for an indefinitely long time.

8. Conclusion

Nature does not like emptiness. Practically all the latest concepts of a physical vacuum are based on this postulate [1, 40, 41]. The universe is filled with a special medium - ether [42]. The one, who once moved a strong magnet closer to a piece of iron, cannot negate the presence of this special medium. Only the acceptance of the fact of the ethereal medium existence allows one to preserve the material basis of light and electromagnetic waves propagation [43]. This medium is a transmitter of gravitational interactions of gravitating bodies. Otherwise, it is necessary to admit the possibility of a gravitating body to "find out" the presence of another body mystically and then tend to it.

The second fruitful postulate - all existing consists of two opposite in sign principles - was put forward in the midfirst millenary B.C. by Chinese philosophers [4, 5]. The opposite principles - Yin and Yang - are not only philosophy categories expressing the idea of world dualism, but are also fundamental principles of the universe physical arrangement. In the traditional cosmogony an occurrence of Yin and Yang categories marks the first step from a random unity of the primeval Chaos to the variety of "lots of things" [4]. Each of these principles contains a potentiality of the other. Examples of separation in two opposite principles could be found in all forms of substance existence, in different scopes of its manifestation, especially when analysing physical phenomena. We know that there are only

two kinds of electrical charges - positive and negative. To date, there is an experimental proof of the existence of both matter and antimatter. Neutrinos and antineutrinos have been predicted and observed [44]. The stated fundamentals of the non-empty ether theory clearly demonstrate this first step of substance self-organizing. The next steps lead to formation of more complicated shapes of the matter, up to creation of biological, alive species of its existence.

The proposed concept of the ethereal medium solves several problems that seemed unsolvable earlier. It explains the "shear kind" of light and electromagnetic waves. It allows one to understand a distinction between the mass of a physical body and the electromagnetic mass of the ethereal medium. It explains the observed form of the laws of light reflection and refraction. It confirms the arrangement principle of any medium, capable to transmit oscillatory perturbations. Such a medium should contain elasticity and mass. The physical values of electromagnetic elasticity and mass of the ethereal medium, deduced by us, confirm it. The presented concept completely correlates with the fundamental equations by D. Maxwell, and consequently, with the theories of electrostatics and electrodynamics. It explains great homogeneity of vacuum. It gives an explanation, why in experiments at collision of particles with high energy, occasionally pairs of new particles of the opposite charge appear - they are generated by the ethereal medium containing these charges [45].

The proposed concept eliminates the paradox of magnetic field, which in references and educational literature is called a vortical one [46]. Earlier, V.P. Dmitriev [36] has earnestly shown that a magnetic field is a shear deformation of the ethereal medium. The "vortical" theory of a magnetic field, as we have shown, cannot be justified, without violation of the principle of energy conservation.

One of the most important consequences of the proposed theory is the explanation of the nature of attractive interaction and inertia of physical bodies. The creation of an elastic pressure gradient of ether by a physical body in the environs of another physical body, also creating an elastic pressure gradient of ether in the environs of the first one, gives rise to the force making these bodies approach each other. This is the reason for gravitation. An interaction of a physical body with the ethereal medium is the basis of inertial forces manifestation.

In the present work, we do not consider the motion of charged bodies and, in particular, of an electron in the ethereal medium. It is necessary to consider a motion of an electron in an electric field, for example in the field of a charged plane capacitor, as a motion in the anisotropic medium of a rotating (i.e. possessing a spin) body. Really, with a plane capacitor in charge an anisotropic electric field appears between the capacitor plates. As is known, a motion of a rotating body in an anisotropic field leads to deformation of the trajectory of the body in such a way, that the plane of gyration would coincide with the plane of anisotropy.

* * *

The proposed concept of the ethereal medium [47, 48] allows one to predict the most elementary perturbations (particles), which can originate in it. As was shown above, the ethereal medium represents a regular spatial lattice consisting of two identical in size, but opposite in sign particles. Their mutual attraction will make these particles occupy the position that is very strict and precise with respect to each other. Thus, the spatial lattice of the ethereal medium, in the end, will be rather homogeneous. However, we can imagine the rise of dislocations or discontinuities in the spatial structure of vacuum due to some reasons. For example, as was examined above, the discontinuities in a vacuum arise with the availability of atoms, ions, electrons i.e. bodies possessing a physical mass. However, in our opinion, in some cases discontinuities may arise without a physical body. Let us imagine elementary types of such discontinuities (dislocations). For example, it is possible to imagine

the presence of an excess particle of a positive sign, situated in the middle of a homogeneous lattice. It will be an example of the simplest dislocation, which can be termed "with positive redundance". On can also envision that in the middle of the lattice there will be a redundant negative particle. Such a dislocation can be called a dislocation "with negative redundance". Two other kinds of dislocations can exist too. One of these kinds may be presented by the absence of a positive charge in the middle of the lattice. Let us term such a kind of dislocation "with positive insufficiency". The opposite kind will be termed "with negative insufficiency". Thus, there can be four types of such simplest (elementary) discontinuities. It is interesting to note, that combining the dislocations "with positive redundance" and "with positive insufficiency" will lead to a mutual annihilation or extermination. The same will happen when combining the dislocations "with negative redundance" and "with negative insufficiency". The similar dislocations (particles) will not possess a mass peculiar to a physical body. However, these "redundant" and "insufficient" particles should have a certain charge, and an electromagnetic mass. They should be the smallest and the most elementary of all possible.

The ethereal medium or vacuum really represents, as P. Dirac wrote, a shoreless ocean. This ocean is filled with elastic, strongly condensed electromagnetic matter. Now it is difficult to say, how the energy enclosed in this matter, can be liberated and used. However, it is doubtless that through the ethereal medium, free space, it is possible to transmit enormous amounts of energy without slightest losses by means of electromagnetic waves of great intensity.

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