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THE ETHER MADE EXPLICIT THROUGH LIGHT, A POSSIBLE UNIVERSAL INFORMATIONAL MATRIX

BY

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Abstract. Supossing that the ether is an infinite elastic medium, the constitutive material law that describes such a behaviour is determined. In a totally particular case, corresponding both to the stress tensor, and also to the strain tensor, it is shown that this constitutive material equation can be identified with an electromagnetic field, and, by extension, the Universe is of a informational type (universal informational matrix).

Keywords: ether; stress tensor; strain tensor; Universe; informational matrix.

1. Introduction

Ether has naturally established itself as the medium that allows the mechanical explanation of the structure of light. In the beginning, it was fiction. We could not say that it is currently considered to be something else, but we will endeavour to rehabilitate it. Let us remember that Fresnel discovered that

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light actually means the propagation of a motion perpendicular to the direction of propagation. This could only be explained by a mechanical model involving a continuum with certain properties that would make it support the propagation of local oscillating motion. The continuum in question was the ether. It also had a molecular structure, for motion referred to "molecules", as well as a continuous structure, in order to propagate that motion from molecule to molecule, as the classical experiment with pendulums swinging perpendicular to their support shows. This is how the ether began to be structured, being lent properties which would satisfy immediate scientific needs and which, as it usually happens, would come into contradiction with each other (Mazilu and Agop, 2010).

The ether has therefore become intolerable because it has contradictory properties: it is incompressible, having a huge rigidity that would allow speeds such as that of light, and yet it does not oppose at all the movement of material bodies through it. The rigidity of matter has always been associated by our sense of touch with its impenetrability: it is difficult for us to imagine how a very rigid material could let material bodies pass freely through it. In Orthofizica, a work that aroused the enthusiasm of the philosopher Constantin Noica, academy member Mihai Draganescu develops a model of the subquantum level of reality, in which ether, as a material medium that fills the spaces between material particles (under the names of dark energy and zero-point energy), is described as consisting of very fine particles - etherons, of mass $m_g \approx 10\text{-}60 \div 10\text{-}70$ kg, behaving, on the whole, like an ideal fluid (Wilhelm, 1985). Therefore, if we consider ether to be a form of matter, the perspective of reality as we know it convincingly shows either that either we might be wrong in our conclusions when we mix the criteria based on the senses with those based on reason, or that we must reject the existence of the ether. The idea that ether may not be matter has never been scientifically studied. In our opinion, however, this is the case, and the concept of ether serves us as a lesson, the introduction of which was written by Huygens and the content of which was developed, to a certain extent, by Fresnel. This section shows how the achievements of these two geniuses come together to help us understand ourselves.

We believe that the Fresnel moment in human knowledge has a special gnoseological significance: the total elimination of mechanical descriptions from the considerations regarding the ether. This task has obviously not been fulfilled, or at least has not been fully completed, since the issue of the ether resurfaces from time to time. Our question is whether the ether must remain a fundamental notion in physics. Among the modern sciences, special relativity dismisses this notion, while general relativity still accepts it as fundamental, and these are the only points of view involved in the argument that we could take as fundamental. Electrodynamics, which can be taken as an exponent of classical theory, maintaining the existence of action at a distance as a force, can follow

any of them. It is not surprising, then, that while it has provided the substance of the arguments when the ether was rejected from existence in the first decades of the last century, it became the advocate of the ether, so to speak, towards the end of the same century. One of the proponents of the thesis on electrodynamic ether is H.E. Wilhelm (Wilhelm, 1985; Wilhelm, 1993). In our opinion, the most important subject raised by Wilhelm is the connection of the ether issue with that of the cosmic background radiation. This leads to a different approach to the issues, indeed more on the side of electrodynamics, making this branch of physics one of the fundamental ones, something of the rank of special or general relativity. The resulting controversy, or perhaps the absence of such a controversy at a scale that we think would be natural for such a topic, shows that Wilhelm's attempt was not quite clearly understood. This can be clearly illustrated by the fact that any discussion on the ether issue is automatically associated with either special or general relativity as a fundamental line of thought.

Let us now remember that, in the beginning, when the concept of ether was taking shape (the early nineteenth century), electrodynamics was one of the several basic ideas. So, it should come as no surprise that it "wants" to retake its place. On the other hand, the fact itself seems to show that the issue of the foundations of electrodynamics itself is as deep as that of the ether, more precisely that they are in fact identical, and therefore it is necessary that it be traced from the very beginning, from the very origin of this concept. And since this origin is related to light, it seems very natural to go with the idea of evaluating the first dynamic theory of light, that of Fresnel. This is where the principles of Newtonian dynamics were first brought to trial. However, the really guilty party – the concept of force – not only managed to evade conviction, but was not even incriminated in any way. The explanation for this is very simple.

Fresnel's theory of light does not really require classical mechanics to be completed. It only requires the idea that light can be represented, at every point in space, by a vector that is periodic in time. Classical dynamics enter here only "fraudulently", so to speak, through the back door. Namely, a vector that is periodic in time can be considered as a solution of a second-order ordinary differential equation, and this equation can, in turn, be considered as an expression of the second principle of Newtonian dynamics. In Fresnel's time, the second principle was the main line of argument in all theoretical problems. In reality, the periodicity of light, as well as many other phenomena related to light, can be presented as a consequence of the deformation of the wave surface when light propagates in empty space or in matter. This is actually a kind of generalized Huygens principle.

Towards the end of the nineteenth century, however, it was understood, under the external pressure of facts, that mechanics had other principles suitable for the purpose, not only that of inertia. As it were, mechanics had therefore

resources in the ether problem, so that while in places it was concluded that it was imperative that it leave the stage, it became in fact even more deeply involved. In order to better understand this issue, we need to refer to an appropriate paper, which should be the product of debates on the issue of the ether. Too early works may not be appropriate, because in those days the concept of the ether was not, as it were, fully shaped. On the other hand, contemporary works may again not be appropriate, because our experience clearly shows that they are prone to succumbing to the mirage of mathematics. Therefore, we must refer to a work devised to be the summa summarum regarding the state of the ether problem, when intellectuals realized that it was time for such an action.

Two well-known scientists have reached, in the ether issue, a speculative level not reached by any other scientist. One of them, Joseph Larmor, analyzed the ether problem in its entirety, evaluating the chances of mechanics as they presented themselves at the end of the 19th century. Indeed, we could not have found any other classic more relevant than him for revealing in detail all the aspects of the mechanical problem of the ether. Larmor captured the moment when mechanics was about to hand the ether baton to electrodynamics, and this moment was fixed, as it should be, naturally, through a comprehensive assessment of the contribution offered by mechanics to the matter at hand. That is why we start here with some of Larmor's remarks on the issue of the ether. On the other hand, at about the same time as Larmor, Henri Poincaré analyzed the electrodynamic point of view on the ether problem, with notable conclusions that do not seem to have appropriate consequences, not only for scientists, but not even for historians of science. We will show here that these conclusions must be taken seriously, because they do offer a whole new approach to the problem of the ether, forcing us to recognize its true significance. Namely that the ether puts limits on mechanics as an environment that does not respond to forces. That is why we start here with some of Larmor's remarks on the issue of the ether. On the other hand, at about the same time as Larmor, Henri Poincaré analyzed the electrodynamic point of view on the ether problem, with notable conclusions that do not seem to have had commensurate consequences, not only for scientists, but not even for science historians. We will show here that these conclusions must be taken seriously, because they do offer a whole new approach to the problem of the ether, forcing us to recognize its true significance. Namely that the ether puts limits on mechanics, as a medium that does not respond to forces.

Considering the physical bases of the problem itself, we must mention that they do not appear much in the literature: we speak instead of mechanical or electromagnetic bases. The ether has no conceptual rank that transcends science, such as matter or space (of course, insofar as it is not an a priori intuition). As we have mentioned before, it was clear from the beginning that the ether problem had to be assigned to mechanics, more precisely to

Newtonian dynamics, because, by any standard, ether had something to do with matter, it was a material formation. This is how the contradictions that tarnish his existence were discovered. In order to have an idea of the ether as a concept of the rank of matter, we must insist on sometimes reading between the lines of classical productions. Persistence is of course rewarded, because from time to time we find observations that explicitly refer to the concept itself. A case in point is the following footnote by Larmor in the preface to Aether and Matter (Larmor, 1900):

"It is not superfluous to repeat here that the object of a gyrostatic model of the rotational aether is not to represent its actual structure, but to help us realize that the scheme of mathematical relations defining its activity is a legitimate conception. Matter may be and likely is a structure in the aether, but certainly aether is not a structure made of matter. This introduction of a suprasensual aethereal medium, which is not the same as matter, may of course be described as leaving reality behind us: and so in fact may every result of thought be described which is more than a record or comparison of sensations."

This excerpt requires some explanation. Note, however, an explicit reference to the physical basis of the problem, the first and last of all literature: the ether *is not a category given by the senses*, but instead makes its presence felt only in the face of reason. Moreover, it must be raised to the same rank as that of matter. In this sense, the above fragment is an original program which, unfortunately, was not followed *ad litteram*.

No one has bothered with a philosophical definition of this "category" as, for example, Lenin tried to define matter: "given to man by the senses... but existing independently of them." No one seems to have seen a philosophical category per se in the ether, and that probably explains why he was not given special attention. But the excerpt above contains an explicit allusion, which also shows us why this happened: it cannot be said that ether is made of matter, as mechanics requires, but, on the contrary, *that matter is made of ether*. What physicist or philosopher would accept this fact? At the end of the road, we see the danger: matter is not primordial, there is something beyond it, so our senses do not help us in obtaining the truth!

Specifically, Larmor refers in the above quote to the gyrostatic model of the ether, assiduously promoted by Lord Kelvin. It can be said that through this model, the second principle of dynamics is back in power, because the model avoids only the polar inertia, *i.e*. the inertia due to the central action of a force on a material point, replacing it with rotational inertia: gyrostatic ether it is a continuous, inertial medium sensitive only to rotations. Following Larmor, what could be challenged here would be the right to mix up reasonings, so to speak. Classical physics, and especially Newtonian dynamics, filled these reasonings

only with their practical part represented by the central force concept. It appears therefore that there is no doubt about the legitimacy of the mechanical approach towards the ether problem. However, our opinion is that *pure reason*, in Kantian terms, must have a substantial weight here when it comes to the description of the ether, because, as Larmor states, it is *supersensory*. In other words, force is the quintessence of man's perceived reality, but the ether must be described as "leaving reality behind"; therefore, through a common inference, *leaving reality behind* would mean *leaving the central force aside*. This would, in our view, be the profound significance of Fresnel's theory, which has not been completed, however.

We must again highlight another point: the definition of ether based on its relationship to matter: *the latter is a structure in the ether*! It is true that we have a unilateral relationship here, but it nonetheless indicates the fundamental fact that, if we want to form the concept of ether, it must have two essential determinations: *ether in space* and *ether in matter*. Only the first of these determinations is not at all accessible to us through the senses, while the second is nevertheless accessible to us in certain circumstances: only second-hand, so to speak, *that is, through matter*.

And because we started quoting from Larmor, let us continue with him, because he seems to be, indeed, the most explicit of the classics in terms of human possibilities when it comes to describing the ether. Once again, it is no coincidence that Larmor chooses mechanics as the right science for the purpose: in fact, mechanics was the universal instrument of nineteenth-century physics. However, a fact that is never mentioned, precisely because the ether is not a transcendent concept, but has been and always is taken only as such, is that *the ether has revealed the limits of mechanics itself*, the content of which is fully and clearly set out in Annex B of the same work, *Ether and Matter* (Larmor, 1900). This is, in our opinion, Larmor's indisputable merit, on the realization of which the very future of science may depend. In order to understand the problem in its essence, it must be emphasized from the beginning that by mechanics Larmor means … the dynamics of matter in volume, in contrast to molecular dynamics.

Let us remember that, in the mechanical explanation given to the propagation of transverse waves representing light, we are dealing with two components of the medium: the molecules that vibrate and which are referred to by molecular dynamics and the support of these molecules - the continuum that transmits motion. The laws that describe this continuum form the mechanics which Larmor refers to, and which he identifies with the dynamics of matter in volume. Indeed, because we are dealing with a continuous medium, we can define a dynamic with the help of the notion of *Newtonian density*. However, the laws of this dynamic are something special.

This was also what led Larmor to recognize that the mathematical theory of the ether in this general mechanics could go far beyond the second

principle, but still cannot go beyond *the third principle of dynamics*. Indeed, this principle and the principle of D'Alembert are considered by Larmor to be fundamental to the ether problem, because they are the only ones involved in describing "material systems treated as continuous systems and not as molecular aggregates." Because the ether is a continuum, these are the only principles left for its description. They are then reformulated by Larmor as follows (Larmor, 1900):

"1) The mechanical action and reaction between any two parts of a material system, which are capable of separate permanent existence, must compensate each other, and therefore must have for their statical resultants equal and opposite wrenches on the same axial line;

2) … if we set down the effective forces which would directly produce (…) motions in (…) separate parts or differential elements of volume (…) considered by themselves as individually continuous but mutually disconnected, then for each part finite or infinitesimal (…) these forces are the statical equivalent of the actual forces acting in or on that part either from a distance or through the adjacent parts."

To understand the need to reformulate the essential principles of mechanics in order to use them in the problems of the continuum, a simple browsing of the classical works of Newton, Huygens, Fresnel, or Cauchy would suffice to see how easily one spoke of "ether molecules" or "ether parts" that act upon one another. This action is not beyond what Newton presented in his *Principia*, but it does lead to an obvious contradiction that has erupted as requirements on the shape of molecules or parts of the ether. Namely, the universality of the interaction force was first recognized between material formations that can be considered as material points, and then carefully extended, through a geometric consideration, to finite bodies and even to the continuum. But the essential feature of material points, which interests us here, is especially that they are "capable of permanent separate existence," as Larmor says, or are "individually continuous but mutually unconnected," and this is true whether we perceive them or not. In this context, it is also easy to understand why we must include D'Alembert's principle in the issue of the continuum, as Larmor did.

In other words, after all considerations, the concept of force is maintained by any theory of ether. "The foundation on which the whole subject develops lies in the notion of force" (Larmor, 1900). This may not seem surprising when it comes to mechanics, but we want to note in particular that force comes here with the third principle of dynamics, which is actually the instrument by which *force is interrogated and defined*. In our opinion, Fresnel's use of the second principle was not even fortunate in terms of physics, because it masks the true nature of the problem. Had Fresnel used Newtonian

philosophy *ad litteram*, he would have understood the importance of the third principle, in that it is necessary to define the action and reaction between matter and ether, just as Newton defined gravity as a centripetal force in comparison with the centrifugal force. It could rightly be said that this gives transcendence to this principle*: it belongs not only to mechanics, but to human experience as a whole.* By comparison, D'Alembert's principle is only an addition that allows us to broaden the scope *of the concept of force* itself, that is all.

For this reason, Larmor finds it necessary, for example, to give an explanation for the difference between the two type of forces that fall into D'Alembert's principle: *external* or *imprinted* and *internal*, such as inertia. The latter are directly linked to virtual movements by classical mechanics. Although this distinction is really necessary for the development of an explanatory theory, the most important fact to be remembered here is that, whether internal or external, those forces still remain forces, their action is described the same, the main feature of this action being polarity or centrality. And, to say it once again, by keeping the forces in the broader scheme, we cannot "leave reality behind"! It is then very natural to know about the ether as much as we know about inertia itself: almost nothing! Furthermore, insisting on the extension of the field of action of the concept of force, not only must any action have a reaction according to the determination of the concept of force contained in the third principle, as it seems philosophically safe and sound, but this reaction must be of a nature that reveals itself to us by the senses, that is, a force. It could be said that because the third principle of dynamics is a kind of principle that transcends mechanics, it leaves room for manoeuvre, and cannot be eliminated from the philosophical discussion of the ether.

However, it must be emphasized once again that the hard currency of mechanics, here and everywhere, is the concept of central force, and this is the point that needs revision first of all. Going deeper, one could say that even today the idea behind the ether problem is that whenever the intellect describes this "result of thought", recognized as an "environment above sensations", it does so through concepts built on the results of sensations, being based on the notion of force. While this fact is taken, classically speaking, as an advantage of a philosophical attitude, we are now in a position of disagreement with the idea. Our view is that there is a contradiction here that must erupt somewhere, despite the fact that science, like any human enterprise, does not need revolutions, except on paper, so to speak! However, if it has not erupted so far, we can notice that at least the spirit of contradiction has persisted throughout the history of electricity and magnetism, and that discussions about the ether have never stopped, being even revived lately. But, as always when such a work is taken over, it is conducted with attacks on special relativity which, in our opinion, has nothing in common with the topic. But what can we say?! Special relativity is a fad, and it is fashionable to attack it in any way, even politically!

Speaking of the transcendence of the third principle of dynamics, we must make special reference to Henri Poincaré. Among the few critical studies, which could be said to concern, albeit indirectly, the problem of ether, that of Poincaré (1897, 1921) must be taken very seriously into consideration. Not just for its meticulous detail on the topic, but also for the complete discussion of the ether from the point of view of electrodynamics, and for the fact that Poincaré holds with conviction on the explicit principles of his profession. Specifically, Poincaré strives to judge every up-to-date electrodynamic theory from three points of view, one of which, represented by the third principle of dynamics, seems purely mechanical in essence, and we would be tempted to believe that it is out of place. Those points of view are as follows:

1) The dragging of light waves, a fashionable topic in terms of astronomy;

2) The conservation of electricity and magnetism, from a purely electrodynamic point of view;

3) The mechanics principle of the equality of action and reaction, that is the third principle of dynamics.

The first two criteria seem to be specific to electrodynamics. It may be interesting to note that Poincaré's basis of judgment is here a *transport theorem*, as it has only recently been seriously considered in electrodynamics. But the most interesting fact on which we must insist is, as I said, that the third criterion does not belong at all to electrodynamics, but to mechanics. However, as we have seen before, that principle must be considered transcendent, which, in our opinion, gives Poincaré the full right to use it in electrodynamics, and it gives us confidence that the results he has reached are sound and reliable.

This is where Poincaré went, through one of his results, far beyond Larmor and, in fact, beyond any of the classics, and we would like to emphasize this as a special moment of knowledge and give it due importance. Poincaré's results show that Lorentz's electrodynamics is the only up-to-date theory that *does not meet* the third of his criteria, namely the third principle of dynamics, according to which the action of the ether must be equal to the reaction on it from material formations "capable of separate existence" as Larmor puts it. However, it is known that Lorentz's theory has many other virtues that make it worth saving in all instances where it appears to lead to contradictions. Following Poincaré's line of thought, one of the natural attempts to save it (apart from the theory of special relativity), is to update it in the light of the third principle of dynamics.

Let us recall here that the essence of Lorentz's theory of electrodynamics is the discrepancy between the time and coordinates that enter the equations of classical mechanics of the motion of electric charges, and those that enter Maxwell's equations of electrodynamics. Lorentz, like Fitzgerald before him, showed that the latter equations refer to the same thing from any point of view in the universe (*i.e.*, they are invariant) only if we accept that the

dimensions of an extended body which the equations happen to describe shortens in the direction of movement by a factor that depends on the speed of movement. Lorentz explained this as a contraction, *i.e*., a *physical process of deformation* due to the resistance the ether puts up against the movement. Later, theoretical physics took it as a pure transformation of coordinates, eliminating the ether from the considerations, and this is the shape in which we know it today.

It is at this point that we are tempted to place the well-known fact which, in our opinion, has a special significance for the issue we are referring to, namely that Poincaré introduced certain stresses of a mechanical nature - *the Poincaré stresses* – with the purpose of explaining the Lorentz contraction and therefore to save the theory (Poincaré, 1897). Indeed, if we think about it: the mechanics of the continuum teach us that no *deformation* of material structures without an accompanying *stress* can be found. Poincaré will have intuited that Lorentz himself, like Fitzgerald before, had described an incomplete procedure when defining the contraction that bears their name. We view it today as a coordinate transformation, and it has always been viewed that way. Originally, however, it was defined as what it needed to be in order to put the theoretical facts in order, that is, a deformation. Nevertheless, those who defined it gave it an incomplete definition, in the sense that it was not physically justified by an appropriate stress. Poincaré's procedure is thus one of the classic examples, probably the first of its kind, in which Lorentz's transformation restores the determination of what it was meant to be from the beginning. As history has shown, this logical step is not enough. As far as we understand the problem, Poincaré was only trying to save a dynamic principle that was out of place: *equality of action and reaction*. Indeed, there is no reaction in this case!

If the ether can be labelled "suprasensory" it is only because it has the ability to penetrate matter freely, that is, because *matter does not respond to the extension of the ether*. Only such an answer could be qualified as a reaction in the classical sense. Conversely, the ether does not respond in any way to the extension of matter. This is the only way to explain the free movement of material formations through the continuous ether. Consequently, there can be no action in the classical sense. Therefore, if we call this extension of the ether a deformation, then it is a deformation that is not accompanied by stresses. This means that the Lorentz contraction cannot be explained by forces between ether and matter, because they do not exist. And if the forces do not exist, it turns out that, *positively*, the ether does not exist. This was the conclusion of special relativity, which gave the Lorentz transformation the determination we know today: that of a transformation of coordinates and time.

There is, however, another positive part of this story: it teaches us how to overcome the concept of force in the problem of the interaction between ether and matter. Indeed, as long as the ether is characterized as a continuum, it is *a continuum that is deformed without producing stresses*. What distinguishes

ether from matter is that it can withstand stresses *without apparent deformations*: those stresses that produce deformations only when they are "released". Now, according to Larmor's conception, we can imagine that matter is made of ether, but not the other way around. Therefore, there is ether in the form of matter and ether in free space, and so we are in a position to characterize the same continuum in two different instances. This is where the concepts of stress and deformation seem to be tailor-made to fulfil Larmor's program of "leaving reality behind". Because the mechanics of the continuum have, as we have seen, an instrument precisely suited to the purpose: *the constitutive law*.

The main advantage of the existence of such a constitutive law is that it allows us to express what we have just said about the ether in space and about that in matter, in an algebraic form. Then it becomes apparent that the shape of the stresses that are not accompanied by deformations is the characteristic of the case of a classical electric field, and the shape of the deformations that are not accompanied by stresses is that characteristic of a classical magnetic field; or vice versa. Consequently, the ether in space is perceived as an electric field, while the ether in matter is perceived as a magnetic field, or vice versa. But since we do not have only ether in matter or only ether in space, the true ether must somehow be a combination of the two species of ether. The simplest combination of the two reveals a mathematical structure that describes *electromagnetic radiation*, that is *light*. Therefore, to sum things up in a philosophical manner, neither matter, "given to man by the senses", is truth, nor the ether "given to man by reason", is truth, but *light is their truth*.

A simple way to obtain a characterization of the ether, in a birefringent crystal for example, is simply to allow into play, in a certain manner, the fact established by Larmor's thesis, namely that there is ether in space and ether in matter. A first natural test would be to admit that ether can be characterized by tensors corresponding to two characteristic vectors, say $\vec{u}$ and $\vec{v}$. A complete tensor describing the ether could then be of the form:

$$w_{ij} = \alpha\delta_{ij} + \beta u_i u_j + \gamma v_i v_j \tag{1}$$

Somewhere along this line one we will notice that these calculations display more symmetry if we write (1) in a different and more convenient form, that is

$$w_{ij} = \lambda u_{ij} + \mu v_{ij} \tag{2}$$

where λ and μ are real parameters describing the extent to which ether is "spatial" and, respectively, "material", the matrices **u** and **v** being defined through

$$\begin{gathered} u_{ij} = u_i u_j - \frac{1}{2} u^2 \delta_{ij} \,;\, v_{ij} = v_i v_j - \frac{1}{2} v^2 \delta_{ij} \\ u^2 = u_1^2 + u_2^2 + u_3^2 \,;\, v^2 = v_1^2 + v_2^2 + v_3^2 \end{gathered} \tag{3}$$

where δ_{ij} is Kronecker's pseudo-tensor. This tensor contains eight measurable quantities: λ, μ, and two intrinsic vectors. When detailed, matrix (2) becomes

$$w_{ij} = \lambda u_i u_j + \mu v_i v_j - \frac{1}{2}(\lambda u^2 + \mu v^2)\delta_{ij} \tag{4}$$

It is then easy to see that this particular tensor has three main values that are real and distinct. Its orthogonal invariants are

$$I_1 = -e; I_2 = -e^2 + g^2; I_3 = -e(e^2 - g^2) \tag{5}$$

where we have used

$$e \equiv \frac{1}{2}(\lambda u^2 + \mu v^2); \vec{g} \equiv \sqrt{\lambda\mu}(\vec{u} \times \vec{v}) \tag{6}$$

Then, the main values of w_{ij} can be calculated as roots of the matrix's characteristic equation, and they are

$$w_1 = e, \qquad w_{2,3} = \pm\sqrt{e^2 - g^2} \tag{7}$$

It so happens that the pair in Eq. (6) is one of the own vectors of **w**, together with its own value. The other two own vectors of **w** are perpendicular, and they are located in the planes of vectors $\vec{u}$ and $\vec{v}$.

The magnitudes

$$w_n = \frac{w_1 + w_2 + w_3}{3}, \qquad w_t^2 = \frac{1}{15}[(w_2 - w_3)^2 + (w_3 - w_1)^2 + (w_1 - w_2)^2] \tag{8}$$

are *the Novozhilov averages* (Novozhilov, 1952) for the normal and shearing components of the **w** tensor in any given point. These quantities can be described, as we shall see, as components of a vector in a frame characteristic for *any* point in space (whether in free space within matter) given by the **w** matrix own vectors. Now we shall define the vector formed by the **w** matrix own values:

$$|w\rangle \equiv \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} \tag{9}$$

Now, if we choose the octahedral plane with a normal given by the unitary vector

$$|n\rangle \equiv \frac{1}{\sqrt{3}}\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \tag{10}$$

the normal component w_n on this plane will be given by

$$\langle n|w\rangle \equiv \frac{w_1 + w_2 + w_3}{3} \tag{11}$$

The other quantity in Eq. (8) appears when we consider the norm of the tangential component in the octahedral plane, that is the vector's norm:

$$|w_t\rangle \equiv |w\rangle - |n\rangle\langle n|w\rangle = \frac{1}{3}\begin{pmatrix} 2w_1 - w_2 - w_3 \\ -w_1 + 2w_2 - w_3 \\ -w_1 - w_2 + 2w_3 \end{pmatrix} \tag{12}$$

A simple calculation yields

$$\langle w_t | w_t \rangle \equiv \frac{1}{5} w_t^2 \tag{13}$$

For the special case of own values (7), the two magnitudes become:

$$w_n \equiv \langle w|n\rangle = -\frac{2}{\sqrt{3}}e, \quad |w_t\rangle = \frac{2}{3}\begin{pmatrix} -2e \\ 3\sqrt{e^2 - \vec{g}^2} + e \\ -3\sqrt{e^2 - \vec{g}^2} + e \end{pmatrix} \tag{14}$$

As long as we claim that only the values (8) are measured – they are in fact averages – The orientation of the vector in (14) in the octahedral plane remains undecided. This orientation is outside out control, nonetheless it can be measured in relation to a direction of reference in the octahedral plane. Let us assume that such a direction is given by a particular tensor $\boldsymbol{\xi}$ of those given in Eq. (3), with the characteristic vector $\vec{\xi}$. Repeating for this tensor the calculations above referring to the normal and shearing component in that particular point in space, we obtain:

$$\langle \xi|n\rangle = -\frac{1}{\sqrt{3}}\xi^2, \quad |\xi_t\rangle = \frac{2}{3}\xi^2\begin{pmatrix} 2 \\ -1 \\ -1 \end{pmatrix} \tag{15}$$

When vector $\vec{\xi}$ is perpendicular both on $\vec{u}$ and on $\vec{v}$, the tensors $\mathbf{w}$ and $\boldsymbol{\xi}$ commute. We have therefore a common reference system, and we can proceed in such a manner that the octahedral planes of these tensors coincide. In this case, the direction of the vector in Eq. (15) is fixed and can be taken as reference in the octahedral plane. The angle ψ of the vector in Eq. (14) in relation to this direction is given by the usual geometric formula as:

$$\cos\psi = -\frac{e}{\sqrt{4e^2 - 3\vec{g}^2}} \tag{16}$$

Therefore, in the given conditions, ψ is independent of the reference vector, and depends only on the description of the ether. By appropriately

choosing a sign of the square root in the denominator of this formula, the origin $\psi = 0$ of that angle appears at e = g. In its turn, this condition means that the angle θ between vectors $\vec{u}$ and $\vec{v}$ is given by the equation

$$\left|\sin\theta\right| = \frac{1}{2}\left|\frac{\lambda u^2 + \mu v^2}{\sqrt{\lambda\mu}uv}\right| \tag{17}$$

As the quantity on the right-hand side of this equation is always greater or equal to one, the angle between the vectors $\vec{u}$ and $\vec{v}$ can only be 90°. Thus, the *initial condition* of the **w** tensor in the octahedral plane translates into the fact that vectors $\vec{u}$ and $\vec{v}$ are perpendicular on each other, and their plane is perpendicular on vector $\vec{\xi}$. If this last vector is given by the direction of a light beam, for example, we have here the classic image of light propagation according to Fresnel.

Now, to conclude, Wilhelm (1985) is right, in our opinion: not only the cosmic background radiation, but the electromagnetic field in general, in its Maxwellian form, is indeed the expression of the existence of the ether. For that reason, the electromagnetic theory of light, far from denying the existence of the ether, is the one that imposes the idea that the ether must remain a transcendent concept, of the rank of matter. Our position is therefore that the ether does exist, and we can see this "with our own eyes" in our daily lives! In fact, in this life we actually see much more: the first of the points of view used by Poincaré in judging current electrodynamic theories is also a universal point of view, an expression of how our eye has adapted to perceive material structures. The stellar aberration related to the dragging of light waves, which is the basis of special relativity, is actually only a measure of our proximity to the physical structures from which we receive light on Earth, the way the colour of light is a direct indication of those physical structures.

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ETERUL EXPLICITAT PRIN LUMINĂ, O POSIBILĂ MATRICE INFORMAȚIONALĂ UNIVERSALĂ

(Rezumat)

Considerând eterul ca un mediu infinit elastic, se determină legea constitutivă de material ce descrie o astfel de comportare. Într-un caz cu totul particular, atât cel corespunzător tensorului tensiunilor, cât și cel corespunzător tensorului deformațiilor, se arată că ecuația constitutivă de material se identifică cu un tensor de tip Maxwell. Se confirmă, în acest fel, faptul că eterul poate fi asimilat unui câmp electromagnetic și, prin extensie, Universul este de tip informațional.