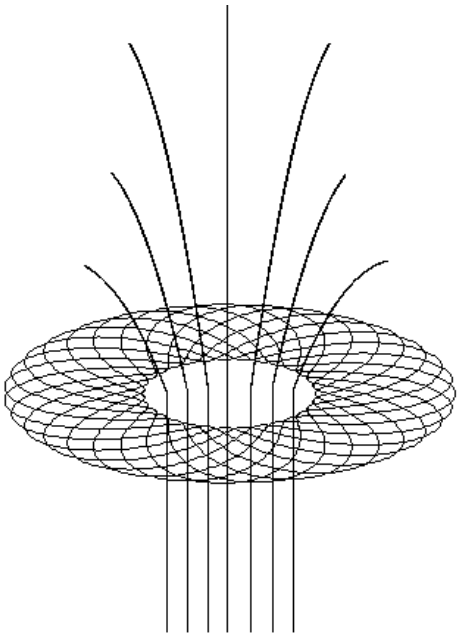
MASS AND ELECTRIC CHARGE IN THE VORTEX THEORY OF MATTER



by Valery Chalidze

Mass and Electric Charge in the Vortex Theory of Matter

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SUMMARY

The book presents foundations of the vortex theory of matter, and demonstrates that the basic properties of photons and particles can be described in a philosophical framework of classical physics with certain suppositions about the nature of physical space which is traditionaly called aether (ether).

The author regards this theory as a synthesis of ideas used by Faraday, Maxwell, W. Thomson, and J. J. Thomson with the knowledge of experimental results of the twentieth century. In the past, the hypothesis of aether as fluid was instrumental in creating the theory of the electromagnetic field. The vortex rings were used to construct model of atom at a time when the existence of elementary particles wasn't known. These days applying vortex models to elementary particles looks more reasonable. Twisted vortex rings with left and right rotation in this theory are models of particles and anti-particles, the vortex being of constant intensity for all such rings. A ring with a straight vortex going through its aperture is used for presenting a charged particle with the sign of the charge defined by the direction of the straight vortex rotation in relation to the direction of the ring's movement. Vortex rings of radius equal to the radius of a

vortex cord is used as a model of a photon. Division of that ring into two rings with opposite twist is a topologically sound model for a description of pair production.

Maxwell's equations are accepted as the actual basis for the description of aether's kinematics. As to the dynamics of aether, it is shown that Newtonian mass of a particle depends not on the quantity of any substance but on the intensity of rotation of its twisted vortex ring. The non-linear inertial property of aether is presumed; the linear dependence of a photon's energy of its angular velocity follows.

The hypothesis of the topological identity of an electron's and proton's rings lead to values of masses for μ, π, K and τ particles which are close to experimental.

A model of electric field as field of vorticular filaments is presented. It is shown that the squer of an elementary charge is proportional to the Plank constant and speed of light.

CONTENTS

HISTORICAL NOTES – 7

Action At A Distance Or Through The Medium; Not Only Medium; Mechanistic v. Electrodynamical Approach

STARTING POINTS – 16

Non-Newtonian fluid; Simple And Twisted Vortex Rings; General Scheme Of Theory; Why This Scheme Will Not Work?

VORTICULAR EVOLUTION – 28

Destruction Of Original Vortexes; Γ_0 – Presumption.; Surface Velocity Rule; Properties Of Vortons' Gas; Shadow Gravitation Hypothesis; Few Points About Shadow Gravitation; Intermediate λ

MAXWELL'S MECHANICS OF AETHER – 39

Fluid And Fluid With Vortexes; Maxwell's Kinematics; Field Of Filaments; Equations For A Field Of Filaments; Summary On Electromagnetic Waves; Equations For Aether With True Vortexes; Model Of Charged Particles; Loose Ends Possibility;

True Vortex And Filaments: Summary And Questions

INTRODUCING ENERGY – 63

Kinematic 'Energy'; Toroidal Solenoid; Newtonian Mass; On Inertia In Aether

ENERGY OF PARTICLES – 74

Energy Of A Charged Particle; Topological Identity Of Proton's And Electron's Rings; 8-transformation; Particles μ, π, K, τ As An 8-transformation; Thomson's Rotation; Thomson's Rotation And Mass

ENERGY OF PHOTON – 86

ELECTRIC CHARGE – 92

CONNECTING ELEMENTARY VORTEXES – 99

Helmholtz Connection; The extreme H-connection: Two Photons Together; Where Does Energy Come From?; Union Of Field Vortexes; Disappearance Of Coulomb Field; Connections Through Field Vortex; Unstable Construction

HISTORICAL NOTES

Action At A Distance Or Through The Medium

It is a very old disagreement: how to approach the explanation of physical interactions. The answer appears simple when we observe a collision of tangible bodies: they interact because they touch each other and we can see it. The fact that atoms from which those bodies are built actually do not touch each other, escapes our observations and at the earlier age of physics there was no need for a hypothesis of a *field* through which bodies actually interact. When physicists turned their attention to the phenomena of interaction without observable contact, as in cases of celestial bodies or charged particles, one had to either hypothesize about a hidden mechanism of this interaction in the space between those bodies or simply believe that interaction is possible at a distance and the knowledge of forces gives us all we want to know. In a way this is a philosophical question before a physical one, a question about what we want to know and what we presume that it is possible to know.

Choosing or rejecting a pragmatic approach to knowledge is only part of the problem. Historically, acceptance of action at a distance went deeper and developed into the concept of

action at a distance which often was quite fruitful in gathering results.

Yet, there is also a tradition of attempts to penetrate deeper than observable facts permit and to theorize about the physical nature of processes in space between interacting bodies. Hypothetic omnipresent *aether* (or *ether*) for a long time was thought to be the *medium* for physical interactions. As far as electrodynamics goes, this approach was used by Michael Faraday who demonstrated, even to pragmatics, that real knowledge can be gained by hypothesizing about imaginary things.

Referring to physicists who were thinking in terms of action at a distance, Maxwell wrote in a preface to his *Electricity and Magnetism*:

> Faraday saw a medium where they saw nothing but distance; Faraday sought the seat of the phenomena in real actions going on in the medium, they were satisfied that they had found it in a power of action at a distance impressed on the electric fluids.

Nobody ever introduced a satisfactory model of that medium -- aether. For the purposes of explaining different phenomena, gaseous or liquid or even solid models were used. Density of aether was assumed in various theories as

very high or very low; the mechanical properties of this medium were often contradictory. Overall, aether as it was presented in the nineteenth century, does not look attractive for use in a consistent theory, but that is only if we are thinking in a framework of substances known to us. To develop aether theory, one must be free to imagine a medium with properties which may not correspond to anything we know from classical mechanics. The goal should be not to reduce all physical interactions to the mechanical, as it was often in the past, but to understand the nature of matter and fields even if we need to subscribe a very unusual property to space or to a substance which fills that space. Then, through that understanding, one may try to approach an explanation of mechanics itself instead of reducing all physical interactions to purely mechanical.

Not Only Medium

There was another, short lived, use of the aether concept at the end of the nineteenth century according to which everything observed not only interacted through aether but also was made of aether. This suppostition was behind William Thomson's presentations of atoms as vortex rings[1] and the development of this idea by J. J. Thomson[2]. In fact it was a natural development of Faraday's and Maxwell's concept of vortexes in aether: it is just one logical step to imagine vortex rings once linear infinite vortexes were used as a model of the physical field.

In this approach -- I call it *universal aether hypothesis* -- physical bodies are in fact some kind of disturbances in the substance which fills space. Closed vortexes came naturally as a model of the simplest kind of such disturbances.

This hypothesis did not occupy the minds of physicists for long. After an experiment of Michelson and Morley in 1887, the concept of aether as a medium was soon abandoned and highly abstract thinking prevailed in physics for the next century. The irony of this revolution is that the Michelson-

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[1] W. Thomson: On vortex atoms, Phil.Mag. 34,15-24,1867

[2] J.J.Thomson, *Motion Of Vortex Rings*, London, 1883. See also the works reviewed in A.B. Basset's *A Treatise On Hydrodynamics*, vol. 2.

Morley experiment shook only the aether-medium hypothesis and logically did no harm to the universal aether hypothesis. But by that time the theory of vortex atoms was in an embryonic state. There was no knowledge of elementary particles which are more likely to be presented as vortex rings than atoms -- only in 1897 J. J. Thomson discovered the first elementary particle -- the electron. In any case the theory of matter made from aether was abandoned by mainstream science and, as far as I know, there was no serious dissent in physics of the twentieth century which produced a plausible picture of the subatomic world on the basis of classical ideas.

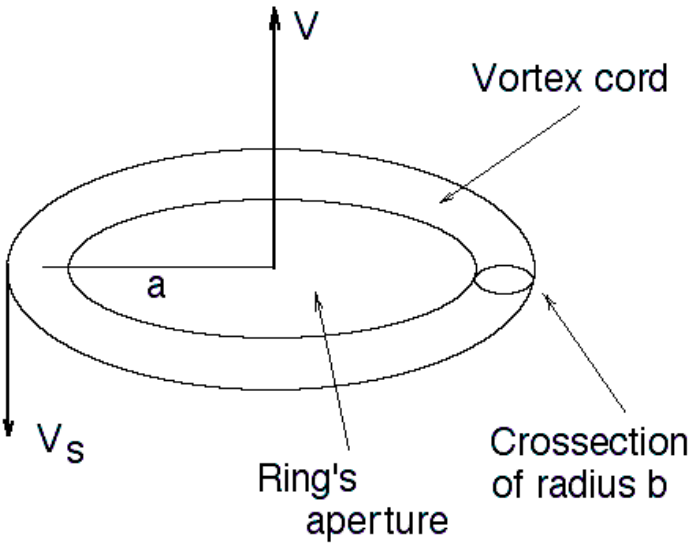
Some old ideas did survive though. The approach of the universal aether hypothesis was, in a way, reincarnated in the Born-Infeld theory with particles viewed as nodes of a field. Empty space itself kept presenting difficulties to physics and from time to time some new suppositions are made about the physical property of space as a medium or as some sort of entity interfering with physical processes.

Mechanistic v. Electrodynamical Approach

There were plenty of attempts in the history of physics to find a purely mechanical explanation for any newly discovered phenomena. Authors of the ninetheenth century's

theories of aether did pay dues to this club and even Maxwell's equations were originally formulated with the use of a mechanical analogy. Myself, I don't search for a mechanical theory of subatomic entities *per se*. Vortexes can be presented within electrodynamics without any mechanical suppositions. However, both mechanics and electrodynamics must explain the facts that entities are moving and exchanging energy. I might say that I am trying to explain mechanical phenomena through electrodynamics and *vice versa*. Almost everything I say here in mechanical terms can be expressed using the terms of electrodynamics.

1. The simplest finite object made from a vortex is a vortex ring.



Characteristics of a vortex ring:

a -- ring's radius,

b -- radius of a vortex cord,

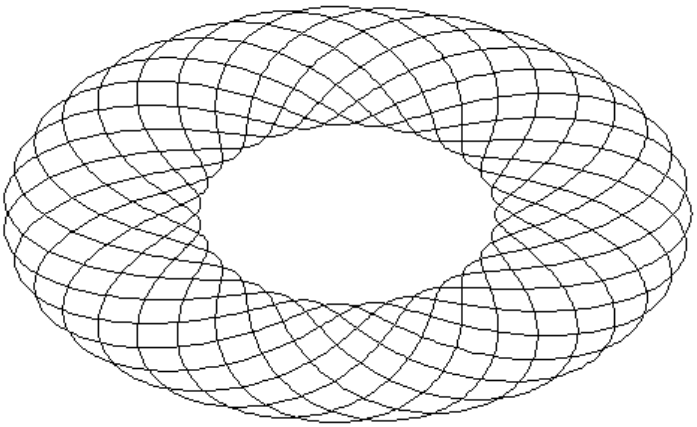
v -- ring's velocity,

v_s -- surface velocity.

For a general discussion it is sufficient to use

$v = \Gamma/4\pi a$

2. Transparent twisted vortex ring with q=3.



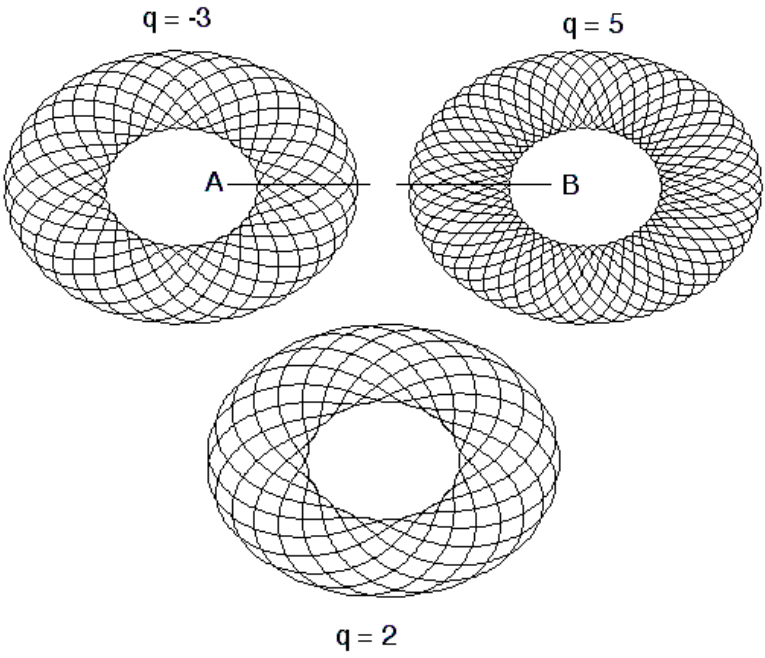
Only surface vortical filaments are shown. They are described by equations

$$x = [a + b \cos(qt)] \cos t$$

$$y = [a + b \cos(qt)] \sin t$$

$$z = b \sin (qt)$$

3. The algebraic sum of the möbiuses of rings remains constant after a connection.



If we are to cut two vortex rings with q_1 and q_2 in points A and B and then to connect them into one closed vortex without an additional twist, the möbius of that closed vortex will be equal to q_1+q_2.

STARTING POINTS

Non-Newtonian fluid

To present a more or less logically consistent theory one must choose some basic points from which a chain of conclusions will be derived. This presents some difficulty as most of physics, including Newton's mechanics, was built to describe the behavior of bodies separate from the surrounding space. I am trying to build a theory of particles which are substantively the same as the surrounding substance and are distinguishable from the surrounding substance only due to the character or intensity of movement of that substance. With that goal I can not, without discussion, apply any parts of previously formulated physics to that substance -- aether. This includes Newtonian mechanics which has to derive from a theory and not be the foundation of that theory. However, I feel free to use kinematics.

For the purpose of this theory, space is three-dimensional and Euclidic. Needless to say, empty space is a product of our abstract thinking although a convenient one. It was never observed in an experiment. In this theory, however, I don't need to hypothesize about "nothingness" as space is filled with ever-present aether. Is it actually a substance in space or

space itself -- I don't care now. Physical properties of aether are to be established in order to arrive at a description of an observed physical phenomena. I emphasize that there is nothing substantive except aether, that aether is not just a medium for interaction between separate bodies. There are, of course, disturbances in aether which we perceive as physical bodies and fields. How aether came into existence and how the disturbances in aether appeared -- these questions are outside of my discussion.

I do not subscribe any physical property or even physical significance to time. In my view time simply does not exist independently of the observer. It doesn't mean however that only humans or other living creatures can play the role of an observer. For example, if some physical entity is hit by some particle over and over -- that entity is an observer of time. Interaction between physical processes and also our ability to compare one process to another gives us perception and use of time. A separate question of course is: can the measurement of time be absolute or do different processes affect that measurement?

This somewhat simplifying statement about time is not a negation of the possibility that peculiar properties of the perception of time might exist. However one should try, for the sake of clarity of knowledge, to go as far as possible

without declaring principles which go against our every day perception of time and space. Declaring time to be a separate dimension raises the question of what is a dimension. In the usual use of Cartesian coordinates, Z represents dimension because it can not be described by using only X or Y. From my decades long struggle to reach the "beginning of mass" and to present a purely kinematic theory of matter, I know very well that if something does constitute a separate dimension, then one doesn't know how to deal without it having just limited means presented by other dimensions. The fact itself that we can measure time with means of other existing dimensions, speaks against declaring time to be a dimension by itself.

I used the words *processes* and *disturbances* obviously to refer to the movement of aether. The possibility of movement is natural to assume due to the fact that there is observable movement of bodies made from aether. One could stretch one's imagination and discuss the physical processes in aether without the movement of aether itself, but in this case there is no reason to fill space with substance -- one would be dealing with the geometry of space and I didn't choose this path. (Historically, aether sometimes was constructed on the basis of analogy with a rigid substance and even Maxwell used elasticity as a characteristic of aether, -- apparently he

was driven to that by believing that electromagnetic waves are transverse, similarly to transverse mechanical waves.)

What is moving during the movement of aether? I assume aether to be fluid and picture the movement of aether as the movement of particles of that fluid. I speak of particles of fluid only in the abstract sense of classical hydrodynamics which was formulated before actual knowledge of the atomistic nature of liquid. The question as to aether being continuous or discrete I leave open.

Presenting aether as fluid is useful and somewhat justified, not just due to the known analogy between electrodynamics and hydrodynamics. I have to arrive at some separate objects in aether which can be used as a model of observable physical particles. The use of fluid opens the possibility to assume the existence of vortexes and to present physical objects as closed vortexes and knots. Also, I want to stay within the realm of topologically imaginable objects and vortexes in fluid present me with such a possibility. Indeed, one can imagine a lot of topologically unique objects made from vortexes starting with a simple vortex ring. Like rope, a vortex can be

tied into complicated knots and every kind of knot will have its unique physical properties. The stability of such constructions is, of course, a separate question.

Simple And Twisted Vortex Rings

It has been known since Helmholtz that vortexes can not end in ideal fluid: either they go to infinity, end on the surface of a vessel which contains fluid, or they exist as closed vortexes. With the presumed absence of any vessel which contains aether of the Universe, the simplest case of a finite object made from a vortex is a vortex ring (Fig. 1). The vortical filaments, forming the vortex cord of the ring, may be concentric circles, or in the case of a twisted cord, may become one of the more complex sets of curves of the following type (in a parametric form), where *a* is the radius of the ring, and *b* is the radius of the cross-section of the ring's vortex cord:

$$x = [a + b \cos(qt)] \cos t$$

$$y = [a + b \cos(qt)] \sin t$$

$$z = b \sin (qt).$$

In this case (Fig. 2) the vortex ring is similar to a Möbius' leaf in the following sense: if the vortex cord of an untwisted ring is cut at some point perpendicularly to the central line of the vortex, then one end is twisted *q* turns, and after that reconnected with another end, it will become a *twisted vortex ring* with vortical filaments which are described by the above equations. I will call *q* the *möbius* of

the ring. In terms of the theory of knots, the sign of q denotes the difference between the right and left twisted rings.

From a topological point of view, if the coalescence or the separation of rings with the same quantity of filaments in a vortex cord occurs (without additional twists), the algebraic sum of the möbiuses of rings will remain constant. For example, if we are to cut two vortex rings with q_1 and q_2 (Fig. 3) in points A and B and then connect them into one closed vortex without additional twists, the möbius of that closed vortex will be equal to $q1+q2$.

Let ω be the angular velocity of the vortex cord and $\Gamma=2\pi b^2\omega$ be the intensity of the vortex cord. An approximation of the velocity of the vortex ring is given by the following formula:

$$v_r = \Gamma\,[\ln(8a/b)-1]\,/4\pi a.$$

For a general discussion it is sufficient to use

$$v_r = \Gamma/4\pi a.$$

As $\Gamma = 2\pi\, v_s\, b$, the vortex has a surface velocity

$$v_s=\Gamma/2\pi b$$

in a system of coordinates moving with a ring.

A twisted ring is in a state of translational movement the same way as a ring with $q=0$, but in addition to that it is in

rotation as a whole and the angular velocity of the ring's rotation Ω is approximately proportional to q.

The special case of a vortex ring is when the ring's radius a is equal to the radius of vortex cord b which can be imagined as a bagel without a hole.[3] Its velocity is approximately

$$v_r = \Gamma/4\pi b$$

Such rings with $a=b$ I use as a model of photons. The velocity of such a ring depends only on the intensity Γ and radius of the vortex cord b and can not be changed by stretching the ring to a larger radius.

A twisted vortex ring with $a>b$ in the vortex theory of matter represents a particle.

General Scheme Of Theory

In the past, the hypothesis of aether as fluid was instrumental in creating the theory of the electromagnetic field. The vortex rings were used to construct a model of atom at a time when the existence of elementary particles wasn't known. These days if one wants to reincarnate the philosophical approach of classical physics, applying vortex

[3] Theoretically, an even more compact vorticular object is possible. See M. M. Hill, *On A Spherical Vortex*, Phil. Trans. of Royal Soc. of London, A. 185, 1894, p. 213.

models to elementary particles looks more natural, of course, then applying it directly to atoms and molecules. Indeed, twisted vortex rings with left and right rotation are promising for a representation of particles and anti-particles. A ring with a straight vortex going through its aperture is promising for presenting a charged particle with the sign of the charge defined by the direction of the straight vortex rotation in relation to the direction of the ring's movement. Vortex rings with $a=b$ can present photons. Division of that ring into two rings with opposite möbiuses q is a topologically sound model for description of pair production.

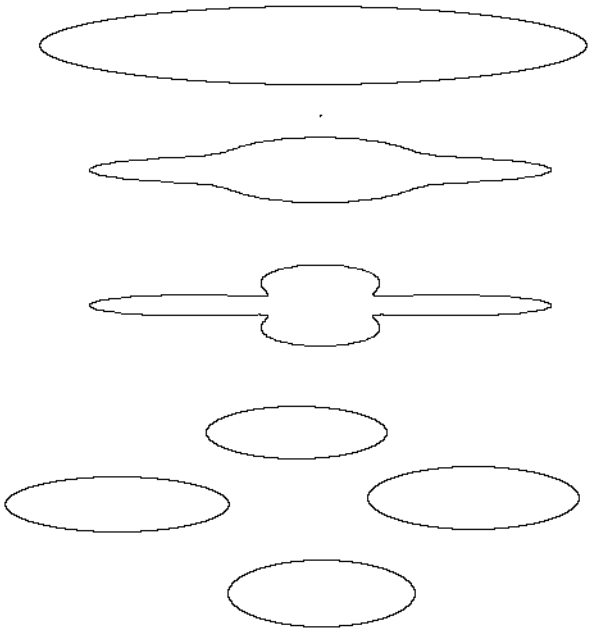
There are also different types of interactions between vortex rings which can serve as a model of interaction between particles. What is more, vorticular objects can be knots of all kinds and this can open the door for presentations of a vast variety of elementary particles. Logically it is an attractive scheme and for a long time I was dealing just with aether and such vorticlar objects. But I had to face the question of stablility.

Why This Scheme Will Not Work

William Thomson, in the end, expressed disbelief in the stability of his vortex atoms. One can show, of course, that; a singular vortex ring can exist indefinitely in an ideal fluid

and can be stable as far as small perturbations are concerned. But particles in Nature are subjected to quite powerful disturbances and yet, at least two kinds of them, electrons and protons are remarkably stable.

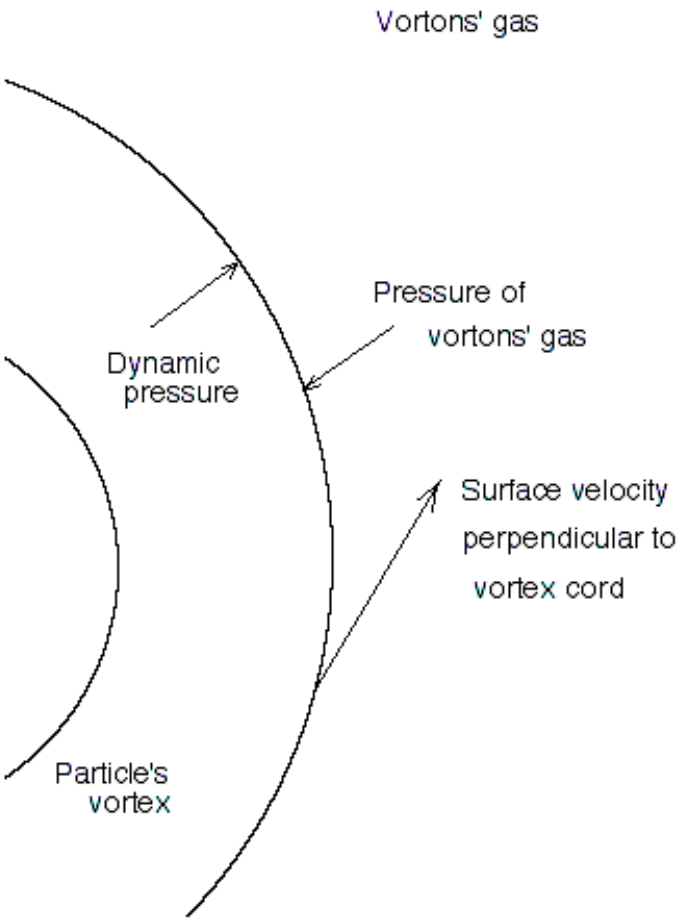
4. Example of division of perturbated vortex:



Constant splitting of vortexes and their division into smaller vortexes provided for conditions in which certain kinds of vortexes can be stable.

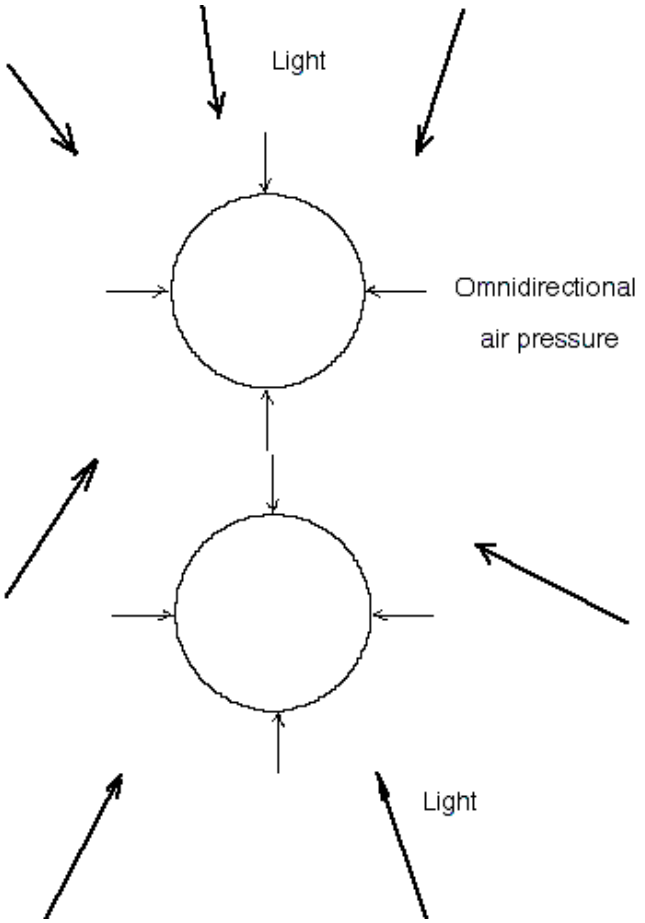
A vortex cord can be stretched with Γ_0 remaining the same, it will be perturbated so areas with larger curvativity R will have smaller speed (as it is approximately proportional to $1/R$), larger rings will divide into smaller ones.

5. **Pressure of vortons' gas**



Balance should be possible between "static" pressure of vortons' gas on the surface of bigger vortexes -- particles and photons -- and dynamic pressure is provided by the movement of aether itself on the surface of those vortexes.

6. Analogy with shadow gravitation



Spheres are subjected to omnidirectional air pressure and this pressure does not cause their motion. But the light pressure (*i.e.*, pressure of the gas with a large free path length) is responsible for a force of attraction between these spheres.

VORTICULAR EVOLUTION

Destruction Of Original Vortexes

While in search of a stabilizing factor, I came to the hypothesis of vorticular evolution which in simplified hydrodynamical approach contains the following suppositions:

•Before particles known to us came into existence, there were no stabilizing factors and no stable vorticular objects in aether.

• The constant splitting of vortexes and their division into smaller vortexes finally provided for conditions in which certain kind of vortexes can be stable.

I am not trying to answer the question of how vortexes in aether come into existence. I only state that, providing there were vorticular objects without stabilizing factors, they were unstable. Instability of interacting closed vortexes in aether can be imagined to be the same as in liquids known to us and it can mean only one thing: vortexes are becoming smaller and smaller. This had to happen simply due to entropic factors and the absence of organizing factors: a bigger vortex means a higher organization of fluid in comparison with a number of randomly moving smaller vortexes.

Γ_0 – Presumption

For further discussion, let the intensity of all stable vortexes of particles be the same -- Γ_0. This is one of the basic suppositions and I have no idea why it is so in Nature if it is true. (It may not always be true because when a particle goes through a vorticular field some filaments of that field may join a particle's vortex.)

Vortex rings of the same intensity can be of different sizes, fly with different velocities, interact with each other, and cause disturbances upon each other. A vortex cord can be stretched with Γ_0 remaining the same, it can be perturbed so areas with larger curvativity R will have a smaller speed (as it is approximately proportional to $1/R$), rings will separate from linear perturbated vortexes, larger rings will divide into smaller ones, and so on.

One can easily imagine this process while observing the transformation of relatively orderly vortical movement in usual liquid into turbulence with many vortexes of different sizes. In such liquid this process will not go too far, as viscosity will weaken vorticular movement and prevent us from seeing what will happen if the destruction of vortexes proceeds for a very long time. A long time is presumably what vorticular evolution of the Universe had. I have to

conclude that the original vortexes without presence of any stabilizing factors were gradually destroyed into smaller and smaller vortexes (Fig. 4) and filled space with ever interacting tiny vorticular rings which now behave like a gas -- I call *vortons' gas*. "Atoms" of this gas -- *vortons*, are tiny vortexes of different intensities, sizes, and velocities moving in all directions. This vorton's gas supposedly fills all observable space.

I don't know to which extent vortons' gas can be described by the usual characteristics used for a description of an ideal gas. I assume, however, that among the traditional properties of gas one is certainly applicable to vortons' gas, namely pressure.

Surface Velocity Rule

The pressure of vortons' gas became a stabilizing factor for the existence of bigger vortexes due to the fact that it limits the velocity of their vortex surface. Indeed, in real liquid of density χ according to the Bernoulli theorem, the equation

$$p = \chi v_s^2/2$$

describes the balance of static and dynamic pressure. For aether I can not use this theorem literally as the dynamic of aether in not known to me. Yet, it is a reasonable assumption

that a similar balance should be possible between the "static" pressure of vortons' gas on the surface of bigger vortexes -- particles and photons and dynamic pressure provided by the movement of aether itself on the surface of that vortex (Fig. 5). So I conclude that to be stable

any vortex, large enough in comparison with vortons, must have the same surface velocity v_s *in order to be in balance with the pressure of vortons' gas.*

As $\Gamma_0 = 2\pi v_s b$, the vortex will have a surface velocity

$$v_s = \Gamma_0 / 2\pi b.$$

I have now the defining factor v_s which must be the same for all particles and photons. This means that due to Γ_0-presumption particles also must have the same radius of vortex cord b_0. To find v_s I note that for a photon, when $a=b$, the ring's velocity is $c=\Gamma/2\pi b$. That means that

$$v_s = 2\ c$$

in a system of coordinates which is moving with that photon's ring. The velocity on the most outer circumference of the ring must be

$$v_s = c$$

in relation to aether at rest. It is exactly this surface velocity that any vortex of photon or particle must have to survive the pressure of vortons' gas. Apparently a moving vortex will experience some deformation due to the difference in surface

velocity depending on the position of a point on a surface and also due to the different exposure of that point to the pressure of vortons' gas. However I don't go into such details here.

The stabilizing effect of vortons' gas works as follows: if for some reason the vortex cord gets thinner, the conservation of the vortex' intensity will cause the surface velocity to be higher and the pressure of vortons' gas will not be sufficient to keep the dynamic pressure in balance with the static pressure, so the vortex cord will have to expand. If the vortex cord gets thicker then the surface velocity gets lower and the pressure of vortons' gas will squeeze the vortex back to radius b_0.

Philosophically it is very pleasant to think that the entropic process of the destruction of vortexes into vortons -- small "atoms" of vortons' gas -- created conditions for stabilizing some vortexes and thus bringing organization into the disorderly world of aetherial turbulence.

Properties Of Vortons' Gas

If the pressure of vortons' gas is the only stabilizing factor for observed particles and photons, then tiny vortexes which constitute this gas are:

1) either unstable and in the process of becoming even smaller due to interaction with each other and with observed vortexes

2) or some of them reached the minimal size permitted by properties of aether.

I don't know which is correct. The important point is that they don't stablize each other so I can not assume that they are uniform in size and intensity and for that reason, in speed.

The average free path length λ of vortons can not be assumed to be, as in an ideal gas of classical kinetic theory, inversely proportional to its geometric cross-section. It must depend on vorticular characteristics and not just dimensional ones. So in imagining the behavior of vortons, I picture tiny vortexes, some of which fly from one galaxy to another without interaction with other vortexes, as well as those vortons which hit each other frequently, and whose λ is very small. They are able to hit the vortex cord of observed particles and photons providing stabilization.

There is no experimental data on the spectrum of λ of vortons. However there is also no reason to suppose that such a spectrum would have any particularities like peek at a certain length, for example. I might as well imagine the random distribution of λ.

The precise mechanism of the interaction of vortons with particles and photons is not clear, of course. Particles and photons can not be modeled after solid spheres as in the classical kinetic theory of gases and for that reason the larger size of a particle does not necessarily mean a higher scattering ability. It is natural to expect that the scattering ability of particles is combined with characteristics which also depend on the velocity of rotation.

Due to a wide range of λ in vortons' gas, along with the omnidirectional pressure, similar to the pressure of regular gas, I must also take into account "shadow" pressure, which manifests itself at distances that are small in comparison with λ. Indeed, even in usual gas in a vacuumized vessel when free path lengths of atoms are as large as the size of the vessel, there will be a small "attraction force" between two plates positioned at the distance conciederably smaller than the free path lengths of the atoms. That is due to the shadow effect. Similar shadow pressure of long path vortons should account for gravitation. There must also be vortons with intermediate λ and they are responsible for an additional attraction force between closely positioned bodies.

Shadow Gravitation Hypothesis

I didn't start exploring the possibility of a bridge between kinematics and dynamics of aether yet, so in the discussion on gravitation I will use the terms "pressure" and "force" in the traditional sense.

In the absence of a better analogy with vortons' gas, I can visualize two spheres surrounded by air whose particles have a small free path length and light beams coming from all directions (large free path length). Spheres are subjected to omnidirectional air pressure and this pressure does not cause their motion with respect to each other. But the light pressure (*i.e.*, the pressure of the photons' gas with a large free path length) will be responsible for a force of attraction between these spheres. This is because some photons are scattered by one sphere before they can reach another one. Light pressure on the second sphere is not balanced due to the shadow from the first sphere (Fig. 6).

The above is an illustration of the *shadow gravitation hypothesis*.[4]

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[4] Particles' pressure as a cause of gravitation was under discussion before. See F. Klein, *Lectures On the Development Of Mathematics In the XX-th Century*, in which (p. 263 of the Russian edition) he mentioned W. Thomson's attempt to explain

This hypothesis leads to Newton's law of gravity if I assume that the gravitational mass of a particle is proportional to its scattering ability and not just to its size. As shown below, the inertial mass of a particle is growing with angular velocity; one would also expect that a higher intensity of rotation in aether increases the scattering ability.

Few Points About Shadow Gravitation

1. Vortons with large λ -- *gravions* I will call them -- can produce the attraction of celestial bodies only if they are coming from the space outside of an area occupied by those bodies. If there are a number of celestial bodies in some area without any source of gravions from within, the attraction will be the only kind of gravitational interaction between them. But if there are also inside sources of gravions, then the gravitational attraction will be weakened. In the case of high intensity of those inside sources of gravions, the attraction could be replaced by gravitational repulsion and the area occupied by said celestial bodies will expand. (This gives a rather obvious meaning to the expression the "expansion of the Universe". If the Universe includes both --

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gravitation by the impacts of vortexes, which Thomson called *ichtioids*. Klein also mentioned a work by Lessage of 1764, which I haven't seen.

sources of gravions and bodies which scatter gravions, it is impossible for the Universe not to expand.)

2. The shadow hypothesis of gravitation does not allow for the gravitational force to grow without limit: there are finite concentration of gravions in space and they can produce only certain pressure depending on the scattering ability of matter. If the masses of two celestial bodies are so large that the bodies are scattering all passing gravions, then adding more mass to those bodies will not increase the gravitational force between them: I might say that the density of the shadows which those bodies project on each other reaches saturation.

3. There must also be a limit of size for a rotating celestial body. In the absence of other factors, if a body does not rotate, its size may be arbitrarily large. If a body rotates then centrifugal force limits the size of a celestial body.

Intermediate λ

Force of attraction between bodies is produced by the shadow pressure of those vortons whose λ is larger than the distance between those bodies. If there continues a spectrum of λ then more and more vortons will participate in producing shadow pressure as the distance between bodies is diminishing. It may very well be that the well known

experiment of Steve K. Lamoreaux actually showed exactly that.

Lamoreaux discovered the force of attraction between two plates very closely positioned to each other. This effect was predicted by Casimir on a basis of different theoretical assumptions than I discuss here. Systematic measurement of the dependence of Lamoreaux' force from distance might give us a picture of part of the λ-spectrum of vortons.

MAXWELL'S MECHANICS OF AETHER

Fluid And Fluid With Vortexes

Using ideal fluid to model aether historically was helpful for formulating the laws of electrodynamics, but it doesn't mean that electrodynamics can be built on a basis of Euler's equation. Either similarities between hydrodynamics and electrodynamics are accidental or aether differs from any fluids known to us. The first conclusion was chosen by twentieth century theoretical physics, the second is left for me to explore. And on this path, I see the only logical way to overcome the contradiction between the fluid-like properties of aether and the non-applicability of Euler's equation to the aether's mechanics: Maxwell's equations themselves should be accepted as the actual basis for the description of aether's kinematics (additional steps should be made to establish aether's dynamics, as Maxwell's equations do not go far enough). For a start I simply need to subscribe kinematical meaning to vectors of electric and magnetic fields E and H and to the sources of those fields -- current j and charge e. Then whatever surprising mechanical properties of aether will follow from Maxwell's equations, they will show in which sense aether differs from usual fluids.

This path was also explored by many physicists at the end of the nineteenth century and brought only disappointments and contradictions. However, the following analysis shows that Maxwell's equations in known form cover both: the movement of aether and interaction of aether with vorticular objects made from aether. For that reason those equations invite contradictions. The clear mechanics of aether can be seen only if those equations are interpreted separately for empty aether and aether with vorticular objects.

Indeed, with the same underlying laws of hydrodynamics, there is considerable difference in possibilities for the description of usual fluid with or without vortexes. In the case of laminar flow we are dealing with indistinguishable particles of fluid characterized by the vector of velocity. Those particles are part of whole fluid, they do not *belong* to any other entity and the natural way to describe the movement of such fluid is traditional hydrodynamics.

In the case of turbulent movement, particles of fluid also belong to this or that vortex. A particle's velocity is still enough for this description if one could solve the hydrodynamic equations. However, the state of fluid can also be characterized by the properties of vorticular entities: momentum, moment of momentum and, in a certain sense, some analogue of mass. These entities interact with each

other according to laws, which are different from the laws of interaction between particles of fluid. And this is exactly the nature of the problem which occurs in electrodynamics: the initial state of a system is given not as a field of the velocity of aether's particles but as a position and intensity of currents, charges, and magnetic fields between them.

To illustrate, I might say that for any kind of fluid, water for example, from a mechanical point of view, there is first of all basic water without vortexes with only water's molecules as particles. And then there are *many kinds of water* each having different mechanics depending on the quantity, size, and intensity of the vortexes which play the role of particles in addition to the water molecules. That different kinds of water can be viewed as different substances as they consist not just of molecules but numerous entities -- vortexes -- which greatly affect the mechanical behavior of a particular kind of water. In electrodynamics, the area of aether with charges and currents also should be seen as a mechanically different substance than just aether.

In hydrodynamics our knowledge historically developed following a simple path: from the study of mechanics of basic fluid itself to the study of isolated vortexes and then to the study of turbulent movement which still presents

difficulties as to a general mathematical description. In electrodynamics knowledge developed backwards: physicists were tied to what was observed: vortexes and their interactions, meaning charged particles, currents, and their attraction and repulsion. Faraday's ideas and Maxwell's equations were a step in establishing knowledge about aether and the properties of vorticular entities in aether. However, that knowledge still has to be decoded.

The degree of this task's difficulties will be clearer if the reader will imagine that we don't know anything about water itself, no density or viscosity and so on. All we know is the way in which observed vortexes interact. How can we move from such limited knowledge to understanding the properties of water? In the case of aether, the task is much more difficult, as all devices for experiments, measuring tools, and standards of measure are made from nothing else but also vortexes.

Maxwell's Kinematics

The simplest way is to connect H with the vector of aether's velocity. This makes Maxwell's equation $div\ H=0$ equivalent to $div\ v=0$ in hydrodynamics. Also it is natural to connect electric current J with the intensity of the vortex in aether due to the similarity of Bio-Savaart's law in hydro-

and electrodynamics.[5] From that law the mathematical rules of analogy follow:

$$H \rightarrow v\sqrt{\chi} \text{ and } J \rightarrow \Gamma\sqrt{\chi}$$

where χ is a constant which I will call for now the *density of aether* postponing discussion on the applicability of the density concept to aether. These rules can be used for applying the formulas of electrodynamics in calculating the interaction between vortexes and the velocity field. This analogy is purely mathematical as not only the value, but even the existence of aether's density has not been established. What is more, once I start to discuss the non-linear inertial properties of aether, the electromechanical analogy will look more problematic.

For now it is helpful to follow the historic path and use this analogy. However, as I am in the dark at this point about the inertial properties of aether, I should not use the term "hydrodynamics". Indeed, the true analogy, which I take seriously, is between the movement of fluid and aether, not between its dynamical properties like density, energy, and so

[5] In the past there were also attempts to present *H* by vortex and *E* by velosity. See Edmund Whittaker, *A History of the Theories of Aether and Electricity*.

on, so strictly speaking, I use a *hydrokinematical* analogy, not hydrodynamical.

The mechanical meaning of E has to be established. One should expect that E is connected with vorticular motion but it definitely does not represent the vortex' intensity itself as that role is taken by the electric current.

There is a long history of attempts to use hydrodynamic analogy in electrodynamics which showed that aether is not an ideal fluid. No big surprise here, as it is known that vortexes can not originate in an ideal fluid. Yet in aether we can originate vorticular movement E simply by changing the field of velocity which corresponds to H. The explanation of that should be found in the special properties of aether which differ from those of ideal fluid and also any fluid known to us.

I picture aether as incompressable and, as far as our knowledge goes, free of the irreversible dissipation of energy, but not without viscosity of some kind as it is viscosity that is responsible for originating vortexes in fluid. Viscosity with no dissipation of energy sounds paradoxical but here it simply means that aether is a special kind of fluid which has *reversible viscosity*. Regular viscosity is the irreversible transfer of mechanical energy to the inner degrees of freedom, including rotational. For aether this

transfer of energy to the inner, exactly rotational, degrees of freedom is possible, but it is evident that the transfer is reversible. Maxwell's equations in vacuum (i.e., without charges and currents) describe precisely the rules of the transfer of translational movement H to rotational E and back.

Field Of Filaments

If particles and photons are closed vortexes and if electric field E is vorticular in nature, does it mean that one can produce a particle (or particle-like entity) every time one originates E by a change of magnetic field? Apparently I should not treat every vorticular motion as a vortex and take into consideration the possibility of loose vorticular one-dimensional entities -- filaments which are made from rotating particles of aether but do not belong to any vortex.

In a *true vortex* filaments themselves rotate and also rotate around each other but loose filaments rotate only separately. To illustrate the difference one should imagine separate thin solid cylindrical rods which are oriented in space differently and each is rotating around the cylinder's axis of symmetry -- those rods represent loose filaments. Then one can imagine all those rods in a tight bunch and

rotating altogether as a solid cylinder - that is a model of the rotation of filaments within a true vortex.

In fluid a true vortex rotates as a solid cylinder with one angular velocity ω and the velocity of particles' movement $v = r\ \omega$ where r is the distance from the axis of rotation. A true vortex also produces a velocity field around itself -- velocity induction -- such that the circulation of that velocity is similar to the circulation of a magnetic field around an electric current. Contrary to that, rotating filaments in aether are simply lines of particles of aether which rotate with a certain angular velocity and, most importantly, do not produce velocity induction. That is just like a static electric field which, unlike an electric current, is not surrounded by a magnetic field.

Similarly to vortexes, separate rotating filaments are closed or go to infinity (I actually don't understand why it is so, but accept it on a basis of analogy with vortexes; it is also supported by the classical concept of electric "lines of force" which are closed, infinite or end on charges). Taking into account the possibility of loose vorticular filaments in aether gives me an additional kind of vorticular motion which is natural to subscribe to an electric field. It will be discussed later that in some cases a true votex can get spread into

separate filaments or separate filaments can get together and form a true vortex.

Now it is clear that if Maxwell's equations are to describe the kinematics of aether, they should be written separately for two kinds of vorticular movement in aether: split vorticular filaments and true vortexes. Indeed, Maxwell's equations cover only relations between each kind of vorticular motion with translational motion. Transformations of a true vortex into separate filaments and back are not covered by Maxwell's equations and for that reason, kinematics of aether described by those equations is incomplete. Historically, during the twentieth century, every experimental evidence of such transformation from loose filaments to a true vortex and back was viewed as a failure of classical electrodynamics and as an invitation to conclude that there are natural limis of what classical physics is able to describe.

Equations For A Field Of Filaments

Splitting Maxwell's equations reflects the differences between the behavior of aether itself and aether with loose filaments -- the first group of equations, and the behavior of objects made of true vortexes in aether --- the second group.

$$\text{div } H = 0 \qquad \text{or div } v = 0 \qquad \text{(M1)}$$

div E = 0	or div $\omega = 0$	(M2)
?H/?t = $-k_1$ rot E	or ?v/?t = $-k_1$ rot ω	(M3)
?E/?t = k_2 rot H	or ?ω/?t = k_2 rot v	(M4)

These equations describe an electromagnetic field when rotational movement is present only in the form of filaments and does not contain true vortexes. There is no magnetic field around an area with a constant electric field. But when ω is changing, reversible viscosity provides for the appearance of a magnetic field. And when velocity is changing, reversible viscosity transfers energy into rotational movement of filaments -- an electric field. This process, as far as it is established experimentally, goes without loss of energy (energy conservation is a separate restriction which put limits on the choice of coefficients. However, I have not introduced energy yet.)

Apparently, in the absence of charges and true vortexes, a field of rotating filaments can exist only in the form of ever transforming to a field of velocity and back.

Traditionally, an electromagnetic field in vacuum is known as a transverse wave and presented in textbooks by pictures of two mutually perpendicular sinusoids traveling throughout space with the speed of light. Aether being fluid, can not have such a kind of transverse wave.

Appearing and disappearing rotating filaments do produce appearing and disappearing velocity fields. Vectors *E* and *H* of those fields are perpendicular to each other but they are not the same as vectors of transverse waves in an elastic body. Rotating filaments of an electric field must be closed into rings around the direction of appearing and disappearing magnetic fields. If this periodic disturbance propagates, it can be called a wave, but it would be, I might say, a vorticular wave.

I have no reason to conclude that the speed of propagation would be the same as the speed of a photon which is the vortex ring moving with the speed of light. Movement of vortex rings is due to certain velocity circulation around a vortex. Separate filaments do not have circulation around it so a closed separate filament will not move due to circulation. The only translational movement, I can see here, is a velocity field (or *H*) produced by a change in intensity of filaments due to reversible viscosity. That is until the filaments of an electric field get together and originate the ring of a true vortex -- then it will have to satisfy the v_s-rule to survive and for that reason it will move with the speed of light. Does this occur each time a "vorticular wave" is produced by a change of *E* or *H*? Is there some minimum of intensity of *E* or *H* for originating the ring of a true vortex?

Can an electromagnetic wave propagate in non-photon form? Or $E \rightarrow H$ transformation actually does not propagate at all until a true vortex of photons is formed? I have no answers to those questions. As I mentioned above, filaments-vortex transformation is not covered by Maxwell's equations and, as far as I know, the initial stage of electromagnetic waves right after its birth was not particulary researched experimentally. I know only that the origination of photons is usually interpreted as something outside of classical physics.

The connection of electromagnetic waves with light was an exciting discovery of the nineteenth century. Then Plank's discovery that atoms radiate energy by portions and Einstein's theory of photo-effect shifted the attention of theoreticians to photons and the speed of light was assumed to be the speed of any electromagnetic radiation. Yet, photons are moving with a speed defined not by aether itself but by certain levels of pressure of vortons' gas. If pre-photon radiation can propagate as a vorticular wave, it must move with a speed which does not depend on the pressure of vortons' gas. So I am leaving coefficients k_1 and k_2 not defined. If aether would be empty, then from the point of view of electrodynamics, k_1 and k_2 would characterize dielectric and magnetic properties of aether itself. But aether is filled with vortons' gas even when there are no particles

and photons around. For that reason I can not say that this first group of Maxwell's equations describes the mechanics of aether itself -- k_1 and k_2 might also characterize vortons' gas which is what is perceived as empty space in electrodynamic experiments. As to aether itself, unaffected by vortons' gas, one can expect to find it only inside of photon's and particle's vortexes i.e., behind the barrier created by the appropriate surface velocity. Only there, in the body of those entities, one should expect electric and magnetic properties as well as density (if it exists) to belong to aether itself.

I have to remind the reader that c in Maxwell's equations appeared simply as a coefficient between electric and magnetic units of measurement. Those units were established on the basis of experiments with fields produced by charges and currents which are objects in aether whose existence is connected with the stabilizing pressure of vortons' gas. For that reason the presence of c in equations of the following group is natural as vorticular objects are experiencing that pressure. But, because I split Maxwell's equations, c, as a characteristic of pressure, should not be in the first group. However, if the coefficients in M3 and M4 are to be established experimentally and the experiment will be

dealing only with radiation in the form of photons, then one will come out with coefficients, connected with *c*.

Summary On Electromagnetic Waves

The velocity of the propagation of non-photon electromagnetic radiation might be a crucial point as far as understanding this phenomenon. There is the assumption in physics that radiation propagates only with speed *c* but there might be some propagation of non-photon electromagnetic radiation if for example, filaments of an electric field follow the movement of aether due to the produced magnetic field.

As to the propagation of photons, the v_s-rule assures that the velocity of photons in a vacuum can not be other than *c* independently of the velocity of the source of the photons.

Maxwell's Equations For Aether With True Vortexes

And then there are true vortexes in aether, which consist of numerous rotating filaments and those filaments are rotating around each other. There is a certain angular velocity ω of rotation of the vortex as a whole and there is linear velocity inside the vortex, proportional to the distance from the central line of the vortex. So, the velocity on the surface of the vortex is ωb where *b* is the radius of the vortex.

As in usual fluid there is a vorticlar induction: the circulation of velocity around the vortex is constant and equal to the circulation of the surface velocity $2\pi\omega b^2$. The field of induced velocity around the vortex is a magnetic field and this field is also responsible for the "self-propelled" movement of the vortex ring, as any part of that ring is experiencing the effect of velocity induced by other parts of that ring.

Maxwell's equation in the presence of a true vortex is

rot H= j or rot v= ω (M4a)

and it is simply stating the connection of *j* with the angular velocity of a true vortex. Equations M4 and M4a describe the relations of the velocity field *H* with two kinds of rotational movement in aether: separate vortex filaments and true vortexes. The first equation is unique for fluid with reversible viscosity and for that reason does not have an analogy in hydrodynamics. The second is the same as for usual fluid. The first shows production of the velocity field only when a vorticular field is changing; the second shows a velocity field around a vortex due to its being.

Now it is time to remind the reader that all previous discussion about the initial destruction of large vortexes into vortons was based upon a rather simplified hydrodynamical model and dealt only with true vortexes. Actually I have no

clear idea what role is played by separate filaments and magnetic field in the behavior of vorton's gas, but reality is most likely more complicated than the above purely hydrodynamical picture. One might expect that vorton's gas is a stochastic mixture of electromagnetic entities: true vortexes, filaments, and magnetic fields.

Model Of Charged Particles

It was simply stated above that an electric current $j \sim J/b^2$ constitutes a true vortex. The following model of charged particles will clarify that. Let's imagine that inside the aperture of a vortex ring of a particle there is a separate straight vortex -- *field vortex* (Fig. 7). The velocity field around the ring is such that fluid in front of a ring moves in all directions away from the ring's axis. I expect that part of a field vortex in front of the ring will be split by the ring's velocity field into separate vorticular filaments. Behind a vortex ring the field of velocity produced by the ring is directed toward the axis of the ring and is squeezing the field vortex so it remains a true vortex or *vortex tail*.

The law of conservation of vortexes is put to the test here and I rely on this law in my conclusion that a field vortex can survive such splitting treatment. As a result of splitting the field vortex, a charged particle has an electric field -- split

filaments -- in front of it but no electric field behind it: only a vortex tail. A true vortex despite its rotational qualities is not an electric field; due to the velocity induction it produces a magnetic field around itself. This model of a charged particle gives me the source of an electric field so

$$\rho = \text{div } E$$

where ρ is the density of an electric charge (the charge being positive or negative depending on the direction of rotation of the filaments in front of a particle in relation to the velocity of a particle.) The vortex behind a particle is a true vortex and there is a magnetic field around it:

$$\text{rot } H \sim \omega_f \qquad \text{(M4b)}$$

which is equivalent to equation (M4a). When charged particles move in certain directions as an electric current, vortex tails get oriented along the direction of movement and produce what is observed as a magnetic field around the current.

There is the appearance of a paradox as far as equation $\rho = div\ E$ is concerrned. Earlier I stated that E is vorticular in nature which means it connected with *rot* of some velocity; for that reason *div E* should equal zero as *div* of *rot* for any vector equals zero, which simply expresses the fact that there is no point in space where a vortex starts or ends. Yet, inside of a particle's ring there is precisely such a situation when

rotating filaments start to be separate and go to the area in front of a particle and a true vortex starts and goes behind the particle. It is only the appearance of a paradox because the conservation of vorticular movement is not violated as one is the continuation of another. Mathematically both are characterized by *rot* of some velocity, but the physical effects of these rotational movements in front of and behind a ring are different.

Loose Ends Possibility

Let the vortex cord of a ring contain N vortex filaments. The topology of the ring depends on q and N. The assumed rule so far was that for a ring to be a separate entity *there must be no loose ends*. This means that qN must be an integer. However, a certain twist of the ring is most likely responsible for its stability. Indeed, if q is too small, the ring will be squeezed by the pressure of vorton's gas into a state with the ring's radius equal to the radius of a vortex cord as in a photon. If q is too large, then, I expect, it will rotate too fast to be in balance with vortons' gas pressure and will not retain a constant radius. Suppose the stable ring can exist only with such q that qN is not an integer. In this case there will be loose ends -- infinite filaments which are squeezed into a true vortex behind the ring and constitute a field of

separate filaments in front of the ring (Fig. 8), just like the front and back parts of the separate field vortex I discussed above. Keeping in mind this possibility, I will still view a charged particle as described before because for the purpose of further discussion, a separate field vortex or field connected with filaments inside the ring is almost the same. However, the persistence with which an electric field follows its particle makes me think that the loose ends possibility might be more promising for an adequate description.

The question arises then, what is a particle? If there are potentially infinite loose ends, should I consider just the ring to be a particle or a ring with all filaments wherever they go? It is not a new question of course: the classical electric field of a charged body could be viewed as part of that body.

In the framework of my model it is natural to see a particle as a ring and view filaments as a field. However, that ring may move as such and make the filaments follow or it may slide along the filaments as a loose knot would slide along the rope (Fig. 9). In the latter case there would be actually no movement of substance when a particle moves, just the propagation of the topological peculiarity along the filaments. However, movement perpendicular to the direction of filaments has to be actual "substantive" movement unless a change in the direction of filaments

preceeds the movement of the particles' ring. I have to leave these fascinating questions without an answer.

True Vortex And Filaments: Summary And Questions

In usual fluid, a traditional object for hydrodynamical study is a true vortex inside of which vorticular filaments are rotating around each other. Presumably, intra-molecular bonds are responsible for the fact that filaments within a vortex stay together. Is there any analogous bonds between vorticular filaments in aether which would hold them together? I do not know.

What I see from my interpretation of the experimental data is that:

•True vortexes exist in aether

•Pressure of vortons' gas plays a stabilising role in keeping vorticular filaments together when they are part of a true vortex.

•True vortexes may split into a bunch of separate filaments due to the splitting velocity field in front of a ring.

•Split filaments in front of charged particles go in different directions coalescing with filaments from other charged particles or, theoretically, going to infinity. This is a Coulomb field.

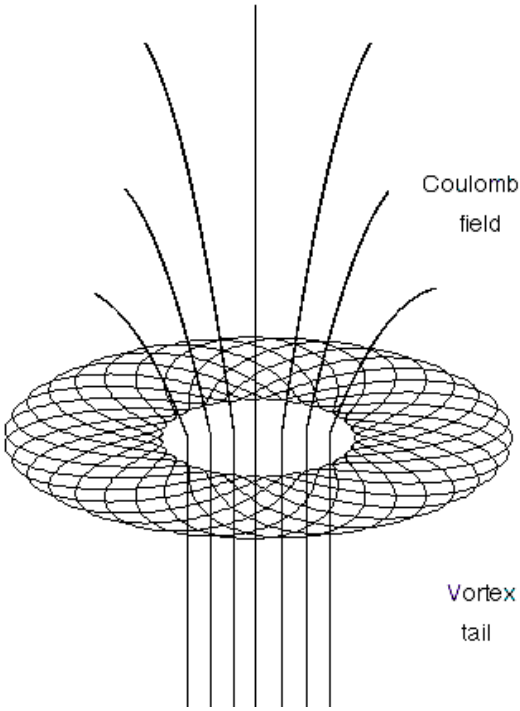
•For some amount of length the vortex tail is oriented along the direction of a particle's movement so even one charged particle constitutes an electric current and its vortex tail produces a magnetic field around that current.

•The higher the particle's velocity, the larger the part of the vortex tail which is oriented along the direction of the particle's movement, so a magnetic field around a moving charged particle depends on the velocity. At some distance from the ring a vortex tail may go in any direction coalescing with tails of other charged particles or, theoretically, going to infinity.

•There is, of course, the question of how far filaments inside a true vortex can be from each other before splitting into a field of separate filaments.

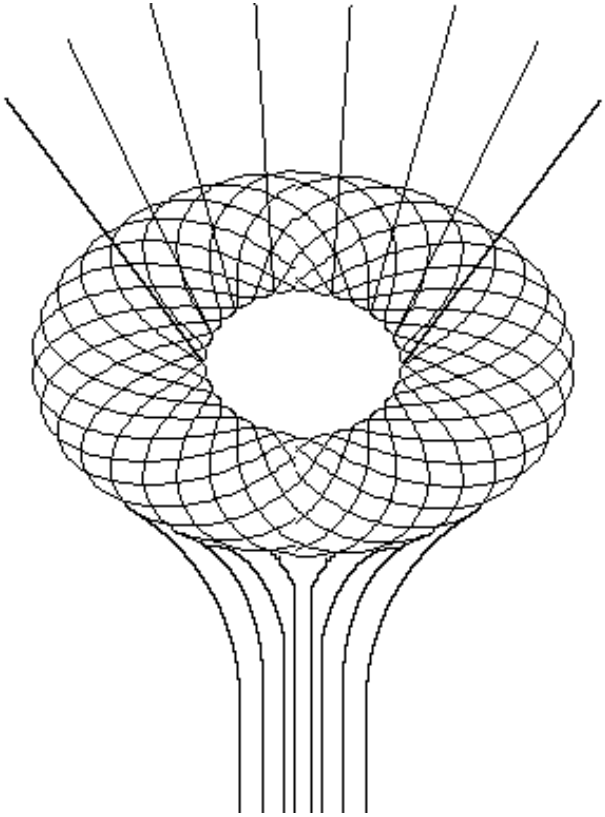
•Nature of filaments must be such that vortons' gas and any electrically neutral entity in aether passes the field of filaments without interaction noticed by us so far.

7. **Coulomb field**



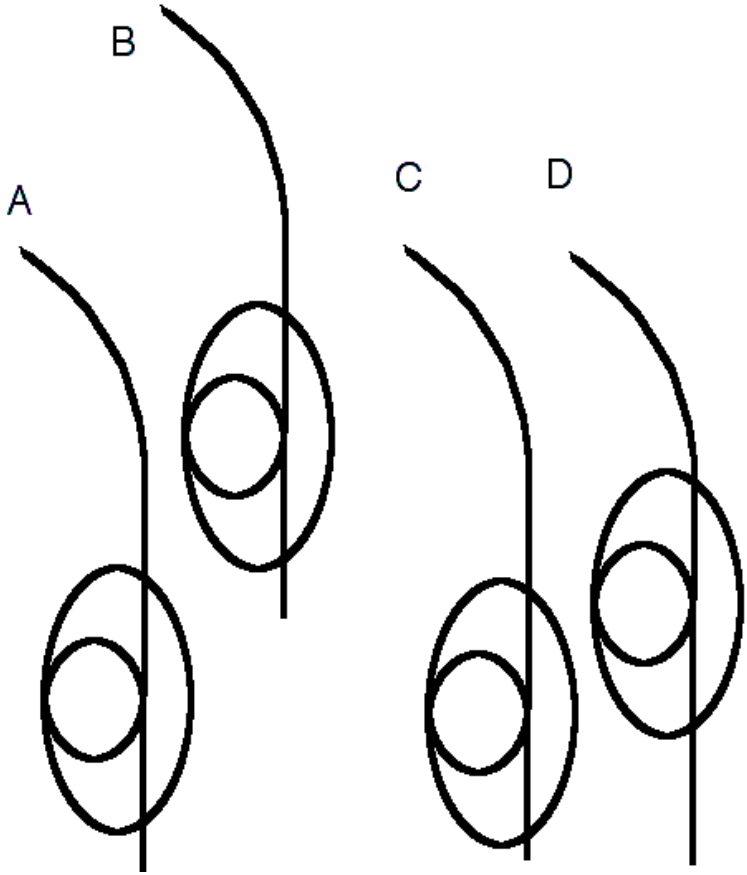
Part of a field vortex in front of a ring is split by the ring's velocity field into separate vorticular filaments. Behind a vortex ring a field vortex remains a true vortex.

8. Possibility of twisted ring with loose ends



If a stable ring can exist only when qN is not an integer then there will be loose ends -- infinite filaments which are squeezed into a true vortex behind the ring and constitute a field of separate filaments in front of the ring. (Lines of a Coulomb field are shown only on the back side of the ring.)

9. Does a particle slide like a knot along the rope?



A knot may move with the rope (A, B) or a loose knot may slide along the rope (C, D). A particle's ring if it has loose ends may move as such and make the filaments follow or it may slide along the filaments. In the latter case there would be actually no movement of substance when a particle moves, just propagation of a topological peculiarity along the filaments.

INTRODUCING ENERGY

Kinematic 'Energy'

I am dealing here with what I hope is the bridge between the mechanics of aether and Newton's mechanics of a particle. So far I have used only a kinematical approach. There was of course reference to the pressure of vortons' gas, but if there is only one substance, one might imagine a kinematic version of the Bernoulli theorem. To clarify, I note that Newton's mechanics provides rules for the exchange of energy and momentum between particles and I did not use those rules yet. In fact, those rules, rules of dynamics, can be used only after introducing mass or, better yet, establishing what mass is and so far in this text the concept of mass has not been used and even the applicability of the density concept to aether is still in question.

Energy is another matter. Without too much attention to its possible definition, physics is dealing with energy in all kinds of processes. Behind the concept of energy there is something which does not depend on the concept of mass and does not depend on Newtonian mechanics. With an inclination to present any physical process as a movement of one entity or another, I view that "something behind the concept of energy" simply as a characteristic of movement

independent of its direction. The historical way to learn about energy and observe energy is to study processes in which bodies exchange energy. However, one may try to find a way to describe energy without such an exchange.

So, for now I say: velocity or angular velocity, as well as the vector of a magnetic or an electric field, characterizes the state of a certain entity in aether and it is vectorial in nature. Energy is a scalar quantity which characterizes that state independently of direction. So, until mass or other substantive characteristics are introduced together with actual energy, I will deal with the kinematic analogue of energy and call it "kinematic energy".

Indeed, to connect energy with movement in mechanics or electrodynamics I need some characteristic of material from which a moving entity is made -- a moment of inertia or density or constants characterizing electric or magnetic properties. There would be no problem at all with mass and the definition of energy in a uniform substance with certain density if the inertial characteristics of any entity would depend only on that density: I could deal only with kimenatics and energy would be essentially the same as kinematic energy. However, even in usual fluid, vorticular entities of a certain volume acquire some inertial properties which differ them from a portion of fluid of the same volume

when it is at rest. In aether, inertial characteristics of a vorticular entity are definitely different from those of aether itself.

There are four obvious ways to connect characteristics of movement and its energy for electric and magnetic vectors of field and for velocity and angular velocity (I ommit the usual 4π which is connected with a choice of measurement's units):

$$\varepsilon E^2/2,\ \mu H^2/2,\ I\omega^2/2,\ mv^2/2$$

These formulas were constructed to look alike simply with the goal that energy presented in this form leads to the simplest form of other expressions. The main thing here is producing a scalar which would characterize the value of a vector independent of direction and characterizing kinematic energy.

Coeficients $\varepsilon, \mu, I,$ and m depend on properties of the substance involved in movement. They are characteristics of a new dimension be it mass or the moment of inertia and so on. It is important to remember that $\varepsilon, \mu, I,$ and m characterize not aether itself, but depend on the state of aether: aether with vortexes has different dynamic properties than aether without vortexes. How far does this difference go? Should I introduce a non-linear quality of inertia in aether? -- This is what is under consideration now.

As I am working here at the cross-road between electrodynamics and mechanics, I have a choice of using either a mechanical or an electrodynamic approach to energy calculation.

Energy of a straight vortex can be easily calculated as the sum of the energy of the translational movement of fluid particles inside of a cylinder or as the energy of an electric field and current. In each case the constant characterizing inertial property of aether is needed. There is a deeper question however: does this or that constant exist for aether itself or characterizes moving aether only. My Newtonian subconscious might trick me into the assumption that if a magnetic field is translational movement in aether, then there is kinematic energy -- and for that reason the density of aether should exist as a bridge between the characteristics of kinematic energy and energy. There is a possibility however, that aether has no Newtonian density at all and only vorticular objects in aether can be recipients of the energy of translational movement induced by a vortex.

Philosophy aside, energy is still to be calculated even if I don't know what it is. All four different approaches to energy calculations of a twisted vortex ring have one thing in common: I don't know the constants characterizing aether's

properties be it magnetic, electric, moment of inertia or mass. The constants must be taken from experiment.

Toroidal Solenoid

Some particularities of a particle's anatomy will be discussed later, but here is a discussion of the energy of twisted rings in general.

A vortex ring with möbius q (and no loose ends for the simplicity of discussion) can be viewed as a toroidial solenoid. Let the vortex cord of a ring contain N vortex filaments. The topology of this construction depends on q and N.

The extreme possibilities are: if $q=0$ then there are N unconnected and untangled filament rings within the vortex ring; with $q=1/N$ a vortex ring contains only one continuous filament which goes around the ring's axis and around the ring's central circumference N times. However, the overall energetic characteristics of a vortex ring most likely does not depend on the manner or number of connections inside a ring, but only on the full length of the filaments and the value of q.

Using a purely mathematical analogy:

$$H \rightarrow 2v\, v(\pi\chi) \text{ and } J/c \rightarrow \omega\, b^2\, v(\pi\chi)$$

I can find the velocity inside the toroidal solenoid, remembering that the intensity of the ring's vortex cord $2\pi\omega b^2$ is the sum of the intensities of N filaments. A magnetic field inside a toroidal solenoid is approximately $H=2qJ/ca$. By analogy:

$$2v\ v(\pi\chi) = 2q\ \omega_0\ b^2\ v(\pi\chi)/a$$

so the linear velocity of ring's rotation as whole -- q-rotation is:

$$v_q = q\ \omega_0\ b^2/a$$

and the angular velocity of this rotation is:

$$\Omega = q\ \omega_0\ b^2/a^2$$

Now there is a step to make to come out with the dynamics of q-rotation and this step calls for new, inertial, characteristics of a vortex. But first, I have to find kinematic energy W which mathematically is simply energy without inertial characteristics ε, μ, m or I_q which were mentioned above.

For q-rotation kinematic energy is:

$$W_q = q^2\ \omega_0{}^2 b^4/2a^4$$

Remembering the v_s-rule and formula for the ring's velocity, I have $\omega_0^2 b^2 = 4c^2$ and $b^2/a^2 = v^2/4c^2$ so:

$$W_q = q^2\ v^2/2a^2$$

There is also kinematic energy of the main vortex independent of twist so the full kinematic energy of rotational movement is:

$$W= \omega_0^2/2 + q^2 v^2/2a^2$$

Newtonian Mass

I don't know if the inertial characteristic for q-rotation and rotation of the main vortex are the same. If they are the same, however, then I can introduce moment of inertia for each rotation $I_0=K b^2/2$ and $I_q=Ka^2$, where K is a constant of the dimension of mass. This is not moment of inertia of aether in the volume of a vortex ring, but a characteristic of aether already in a state of vorticular movement. For energy of q-rotation I get:

$$E = Kq^2 v^2/2$$

Now, if I replace $K q^2$ by m, this gives me the Newtonian energy of a particle:

$$E = m v^2/2$$

This energy owes its existence to the angular velocity of q-rotation which changes together with the velocity of the ring's translational movement: translational velosity v can not change without a change in the angular velocity of q-rotation -- they both depend on the ring's radius. In this scheme no energy at all is subscribed to the translational movement of a

particle. Presence of v in the expression for energy is simply a result of preference for use of the observed velocity instead of the angular velocity of q-rotation.

Newtonian mass *m* depends on *q* and, as I will show later, on other factors influencing the rotation of rings as whole. This expresses the purely vorticular nature of the inertial property of a particle. (Note: discussion on mass here does not take into account changes in mass due to high velocity.)

The first member in the formula for a particle's energy -- $mc^2/4q^2$ -- corresponds to the well known mc^2 which J. J. Thomson introduced in the 1880s in his work on electromagnetic mass. Later that part of a particle's energy become known as "energy at rest". In vortex theory this expression loses its meaning, of course, as there is no possibility for an elementary vorticular object to be at rest, so Thomson's energy should be viewed as the energy of a vortex cord independent of q-rotation. Apparently Thomson's mass does not depend on *q* and equals Newtonian mass only when $q=1/2$.

I am not religious about the universality of belief that mc^2 is the main energy of every particle. Theoretical prescriptions could influence the interpretation of experiments. However, there is the obvious possibility that $q=1/2$ for some particles and in that case Newton's and Thomson's mass are the same.

That would be fine, except for the following hypothesis that protons and electrons have topologically identical rings -- in that case Thomson's mass of electrons and protons would be the same and the problem should be approached on the basis of what energy is realized during annihilation -- something I don't do in this text.

On Inertia In Aether

It looks like vorticular movement should be viewed as the main storage of inertial properties. Inertia of the field of velocity of aether itself could be small or negligible in comparison with inertia of rotational movement.

This goes well with observations of electromagnetic phenomena. Indeed, the symmetry of Maxwell's equations, as far as electric and magnetic fields are concerned, is easily observed and was discussed by many authors.[6] However, it is only mathematical symmetry and this reinforces a useful philosophical point that mathematics should be a tool, but should not serve as a source of physical ideas. Physically important asymetry is clear from the fact that a constant magnetic field can not produce an electric field directly or

[6] See bibliography in: V. I. Fushchich and A. G. Nikitin, *Simmetria uravnenii Maksvella*, Kiyev, 1983.

indirectly but an electric field produces current and that current, even when constant, produces a magnetic field.

A constant magnetic field is a field of velocity induction and there must be an electric current in order for a constant magnetic field to exist. That field carries energy, yes, but it lacks inertia. Left to itself, a magnetic field can not stay constant. It diminishes and produces an electric field due to the reversible viscosity of aether. It does not propagate by inertia independently of an accompanied electric field -- at least we are not aware of such phenomena. A true vortex can remain to be such and that supports the point that vorticular movement is the only kind of inertial movement in aether.

Only if we think in the framework of Newtonian mechanics, then we can say that, left to themselves, particles move due to the inertia of translational movement. Actually Newtonian inertia is inertia of the rotational movement of vortex rings and not inertia of the translational movement of those rings. In terms of conservation laws, I emphasize the conservation of moment of momentum of a true vortex as an expression of mechanical inertia.

All the above contraposition of rotational and translational movement in aether might be partially invalid simply due to the possibility that with our means of observation the energy of translational movement unaccompanied by vorticular

movement escapes our accounting. Indeed, as far as observations of a magnetic field go, we register only the behavior of vorticular particles in that field and not the field itself.

ENERGY OF PARTICLES

Energy Of A Charged Particle

If energy of q-rotation is what is observed as the Newtonian energy of a particle, then the energy of q-rotation of a charged particle should be calculated together with the rotation induced by a vortex tail. That induction v_{ind} adds $\pm v_{ind}/a$ to the angular velocity of a ring depending on the direction of rotation.

As a particle experiences induction only from a vortex tail and not from the field of filaments, the value of v_{ind} here is half of what an infinite field vortex of intensity Γ_0 would induce in a point on the central circumference of a ring and equals:

$$v_{ind} = \Gamma_0 / 4\pi a = 2\pi \omega_0 b_0^2 / 4\pi a = \omega_0 b_0^2 / 2 a$$

The angular velocity of a ring's rotation together with this induction:

$$\Omega = q \omega_0 b^2/a^2 \pm \omega_0 b^2/2 a^2 = (q \pm 1/2) \omega_0 b^2/a^2$$

The energy of a ring's rotation:

$$E_q = K (q \pm 1/2)^2 v^2 / 2$$

So, the Newtonian mass of a charged particle is:

$$m = K (q \pm 1/2)^2$$

One might try to find different values of q which would give masses of different particles. As I know nothing about

the possible range of q as well as K, the choice is quite wide. I don't take this fitting exercise too seriously, however. There should be an additional reason for subscribing this or that value q to particles.

Due to the induction of a field vortex, there is $\pm 1/2$ in the formula for mass and this provides for the possibility of the same q for different particles with different directions of field vortex -- I call such particles complementary. Complementary particles and anti-particles are identical in the topology of a ring and differ only in the direction of induced velocity and as a result, in the sign of an electric charge.

Now I will entertain an interesting idea: stable particles -- electron and proton -- might have the same q as q-rotation is definitely a factor responsible for the stability of a rotating ring and it is less probable that there will be two values of q which would assure that stability.

Topological Identity
Of Proton's And Electron's Rings

In order to use the idea expressed above, I have to assume that in the formula for the mass of charged particles either q, or a second member which reflects vortex induction, does

not exactly equal 1/2 and the difference is d_q. This gives me two possibilities for mass:

$$K\ d_q^2 \text{ and } K\ (1+d_q)^2$$

In this case if a small electron's mass is $K\ d_q^2$, then the mass of a complementary particle -- a proton -- is $K(1+d_q)^2$.

Let's sort the possibilities now. With the same ring's R topology, given by the absolute value of q, there are four possibilities: R++, R+-, R-+, R--. The first + or - shows the right or left rotation of a ring which is a sign of q. This defines a particle or anti-particle. The second + or - shows the right or left rotation of a field vortex which signifies the sign of an electric charge of a particle. So, R++ and R+- are a proton and an electron and R-- and R-+ are anti-proton and positron. (I did not analyze how well it goes with loose ends possibility.)

Using the mass of an electron as the mass unit I have for protons and electrons:

$$m_p = 1836.12 = K\ (1 \pm d_q)^2 \text{ and } m_e = 1 = K\ d_q^2$$

The two solutions approximately are

$$K_1 = 1751.42;\ d_{q1} = .0239$$

$$K_2 = 1922.82;\ d_{q2} = .0228$$

Further, I use K_1 and d_{q1} as K and d_q simply because I don't have enough guidance to make a choice. I should

remind the reader that d_q most likely characterizes proton-electron ring with its möbius being approximately 1/2, so

$$q=1/2+d_q \text{ and } D=1/2$$

$$\text{or } D=1/2+d_q \text{ and } q=1/2.$$

As to *K*, this constant can be viewed as appropriate for use with other *q*, in case one would try to explain the multiplicity of unstable particles by subscribing to them different degrees of twist. The following discussion, however, is devoted to the possibilities of other particles produced by the same proton-electron ring.

8-transformation

Let's imagine that a ring is stretched into an ellipse, then deformed into something like Kassini's oval and after that the left side of it turned + or -180° so it forms a figure similar to the number eight (Fig. 10). The direction of that turn I call a plus or minus 8-turn. Then let's imagine that figure "8" is folded to form a ring again. I call this double ring the result of an 8-transformation or simply an 8-ring. I can imagine the same procedure to be repeated *n* times and the result will be 8n-ring. Apparently, if the quantity of filaments in a cord of the initial ring is *N*, then, after consecutive 8-transformation, cord of 8n-ring will have *2N, 4N,* and so on of filaments. This means that if some property of some group of vorticular

objects is characterized by the consecutive power of 2, then there is reason to suspect that vortex rings of that group are connected by 8-transformations.

This transformation is not as artificial as it may sound. Indeed, a twisted ring with a möbius 1/2 containing *N* filaments is in fact an 8-ring made out of non-twisted ring with *N/2* filaments.

Because an 8-transformation changes the overall twist, it must effect the overall rotation. In the case of the same directions of all 8-turns, in the formula for mass I can approximately account for the increased twist by adding q_{8n}. For 8-transformations of an electron the following are masses of 8n-rings:

$$m_n = K (d_q+q_{8n})^2$$

Particles μ, π, K, τ As Result Of 8-transformation

There is a family of particles whose common characteristic is that they can go through decay and end up with an electron. Particles π, K, and τ have masses {273, 967, 3477}. If these particles are made of a transformed electron's ring, then to produce such masses an electron ring should have the following additional twists:

{.37,.72, 1.39}.

These numbers are quite close to those proportional to the consecutive power of 2 and for that reason I can suspect that π, K, and τ are the result of the consecutive 8-transformations of an electron. What is more, the additional twist of π–meson --.37 -- if applied in a different direction produces mass quite close to μ–meson:

$$K\,(d_q - .37)^2 = 210$$

This gives me a reason to look for a similar family of particles around protons. However the minimal increase of twist due to the 8-transformation of electrons is .37. If I apply the same to protons, it is too large to produce a family of particles with masses close to protons. The only possible candidate for the 8-transformation of a proton is Ω particle of mass 3272 which correspond with an additional twist .34. However, I only look into numbers for unstable particles with relatively long life. I also did not try to calculate masses of particles which may be produced by 8n-transformation with different directions of 8-turns following one another.

General note: for the sake of clear illustration I described here how 8n-rings can be produced from a simple ring. In Nature more probable is the other way: the reverse 8-transformation as one might conclude from the reactions of the decay of particles such as μ, π, K, and τ. It is thinkable

that there is an initial formation of 8n-rings during a pair production of twisted rings from non-twisted rings.

The special question is: what is the exact behavior of a field vortex during 8-transformation? Obviously, if there are 8-ring (double ring) with a field vortex going through its aperture and splitting in front of that 8-ring into a Coulomb field, then the reverse 8-transformation must deal with a field vortex somehow before a single ring with its field is produced. One can imagine the probable separation of some vorticular object which might be what is called a neutrino of one kind or another. I did not analyze this process.

One must also remember that the 8n-transformation of non-twisted vortex rings is topologically possible. What is more, the direction of an 8-transformation twist can be different during each consecutive 8-transformation. So it is topologically possible to make multiple 8n-ring with a small overall twist.

Thomson's Rotation

Additional rotation of the ring can be the result of the fact that the ring is never an ideal toroid. J.J. Thomson studied the deviation of a vortex ring from the ideal form, and established that perturbated rings are actually similar to toroidal solenoids. He was dealing with non-twisted rings so

the expression "toroidal solenoids" I use now to characterize the spiral form of the vortex cord itself, not a toroidal solenoid formed by the filaments inside of a twisted ring. (Fig. 11) In his words[7]:

> ...we can represent displacement of this kind by conceiving the central line of the vortex cord to be wound round an anchor ring of small transverse section so as to make n turns round the central line of the vortex ring, and this form to travel along the anchor ring …

Thomson found that the velocity of such a rotation is:

$$v_T = (\Gamma\, v(n^2-1))/4\,\pi\, a$$

This formula shows that the perturbation of first order (which represents the elliptical deformation of a ring) does not lead to additional rotation and for that reason will not cause a change in mass. However, there could be other physical consequences of such perturbation which will differ by sign. It is possible that electron and proton are always in one of these states of elliptical perturbation as it is difficult to imagine a ring which is not disturbed at all.

Thomson's perturbations of a vortex might also be characteristic of the state of a field vortex when the

[7]J.J.Thomson's *Motion Of Vortex Rings*, London, 1883.

Coulomb field disappears and we are dealing with an enclosed field vortex which goes through an aperture of one or more of the particle's rings (see below). These perturbations will create different states of the system characterized by numbers *n* of half-waves along the vortex cord. Rotation of the perturbated vortex with an angular velocity Ω_T must be taken into account in calculating the full rotational energy.

Thomson's Rotation And Mass

Thomson's calculation was performed in the framework of classical hydrodynamics and without the limitations of the v_s-rule. What is more, I am dealing with twisted rings which are already toroidal solenoids as far as the internal filaments are concerned. Thomson's perturbations of order *n* means that a toroidal solenoid with *n* coils is made from a toroidal solenoid characterized by möbius *q*. Most likely this will affect the resultative rotation by way other than just adding one to another. However, for general discussion I can present the effect of Thomson's rotation on the mass of a ring through q_{Tn} added in parentheses in the expression for mass:

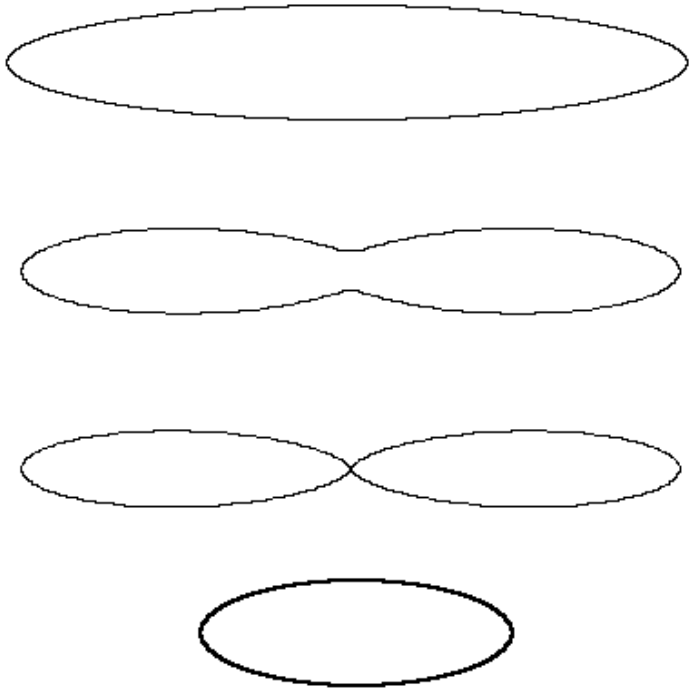
$$m_n = K\,(1 \pm q_{Tn} \pm d_q)^2$$

Due to the possible non-linear interaction of T-rotation with q-rotation I can not expect a simple dependence of q_{Tn}

from n, although q_{Tn} will increase with n. This might account for particles with masses close to a proton's. If a particle can be transformed to a proton like Σ or Ξ one might explore the possibility that those particles are actually protons in the state of Thomson's perturbation of a certain order n. Indeed, with the masses of those particles being {2327, 2585}, the additional twist is {.13, .19} which might reflect that of Thomson's rotation of order 2 and 3.

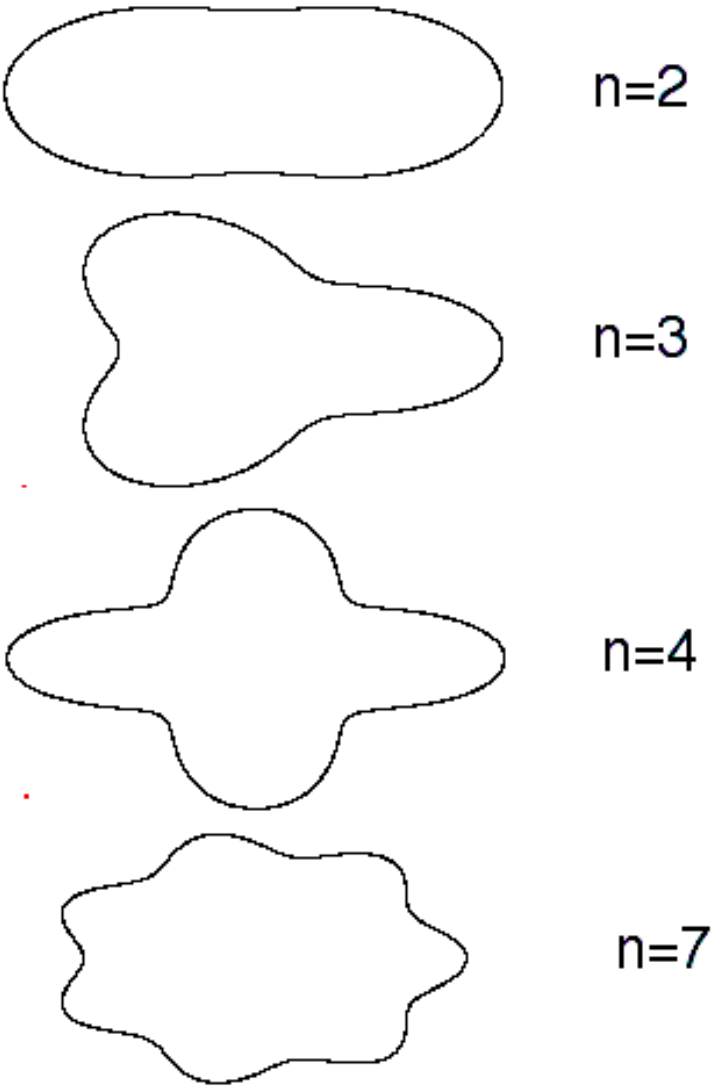
If Thomson's rotation is responsible for what is perceived as different particles, it should be noticed that those particles which are the result of an 8-transformation also can form their own "family of particles" with different masses due to Thomson's rotation.

10. Stages of 8-transformation of a Ring



A ring is stretched into an ellipse, then deformed into something like Kassini's oval and after that the left side of it turned + or -180°. As result it forms a figure similar to the number eight. Then that figure 8 is folded to form a double ring which I call an 8-ring.
This transformation is not as artificial as it may look. Indeed, a twisted ring with möbius 1/2 containing *N* filaments is in fact an 8-ring made out of *N/2* filaments.

11. Thomson's rotation



Central line of perturbated vortex ring.

ENERGY OF PHOTON

Earlier I discussed the stability of a vortex cord in the enviroment of vorton's gas and introduced the v_s-rule. The stability of a vortex ring is a separate question. In empty aether a vortex ring can exist and be stable in the absence of disturbances. It will move with a velocity defined by the intensity of the vortex and its radius. In usual fluid vortexes tend to shrink, but the velocity field of the vortex ring produces a stretching tension which keeps that ring to be of a constant radius. However, in aether under the pressure of vortons' gas, a ring with $q=0$ will be squeezed until its volume will reach the minimum which means its radius a will be equal to radius b of its vortex cord and its velocity will be $c=\Gamma/4\pi b$ for any photon.

Twisted rings resist this squeezing and can have a different then b, although it could be that only for a certain möbius of the ring stability is possible.

V_s-rule provides for the constant velocity of a photon, independent of the velocity of the source of radiation -- a vortex ring moves thanks to the inertia of vorticular movement and not due to Newtonian translational inertia. Those notes take care of a photon's kinematics.

As to energy, a photon is known to defy all traditional expectations, be it Newtonian or Maxwellian. The dependance of its energy of ω and not ω^2 was one of those puzzling facts which called for the disbelief in applicability of classical electrodynamics to subatomic entities.

To deal with this, I have to remind the reader that I never established the actual nature of the inertial properties of aether. I did look into the energy of particles from the traditional mechanical point of view, subscribing to a vortex such characteristics as moment of inertia and energy. I just assumed that moment of inertia is dependent on the activity of movement but did not establish the nature of that dependence. That worked fine for particles and I showed that Newtonian mass and energy can characterize a twisted ring. However, I was dealing with the constant angular velocity of a ring's vortex ω_0. The only variables there were q, which provides additional rotational movement, and the radius of a ring, which defines the velocity of both -- rotational and translational movement. So, if inertial characteristics of aether do depend on the angular velocity, then it wouldn't show itself in a case of a certain angular velocity ω_0. Constant K, which I used to introduce a new dimension -- mass, might be a function of ω but if ω does not change, there is no way to notice it.

For photons the angular velocity is not constant, $\Gamma ? \Gamma_0$, and the non-linear nature of the inertial characteristic of aether is expressed in a proportionality of energy to ω. Indeed, the rotational energy of a vortex ring of radius b is essentially the same as the energy of a straight vortex cord of length $2\pi b$. It is equal to the moment of momentum M_{ph} of that cord multiplied by ω.

In linear mechanics it would be that $M_{ph}=I_{ph}\omega$ with moment of inertia I_{ph} being dependent on the mass of the vortex cord and its radius. In aether, inertia is connected with vorticular movement, so the mass of a non-rotating cylinder made from aether is simply not defined.

The primary inertial characteristic of such a cylinder is not mass but moment of inertia I_{ph} and one can observe it if:

that cylinder is rotating and

the surface velocity follows the v_s-rule, and also if

that cylinder is bent into a vortex ring.

When it is observed, however, the rotational energy of this ring is proportional to ω which means that:

$$I_{ph} \sim 1/\omega$$

Only in that case $M_{ph}=I_{ph}\omega$ can be constant which makes the energy proportional to ω and not to ω^2, as in linear classical mechanics.

Interpretation of this non-linear character of aether's inertia can be presented in words: *the rotatability of aether is growing with the intensity of the rotation.*

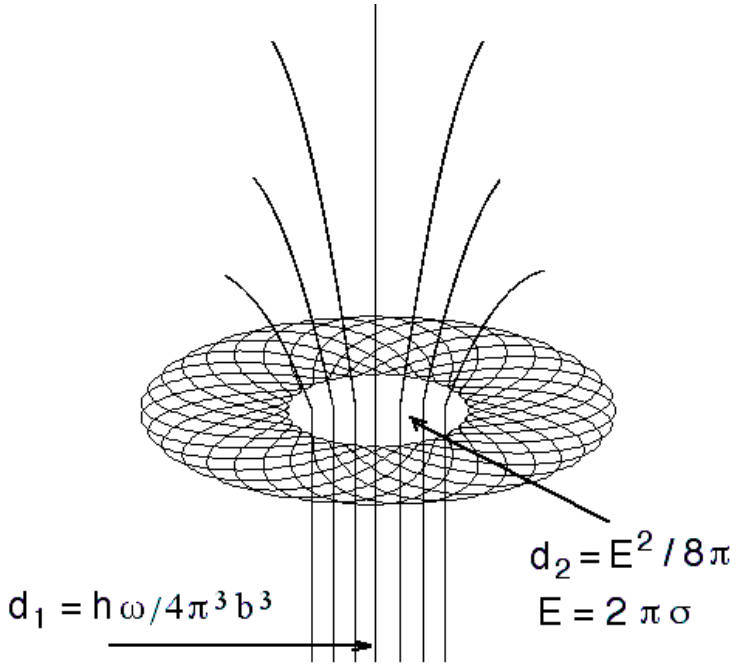
This may be seen as contradictory to the fact that the dielectrical and magnetic property of vacuum does not depend on the intensity of field. However, vacuum of classical electrodynamics is not simply aether, it is aether filled with vorton's gas and in any place where we make measurements the average intensity of the vorticular movement of all vortons is practically constant, so our experiments with electric and magnetic fields do not point out changes of aether's inertia when the fields are changing: aether already has a certain level of rotatability due to the vortexes of vorton's gas.

Inside a photon there is no vorton's gas to provide a certain level of rotatability, aether there is only as rotatable as its own votricular movement can provide for. So, it is low in the case of small ω and consequently, the moment of inertia is high.

As to vacuum, with its practically constant level of rotatability, the shadow gravitation hypothesis may provide the possibility of measuring changes in the inertial characteristics of a vacuum when the average intensity of vorticular movement is changing. Indeed, on the Earth's

surface (point A) the quantity of vortons per unit of volume is somewhat lower than in interplanetary space (point B) due to the fact that Earth scatters part of the vortons with a large free path. For that reason ε and μ in points A and B must be somewhat different. However, I have no knowledge of contemporary precision of measurements and can not expect that this effect can be experimentally noticed.

12. Density of energy in an area between a vortex tail and a Coulomb field.



There are three areas of interest: inside of vortex tail; then a place where filaments are already separate, but still go practically parallel to each other; and an area where filaments go in different directions just like in classical pictures of the lines of force of a Coulomb field.

ELECTRIC CHARGE

Now I will look closely at the place inside the aperture of a particle's ring where a vortex tail, which is a true vortex, gets spread into a bunch of separate filaments providing for the existence of a Coulomb's field in front of a particle. There are three areas of interest (Fig. 12): inside of a vortex tail; then a place where filaments are already separate, but still go practically parallel to each other; and an area where filaments go in different directions just like in classical pictures of the lines of the forces of Coulomb's field. That field is produced by one elementary charge *e* and my goal here is to connect that charge with the vorticular characteristics of a vortex tail. I am taking into account only electric energy in those areas, which means rotational energy.

1. A vortex tail is assumed to be of intensity Γ_0 and radius b_0 so angular velocity is ω_0. The density of the rotational energy inside of the vortex tail is the same as inside a photon's vortex if that photon would have angular velocity ω_0:

$$d_1 \sim h\,\omega_0/\,(4\pi^3\, b_0^3)$$

2. In the second area, energy density is the same as in uniform electric field of flat capasitor:

$$d_2 \sim E^2/8\pi$$

The vector of electric field E is equal $2\pi\sigma$ where σ is the surface density of the charge. With charge e and a surface of area equal to πb_0^2, $\sigma = e/2\pi b_0^2$, so $E = e/b_0^2$ and

$$d_2 \sim e^2 / b_0^4$$

I can not assume $d_1 = d_2$. Indeed, inside of the vortex tail filaments themselves rotate and also rotate around each other. As a true vortex splits, filaments do not rotate around each other. I have no idea how it is happening in detail.

So, I have to write $d_1 k_e = d_2$ where $k_e < 1$ shows what part of the rotational energy of a true vortex belongs to the filaments' rotation itself. This coefficient depends on the quantity of filaments inside of a vortex similar to my examples of the rotation of separate solid rods and the rotation of those rods as a bunch. So I have:

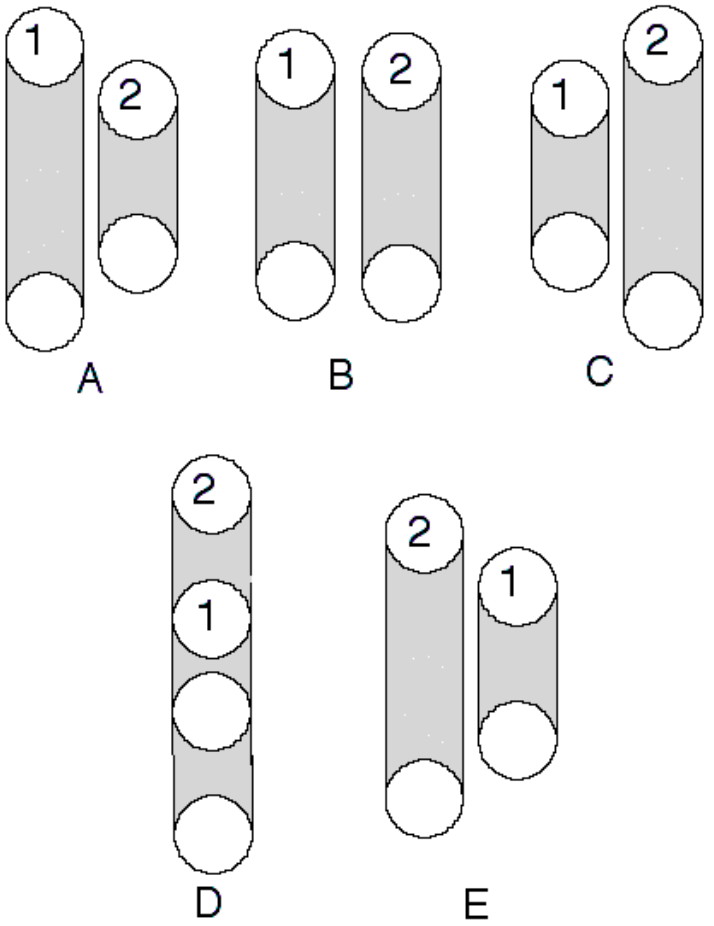
$$e^2 / b_0^4 \sim k_e h \omega_0 / (4\pi^3 b_0^3)$$

which means that:

$$e^2 \sim hc.$$

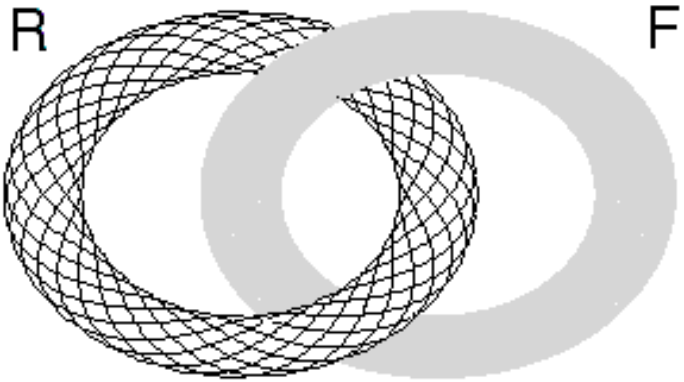
Dependence of an electric charge on h is natural as any energetic characteristic of an aetherial entity must be connected with a way through which inertia of aether depends on the intensity of rotation. Dependence on c is due to the fact that a Coulomb field is produced by splitting a field vortex and size of that vortex is defined by the v_s-rule.

13. Helmholtz connection



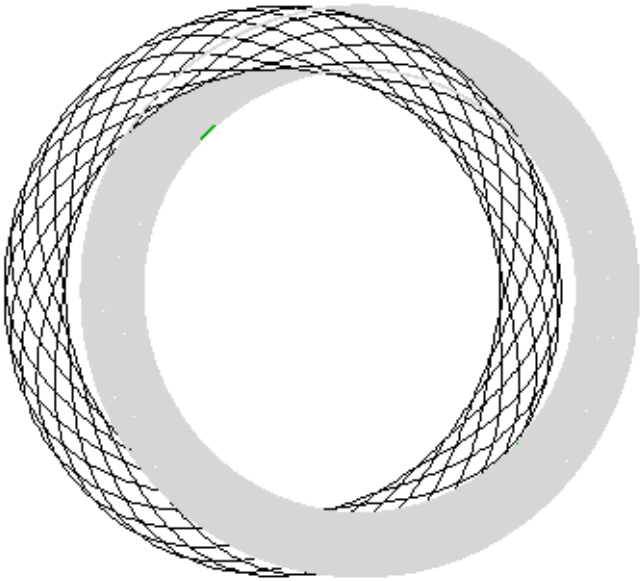
Consecutive positions of rings 1 and 2
in an H-connection.

14. K-connection of ring and field vortex



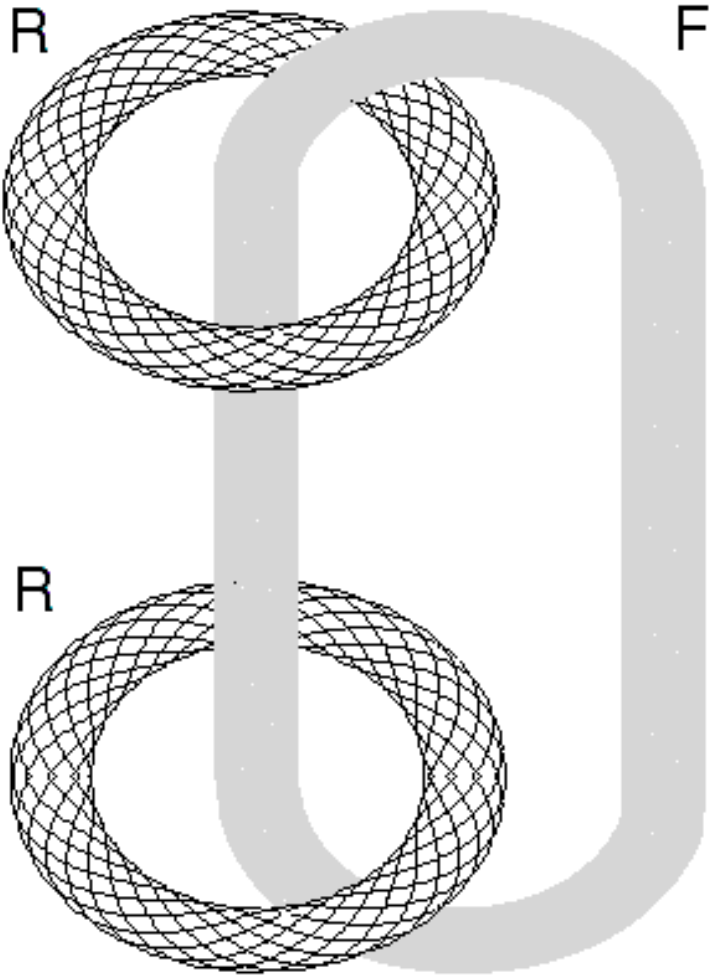
Aside from producing the magnetic field of a moving particle, a vortex tail does not manifest itself as far as a free particle is concerned. But it can participate in producing an interesting phenomena. One can imagine that under certain conditions filaments in front of a charged particle may not get split at all so the charged particle would not have a Coulomb field. An unsplit field vortex in front of a particle I call a vortex herald.

15. Possible H-K-connection



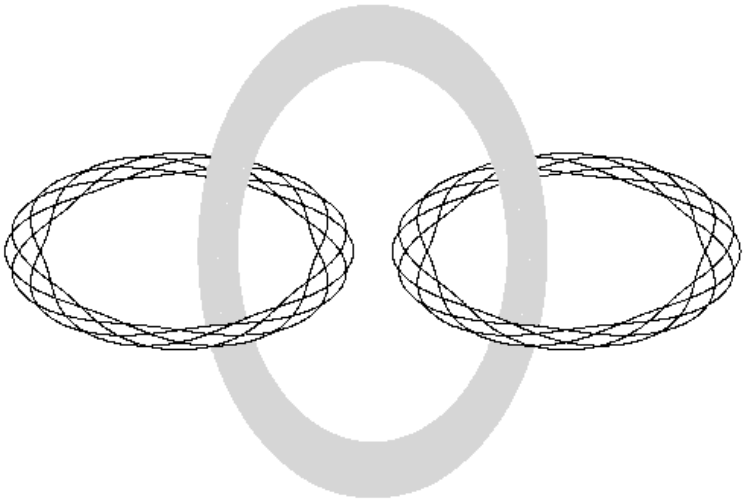
Two rings could be in a K-connection but if their vortex cords are very close to each other then they would behave like rings in an H-connection.

16. Two particles of the same charge connected by a field vortex



Vortex tails of two particles of the same charge are connected with vortex heralds.

17. Two particles of different charges are connected by a field vortex



Vortex tails as well as vortex heralds of two particles of the opposite charges are connected. Particles fly next to each other.

CONNECTING ELEMENTARY VORTEXES

Helmholtz Connection

It is known that vortex rings which remain separate, in a topological sense, can be connected through velocity field in their movement along the same axis (Fig. 13). Such movement of a pair of vortexes was described by Helmholtz as follows:

> ...the foremost widens and travels more slowly, the pursuer shrinks and travels faster, till finally, if their velocities are not too different, it overtakes the first and penetrates it. Then the same game goes on in the opposed order, so that the rings pass through alternately.[8]

One may suspect that there must be some energy spent in order to destroy the union formed by this H-connection. In usual fluid the "binding energy" in this case will be defined by the difference between the sum of the energy of the

[8] Quoted from A. E. H. Love, *On the Motion Of Paired Vortices With A Common Axis*, Proc. of the London Math. Soc., vol.XXV, p. 185 (1894). See also W. M. Hicks, *On the Mutual Threading of Vortex Rings*, Proc. of the Royal Soc. of London, Series A, Vol. CII, p.111 (1923).

circulaton fields of the rings when separate, and the energy of the circulation field of the two rings together.

In aether I calculated only rotational energy as the main energy of a particle. There is the possibility that in an H-connection two twisted rings affect each other's rotation, slowing it in case they rotate in the same direction. In this case masses of rings will be somewhat smaller than when they are separate and the level of this effect must depend on the distance between the rings. There must also be effect of shadow pressure of vorton's gas which is responsible for the "attraction" of rings in an H-connection.

The Extreme H-connection: Two Photons Together

What will happen if one would manage to stretch a photon a little to achieve $a>b$ and then to place it into an H-connection with another photon of equal angular velocity? I expect, that under the pressure of vorton's gas, two photons will end up occupying the same space. Indeed, filaments inside each photon are not entangled as in the case of a particle -- so when two photons are squeezed by outside pressure, there is no way for those filaments to remember to which photon each one belongs. Such a union would simply double the concentration of filaments within the vortex cord

without changing the angular velocity or radius (due to the v_s-rule).

This mental experiment brings an interesting result: observed energy of two photons occupying the same space is equal to the energy of one photon. In traditional terms, the binding energy for two photons of the same ω is equal to the energy of one photon. The concept of binding energy is not out of place here but the value of it is unusually large due to the v_s-rule. That rule assures, that as long as the angular velocity is the same, the concentration of filaments inside a vortex does not affect the observable energy or circulation around the vortex cord.

There is an interesting concequence of this unusual property of the vortex surrounded by vortons' gas: if two photons of energy *W* in the same place are indistinguishable from one photon, then maybe one can split any photon in two. One would have to have to apply energy *W* to produce such a split.

What is said about the binding energy of photons in an extreme H-connection, was based on the traditional belief in the conservation of observed energy. One might speculate, however, that this type of photons' connection (if it is possible) can actually be the way for energy to hide inside of a vorticular entity with a smaller observed energy. The

question arises: does the rule of conservation always work for observed energy or should one be ready to deal with energy hiding inside a vortex?

This also leads to a question: what is the "normal" concentration of filaments inside a photon and what is the minimal concentration?

Where Does Energy Come From?

What was said here about the photon's energy might very well be only about photons with $\omega<\omega_0$. If energy conservation is expected even in high energy reactions, one might be bewildered about the possibility of photons being powerful enough to produce a pair of massive particles. Simple photons with angular velocity, not exeeding ω_0, can not do that. However, there is the possibility of multiple photons in an extreme H-connection, which can store a lot of rotating filaments. Also there is the possibility for multiple 8n-rings made from non-twisted vortexes. Earlier I mentioned that it is topologically possible to make multiple 8n-rings with small overall twist if different directions of 8-turns are applied. Such rings could behave essentially like photons and could collect enough rotating filaments to produce pairs of particles. My reference to the concentration of rotating filaments as a way to store energy might actually

mean that energy may hide inside of a photon-like entity without manifesting itself until some transformation into particles occurs.

However, there is also the question of possible limits for the conservation of what we perceive as energy. However, so far I feel comfortable with viewing vorticular filaments as storage of energy without deviation from overall conservation regardless of the degree of energy manifestation.

Union Of Field Vortexes

Interestingly enough, the v_s-rule also provides for the possibility of straight vortexes to get together and become indistinguishable from a singular vortex as far as kinematic properties go. That means $\Sigma\Gamma_0=\Gamma_0$ despite the fact that the concentration of vorticular filaments will double, triple, and so on. If such multiple vortexes become field vortexes of some particle or system of particles, then a high concentration of filaments will reveal itself through a Coulomb field -- it will be clear that the source of that field is not a single elementary charge, but multiple charges.

Disappearance Of A Coulomb Field

Aside from producing the magnetic field of a moving particle, a vortex tail does not manifest itself as far as free

particles are concerned. But it can participate in producing an interesting phenomena. One can imagine that under certain conditions the filaments in front of a charged particle may not get split at all so that the charged particle would not have a Coulomb field. An unsplit field vortex in front of a particle I call a *vortex herald*. One also can imagine constructions in which particles are entangled with each other by their field vortexes. For stable construction, particles connected with a field vortex must move in the same direction and with the same average speed.

Connections Through Field Vortex

For one or two particles here are the simplest topological possibilities for the connection of a vortex tail and a vortex herald :

1. Vortex tail and vortex herald of the same particle are connected (Fig. 14). This is still a charged particle, but there is no Coulomb field so it would be observed as a neutral particle. The connection of two or more rings when they are going through each others apertures, I call the K-connection, after William Thomson who expected the rings of his vortex atoms to be connected into molecules in this manner. (Field vortexes were not under discussion at that time.)

One can imagine H-K-connection when two rings are in a K-connection but if their vortex cords are very close to each other then they would behave like rings in an H-connection (Fig. 15).

2. Vortex tails of two particles of the same charge are connected with vortex heralds. As shown on Fig. 16 rings of particles are following each other. Such two particle construction also will behave as neutral.

3. Vortex tails as well as vortex heralds of two particles of opposed charges are connected. Fig. 17 shows that particles fly next to each other.

Two charged particles connected by one of these ways do not attract or repel each other through a Coulomb field as there is none, but instead they interact through t tension of the true vortex which connects them and there must be some barrier to the disturbances intensity which can ruin this union.

Unstable Construction

There is also the possibility of an obviously unstable construction, when, let's say, two electrons with different velocity vectors, are connected by a field vortex. As they move, the distance increases and the field vortex gets stretched with intensity Γ_0 remaining the same. In the

absence of interference from other particles, those electrons could be connected in this manner for some time as there is no known limit to the degree of stretching of the field vortex. If such construction is possible, the interesting property of It would be that, regardless of distance, any disturbance of the vortex field on one end will be sent as information through the field vortex to the other end without spreading the intensity of that signal in all the surrounding space. Indeed, if particles communicate through a Coulomb field, the signal's intensity is diminishing with distance, yet through the field vortex the signal will reach the other particle presumably unharmed regardless of the distance. The speed of this communication is unknown to me, but can not be assumed to be equal to *c*.

As to the character of such communication, the simplest is to picture that one electron, due to some circumstance, got released from the bondage of an unsplit field vortex and becomes a free particle carrying a Coulomb field in front. The second electron will receive such a signal and eventually become a free particle.

END