# The Double Helix Theory of the Magnetic Field

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Abstract. The historical linkage between optics and electromagnetism can be traced back to the year 1855, when Wilhelm Eduard Weber and Rudolf Kohlrausch, by discharging a Leyden Jar (a capacitor), demonstrated that the ratio of the electrostatic and electrodynamic units of charge is equal to $c\sqrt{2}$, where c is the directly measured speed of light. Although not initially aware of the connection to the speed of light, Weber interpreted $c\sqrt{2}$ as a kind of mutual escape velocity for two elements of electricity in relative motion, such as would enable the induced magnetic force to overcome the mutual electrostatic force. A few years later, James Clerk Maxwell converted this ratio from electrodynamic units to electromagnetic units, hence exposing the speed of light directly. On connecting Weber's ratio to the dielectric constant in an all-pervading elastic solid, Maxwell concluded that light consists in the transverse undulations of the same medium that is the cause of electric and magnetic phenomena. The differing perspectives of Weber and Maxwell can be reconciled by linking the speed of light to the circumferential speed of the electric particles surrounding the tiny molecular vortices that Maxwell believed to be the constituent units of the luminiferous medium. If we consider these molecular vortices to be tiny electric current circulations, mutually aligned along their rotation axes to form magnetic lines of force, magnetic repulsion can then be explained in terms of centrifugal pressure acting sideways from these field lines. And if these molecular vortices should take the more precise dipolar form of an electron and a positron in mutual orbit, we can then further explain magnetic attraction, this time in terms of the more fundamental electrostatic force being channeled along the double helix of electrons and positrons that forms a magnetic line of force.
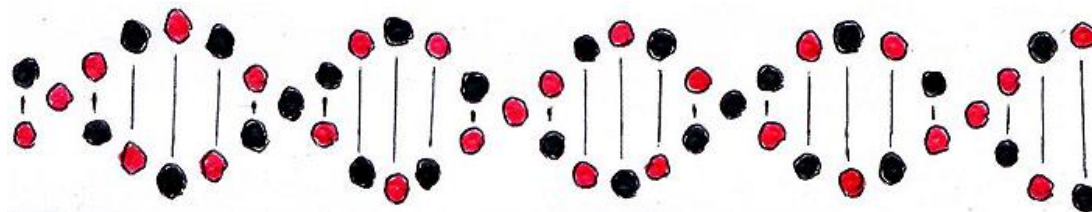
Introduction

I. A wave requires a medium of propagation, and since light exhibits wave behavior, it is reasonable to assume that a physically real luminiferous medium pervades all of space, and we have further reason to believe that this medium is a dielectric. The dielectric nature of space is inferred from the electric capacitor circuit in the dynamic state. It is unlikely that the surrounding magnetic field will discontinue in the capacitor region while the current is flowing. When a dielectric slab is present in the space between the capacitor plates, we acknowledge the existence of a polarization current, and there is no reason to

assume that the situation would be any different when the dielectric slab is not present. Perhaps more contentiously, the idea that space is dielectric might also be inferred from Kepler's second law of planetary motion. This law, which is essentially the law of conservation of angular momentum, can be used to show that centrifugal force is an outward radial pressure that obeys the inverse cube law in distance. Whereby the inverse square law of gravity indicates a monopole field, the inverse cube law suggests that space contains an electric dipole field as well.

The Aether (The Electric Fluid)

II. E.T. Whittaker wrote,

" - - - *All space, according to the young [John] Bernoulli, is permeated by a fluid Aether, containing an immense number of excessively small whirlpools. The elasticity which the Aether appears to possess, and in virtue of which it is able to transmit vibrations, is really due to the presence of these whirlpools; for, owing to centrifugal force, each whirlpool is continually striving to dilate, and so presses against the neighbouring whirlpools - - -*", [1].

John Bernoulli was working on the refraction of light. In 1861, James Clerk Maxwell attempted to explain the magnetic field in terms of a sea of such excessively small whirlpools. In his paper ***"On Physical Lines of Force"***, [2], he used such a concept to explain magnetism on the basis that these vortices are aligned solenoidally with their rotation axes tracing out magnetic lines of force. He explained magnetic attraction between unlike poles in terms of a tension existing along the lines of force that connect directly between the two poles. In the case of magnetic repulsion, magnetic field lines spread laterally outwards in the space between two like poles. Maxwell explained the repulsion as being due to centrifugal pressure existing in the equatorial plane of the vortices, hence causing a lateral pressure between immediately neighbouring lines of force. Maxwell's model can be better understood if we replace his molecular vortices with rotating electron-positron dipoles, each of which consists of an electron in a mutual circular orbit with a positron, [3], [4]. Such a vortex will then double for an electric dipole and a magnetic dipole.

Aether, alternatively known as electric fluid or free electricity, is the stuff of all matter. Electrons will be considered to be sinks in the aether. Aether is pulled into these electron sinks, hence causing a tension which will cause a *'pull force'* to act on other particles. A positron is an aether source from which a pressurized fountain of aether emerges. The aether is dynamical, compressible, stretchable, and it gives fluids their characteristics. There will be a vector **A** equal to $\rho\mathbf{v}$, where ρ is the density of the aether, and **v** is the velocity of an element of the aether, and the question of what this velocity is measured relative

to will be discussed further down. Modern textbooks refer to **A** as the *'magnetic vector potential'*, but it more accurately constitutes a momentum density. The vector **A** can represent both gravity and electric current. Conduction current is however, commonly denoted by the symbol **J**, whereas **A** tends to be reserved for the circulating current in a tiny molecular vortex. Maxwell identified the quantity **A** with Faraday's *electrotonic state*. If we keep the aether density constant in time, we can expand the force expression $\mathbf{F} = d\mathbf{A}/dt$ to obtain,

$$\mathbf{F} = \partial\mathbf{A}/\partial t - \mathbf{v}\times\mathbf{B} + \nabla(\mathbf{A}\cdot\mathbf{v}) \tag{1}$$

where $\mathbf{B} = \nabla\times\mathbf{A}$. See **Appendix A**. Equation **(1)** is recognizable as the *'Lorentz force'*, but the terms in the Lorentz force appeared in Eqs. (5) and (77) of Maxwell's 1861 paper, which was written when Lorentz was only eight years old. It would be more accurately called the *'Maxwell Force'*. Taking the curl of Equation **(1)** we obtain,

$$\nabla\times\mathbf{F} = \partial\mathbf{B}/\partial t + (\mathbf{v}\cdot\nabla)\mathbf{B} = d\mathbf{B}/dt \tag{2}$$

which is a total time derivative expansion of Eq. (54) in Maxwell's 1861 paper. See **Appendix B**. Oliver Heaviside always referred to Maxwell's Eq. (54) as Faraday's law, even though it is not strictly speaking Faraday's law as such. Maxwell's Eq. (54) is similar to Faraday's law, but it doesn't account for convectively induced electromotive force.

The first term on the right-hand side of equation **(1)** represents the force due to tension or pressure in the aether. Around a sink or a source, this tension or pressure can be split into a radial (irrotational) component and a transverse (angular) component. The irrotational radial component can be represented in the form $\nabla\Psi$, where Ψ is a scalar potential function. The second and third terms on the right-hand side of equation **(1)** are convective terms representing the fundamental hydrodynamical basis that underlies the inertial forces, but it's not until we have established the physical context that is the cause of the uniform straight-line inertial path, that we can better understand the individual manifestations of the inertial forces, such as the Coriolis force, the centrifugal force, and the magnetic force, $\mathbf{F} = q\mathbf{v}\times\mathbf{B}$.

Maxwell's sea of molecular vortices provides this necessary context as well as providing the reference frame relative to which velocity, **v**, is measured. In a sea of molecular vortices, these convective forces can manifest themselves in several fashions. The transverse Coriolis force arises in cyclones and in non-circular planetary orbits in conjunction with the conservation of angular momentum. We also witness a Coriolis force in a rotating rigid body when it is forced to precess. This induced Coriolis force can prevent a pivoted gyroscope from toppling under gravity. Meanwhile centrifugal pressure in the electron-positron sea at the interface between two gravitational fields keeps the planets

from falling into the Sun. In the case of a rattleback (Celtic stone) being rotated on an asymmetrical axis, centrifugal force acting on the individual elements causes the rotation axis to realign. This can completely reverse the direction of rotation, [5]. The convective forces are also responsible for the magnetic force that is induced on a current carrying wire in a magnetic field, and also for the induced electromotive force inside a wire that is moving at right angles through a magnetic field.

The Double Helix Alignment

III. It is proposed that the default alignment in a sea of rotating electron-positron dipoles is the most fundamental manifestation of both the Coriolis force and Ampère's Circuital Law. In the steady state, the electron-positron dipoles will all be rotating in the same direction as their immediate neighbours and they will be aligned in a double helix fashion, with their rotation axes tracing out magnetic lines of force. An electrostatic tension will exist along these lines of force because the electrons and the positrons will be alternately stacked. See Fig. 1 below,
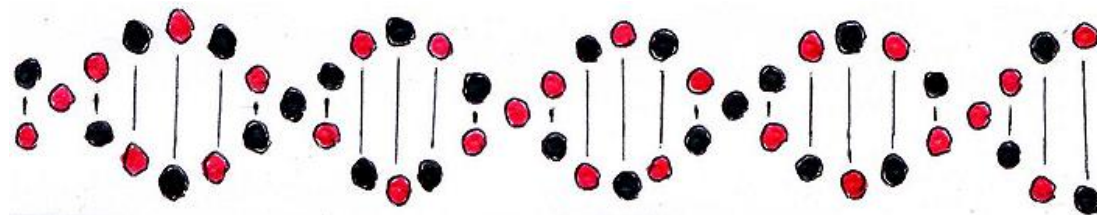

Fig. 1. A single magnetic tube of force. The electrons are shown in red, and the positrons are shown in black. The double helix is rotating about its axis with a circumferential speed equal to the speed of light, and the rotation axis represents the magnetic field vector **H**.

The electrostatic tension in the lines of force is the cause of magnetic attraction between unlike magnetic poles. The double helix lines of force will behave like helical springs and pull the two unlike poles together. There is an element of flexibility as regards the magnitude of the tension in the lines of force, in that the helix angle can vary. In the equilibrium state, the tension along the lines of force will be counterbalanced by a centrifugal aether pressure in the equatorial plane between adjacent dipoles. This centrifugal pressure acts laterally from the lines of force, and it is the cause of magnetic repulsion between like magnetic poles.

The electron-positron sea will be referred to as *'The Electric Sea'*, in order to distinguish it from the pure aether itself.

The Speed of Light

IV. Referring to Part III in Maxwell's 1861 paper, which is the elasticity and electrostatics part, we will initially stick with Maxwell's system of units and symbols for ease of reference. Hooke's law appears at Eq. (105) in the form,

$$R = -4\pi E^2 h \qquad \textbf{(Electric Displacement Equation)} \qquad (3)$$

where R is electromotive force, E is the dielectric constant, and h is displacement. This equation will now be extrapolated to the context of a rotating electron-positron dipole of radius h, that is bonded into the greater sea of such dipoles. These dipoles will be pressing against each other with centrifugal force in their equatorial planes, while striving to dilate. This centrifugal pressure between neighbouring dipoles will be the source of the equatorial elasticity, and since the dipoles are all spinning in the same direction, the effective speed for the purposes of centrifugal potential energy will be the mutual transverse speed, which will be twice the circumferential speed. Centrifugal potential energy is the same thing as transverse kinetic energy, and summed over the two particles of the dipole this will be equal to $m(2v)^2$, or $4mv^2$, where $2m$ is the combined mass of the two particles, and where v is their circumferential speed. Mass is considered to be a measure of the amount of aether. This centrifugal potential energy will be equal to the maximum linear kinetic energy as resolved along a diameter in relation to the projected simple harmonic motion. This in turn will be equal to the maximum potential energy that we obtain from Hooke's law. Since we are dealing with shared elasticity over the two particles within the dipole, this maximum potential energy will be $2\pi E^2 h^2$. Therefore,

$$4mv^2 = 2\pi E^2 h^2 \qquad (4)$$

and hence,

$$2mv^2 = \pi E^2 h^2 \qquad (5)$$

The centrifugal potential energy, $4mv^2$, is the consequence of an outward centrifugal force and an equal and opposite inward centrifugal force generated by the neighbouring dipoles. As such, if we double the outward centrifugal force, we will split the dipole. The input energy needed to split an electron-positron dipole is therefore $2mv^2$. We also know from the 1932 Carl D. Anderson experiment that this energy is the 1.02 MeV associated with a gamma ray photon, and that this corresponds exactly to $2mc^2$, where c is the speed of light, [6]. Hence it follows that the circumferential speed of the electrons and positrons in the dipoles of the electric sea is equal to the speed of light, [4], [6], and that,

$$c^2 = \mathrm{E}^2/\mu \tag{6}$$

where μ is the areal density, $2m/\pi h^2$, of an electron-positron dipole. Equation **(6)** is equivalent to the Eq. (135) in Maxwell's 1861 paper, which he derived from Newton's equation for the speed of sound as it appears at Eq. (132), and which is more familiar nowadays in the form,

$$c^2 = 1/\mu\varepsilon \tag{7}$$

where ε is the electric permittivity and where μ is the magnetic permeability. By multiplying the top and bottom lines of equation **(7)** by area, we end up with,

$$E = mc^2 \tag{8}$$

where E is the centrifugal potential energy, not to be confused with the dielectric constant, E, above, or with the electric field, **E**, further below.

Maxwell never knew the size of his molecular vortices, but it would be reasonable to assume that they are small enough to flow through the interstitial spaces between the atoms and molecules of ponderable matter, as like water flows through a basket. We could assume that the circumference of these dipolar vortices is equal to half of the Compton wavelength for an electron, since gamma radiation of this wavelength, or lower, can resonate with the dipoles and split them apart, as has just been explained above. This would make their diameter 0.3863 picometres, hence setting them at about one thousandth the size of the average atom. The density of the vortex sea will however be difficult to calculate because the balance between the electrostatic force in the axial direction and the centrifugal force in the equatorial plane would point to inter-particle spacings between neighbouring vortices on the femtometre scale. Since this is very much less than their actual diameters, the magnetic lines of force will in effect become *tubes of force*. Then on the issue of the density, as an absolute minimum, if we were to simply consider only the diameter of the vortices, the density of the vortex sea will already be into the region of fourteen hundred times denser than lead, but it will surely be many orders of magnitude yet higher than that still.

Electromagnetic Radiation and Displacement Current

V. Maxwell first introduced displacement current in the preamble to Part III of his 1861/2 paper ***"On Physical Lines of Force"***, [2]. Converting to SI units and using modern vector notation, the electric displacement vector, **D**, was introduced through the electric elasticity equation, $\mathbf{D} = \varepsilon\mathbf{E}$, where ε is the

electric permittivity, inversely related to the dielectric constant, while **E** is the electromotive force. It was introduced in connection with the displacement of electric particles in the luminiferous medium, with the associated displacement current, $\partial\mathbf{D}/\partial t$, therefore being equal to $\varepsilon\partial\mathbf{E}/\partial t$.

Returning for a moment to Part I of the same paper, Maxwell identified the circumferential velocity of his tiny molecular vortices, with the magnetic intensity which we would normally write as **H**. Maxwell's concept of magnetic intensity is therefore such that it is a measure of vorticity. See **Appendix C**. In Part III, Maxwell continues this theme by initially considering the displacement mechanism to be a rotatory effect. But as the analysis progresses, it all starts to get more like simple linear polarization, and in the years that followed Maxwell, displacement current became closely associated with capacitors. This was unfortunate since wireless electromagnetic waves are not an electrostatic effect. EM radiation is tied up with time-varying electromagnetic induction. While Ampère's Circuital Law, in connection with Maxwell's displacement current, takes the form,

$$\nabla\times\mathbf{B} = \mu\varepsilon\partial\mathbf{E}/\partial t \tag{9}$$

it is essential for the purpose of deriving the electromagnetic wave equations, that the electromotive force, **E**, satisfies the Maxwell-Faraday law of electromagnetic induction,

$$\nabla\times\mathbf{E} = -\partial\mathbf{B}/\partial t \tag{10}$$

as opposed to Coulomb's law of electrostatics, so that $\mathbf{E} = -\partial\mathbf{A}/\partial t$, where $\nabla\times\mathbf{A} = \mathbf{B}$. The perfect physical context for these equations lies in the domain of a rotating electron-positron dipole, because such a dipole constitutes a closed electric current circulation. We need space to be densely filled with these dipoles, in order to serve as relay circuits in the time-varying electromagnetic induction process. The vector field, **A**, represents the circumferential momentum, **B** represents the vorticity, while **E** represents a circumferential force that causes a torque. As per Faraday's Law, the circulation momentum, **A**, will accelerate when it is exposed to a changing magnetic field emanating from a neighbouring dipole, in other words when exposed to the changing vorticity of a neighbouring vortex that is angularly accelerating (or precessing). When this happens, excess aether swirls across from the angularly accelerating vortex to its neighbour.

The displacement, **D**, as Maxwell initially suspected, is an angular displacement, while displacement current itself corresponds to the electromagnetic momentum, **A**, particularly in the dynamic state. Electromagnetic waves are a propagation of fine-grained angular acceleration (or precession) through the electric sea of tiny aethereal vortices, [7], [8], and the undulations are accompanied by a net flow of pressurized electric fluid (aether).

The propagating pressurized aether emerges from the positron of a vortex, overflows into its neighbour and sinks into its neighbour's electron. This causes a torque which causes the cycle to repeat with respect to the next vortex in the line. This net flow of pressurized aether gives rise to radiation pressure.

Radiation Pressure

VI. Light exerts a force on a physical target. Maxwell calculated the force associated with radiation pressure to be,

$$F = dp/dt = (1/c)dE/dt \tag{11}$$

where E is energy, c is the speed of light, and p is momentum. By substituting

$$p = mc \tag{12}$$

into equation **(11)**, where m equals aethereal mass, we obtain the relationship,

$$c^2 dm = dE \tag{13}$$

which implies that electromagnetic radiation is a net flow of aethereal mass which is related to energy by the equation,

$$E = mc^2 \tag{14}$$

But just because equation **(14)** relates numerical values, it certainly doesn't mean that mass and energy are equivalent, as is nowadays wrongly claimed to be the meaning of this famous equation. The speed of light is the *'Mach number'* for the electric sea by analogy to the speed of sound in air, and it is only in connection with electromagnetic radiation in the electric sea that this equation possesses any physical significance. Gilbert Lewis published this approach to the equation $E = mc^2$ in 1908, [9].

The Inertial Forces

VII. Contrary to what it says in modern textbooks, the inertial forces are not caused by making observations from a rotating frame of reference. They are a consequence of Newton's first law of motion, and they are described in an inertial frame of reference in polar coordinates relative to any arbitrarily chosen

polar origin, this origin usually being the centre of rotation of the system under investigation, [5]. The inertial forces, just like the convective electromagnetic force, $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$, are caused by the physical interaction of a moving object through the electric sea. The inertial forces differ from this magnetic force only in the manner of the physical interaction, but the general underlying principles are the same. The electron-positron dipoles that fill all of space press laterally with centrifugal force against all moving objects. In the case of a charged particle moving at right angles to the lines of force in a solenoidal magnetic field, the centrifugal force acting at right angles to the direction of motion will act differentially on either side of the motion owing to the fact that all the dipoles are spinning in the same direction. The result is that the moving particle experiences a force, $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$, which deflects it at right angles to its direction of motion. $\mathbf{B}$ is magnetic flux density, and since $\mathbf{B} = \mu\mathbf{H}$, and since $\mathbf{H} = 2\boldsymbol{\omega}$, where $\boldsymbol{\omega}$ is the angular speed of the tiny dipoles, we can write the magnetic force in the form, $\mathbf{E} = 2\mu\mathbf{v} \times \boldsymbol{\omega}$, where the magnetic permeability μ represents a density, hence exposing the magnetic force to be a close cousin of the Coriolis force. However, when acting directly between two neighbouring vortices, the magnetic force manifests itself as a plain centrifugal force, in the same sense as the water pressing against the inside walls of Newton's rotating bucket.

Gravity, electrostatic attraction, and magnetic attraction, on the other hand, are not inertial forces. These are caused by pure aether flow, and they obey the inverse square law. The 1887 Michelson-Morley experiment strongly suggested that the gravitational field of the Earth entrains an extended region of the electric sea while it is undergoing translational motion in its orbital path around the Sun. The entrained region of electric sea which surrounds a moving planetary object will constitute the gravitosphere, and it will extend to the shear region which exists at the interface with neighbouring gravitospheres. A planetary object and its surrounding gravitosphere move as one, in like manner to an egg yolk and its surrounding egg white. The gravitosphere is caused by a large-scale flow of pure aether through the electric sea and into the planet. This will exert a torque on the tiny dipoles of the electric sea, causing them to precess such that their precession axes are aligned with the gravity flow. Gravitational field lines from adjacent planets meet laterally and spread outwards, and because of the precession of the tiny electron-positron dipoles at the interface, the gravitospheres of neighbouring planets will press against each other with centrifugal force. This centrifugal force is the cause of electrostatic repulsion on the large scale. It will increase both with the rate of the gravity flow and as the mutual transverse speed of the two planets increases, and because it is sourced in the tiny dipoles at the shear region, it will increase with an inverse cube law in distance. A reversal threshold exists where the repulsive force dominates over the attractive force. Lorentz need have had no worry about vortices forming at the interface since they are essential for both the centrifugal force mechanism and as part of the medium for the propagation of light. Neither

need Lorentz have worried about how this interface would impact upon stellar aberration. The aberration simply takes place at the interface.

The fact that gravitational attraction obeys the inverse square law while centrifugal force obeys the inverse cube law means that planetary orbits are stable. It also means that weakly charged sink-based objects will attract and not repel. Gravity is weak negative electric charge, which is below the reversal threshold, and so planets only repel each other when their mutual transverse speeds are high enough. Although large planetary objects entrain the luminiferous medium while undergoing translational motion, we know from the 1925 Michelson-Gale experiment that this does not appear to be so either in the case of rotational motion (also confirmed by the Foucault pendulum experiment), or in the case of small objects with negligible gravitational fields that are undergoing translational motion. It is often argued that if a luminiferous medium existed, it would cause friction in space, and that the planets would fall into the Sun. But rather than causing friction, the electric sea actually causes Kepler's laws to be the way that they are. The electric sea is the source of the inertial forces.

In the case of an electron and a positron which are spiralling inwards in a positronium orbit, the accumulating aether pressure between them does not cause them to recoil at the moment of closest approach, as would occur with a comet at perihelion. Instead, they take their place inside the double helix magnetic field structure, and the accumulated aether pressure itself recoils in two opposite directions in the form of gamma photons. The angular momentum of the positronium orbit is transferred into the fine-grained angular momentum of electromagnetic radiation. No actual electron-positron annihilation takes place as is commonly believed, [4], [6]. The electron and the positron are still physically present, bonded inside the background electric sea. The aether hydrodynamical approach therefore exposes the source of centrifugal force as lying in the fluid-like aether between two electron-positron dipoles, hence explaining why the electric sea can behave like a fluid for the purposes of planetary motion and yet still behave like a solid for the purposes of electromagnetic radiation. In a planetary orbit, the shear region at the interface between two gravitational fields, is cushioned by a centrifugal hovercraft effect, while in electromagnetic radiation the tiny vortices maintain their positions within the double helix solid.

Electric Current

VIII. Just as a gravitational force field involves an aether velocity field, so also does the electric force field that drives an electric current in a circuit. This flow of pure electric fluid is the fundamental essence of electric current, and it enters a circuit under pressure from an external power source. When the electric fluid

flows, it imparts its acceleration to charged particles in its path, but it does not impart its velocity to them. It pushes positively charged particles along in the direction of the flow, while negative particles, being aether sinks, eat their way in the opposite direction towards the current source. The terminal speed of the electric current will be determined by the electromotive force and the impedance of the circuit. Due to resistance, R, in a conducting circuit, the charged particles reach terminal drift velocities that are many orders of magnitude less than the speed of the primary aethereal component of the current. As regards the speed of the aethereal component, if the resistance, R, is zero, and the reactive impedance is low enough, the current can reach the speed of light. This occurs in the case of Maxwell's displacement current in space in conjunction with electromagnetic radiation. This maximum speed is the average speed that aether flows between positrons and neighbouring electrons in the luminiferous medium, and it is widely accepted that in cable telegraphy the aethereal current speeds are also in this same order of magnitude.

More generally, since changes in the electromotive force (aether pressure) in an electric circuit will be transmitted by the flow, these changes will travel at whatever the flow speed is in the particular circuit. In the case of alternating current, when a wire loop is rotating in a magnetic field, it is actually screwing aether out of the positrons of the electric sea. This is the basis of the AC generator. Pressurized aether will be pumped by the generator from the electric sea into the circuit during both halves of the AC cycle. The thing that changes during each half of the cycle is the direction of the circulation of the aethereal current, but net pressurized aether enters the circuit during each of the two half-cycles.

The Tidal Force

IX. The tidal force is often wrongly attributed to the moon's gravitational pull on the Earth. The moon's gravitational field does not however come into contact with the Earth. Objects on the Earth's surface are pulled downwards exclusively by the Earth's gravity acting from underneath. The tidal bulges in the sea therefore require an alternative explanation.

We know that the tidal force obeys the inverse cube law in distance. It has been suggested that this is because we are considering the change in the gravitational force as between the part of the Earth farthest from the moon and the part of the Earth nearest to the moon. This argument does not however hold up, because the moon's gravity does not actually pull any part of the Earth closer to it. The fact that we are dealing with an inverse cube law should be the clue that we are dealing with yet another effect of the electron-positron dipoles in the all-pervading electric sea. This effect will be something different than the inertial forces and the electromagnetic forces, yet closely related. The tidal force

will likely be a pressure that is exerted laterally from the precessing electron-positron dipoles within the gravitational field lines, as opposed to arising from any pull which acts along those lines. The gravitational field line pattern for the entire Earth-moon system exhibits cylindrical symmetry along an axis of symmetry joining the Earth and moon, and as such, the sideways pressure from the precessing vortices within the gravitational lines of force will constrict the system around this axis of symmetry. This will have a tendency to elongate the two planetary bodies along the line that joins them, and this tendency will be particularly effective on fluids, which is why the tidal force causes the seas to rise up relative to the land.

Conclusion

X. Maxwell introduced the speed of light into his electromagnetic theory from the 1855 Weber-Kohlrausch experiment, [10], by connecting it to the elasticity factor in his displacement current. Maxwell's displacement current requires the agency of an elastic solid in order that it can be substituted for the electric current term in Ampère's circuital law, a substitution which is necessary for the derivation of the electromagnetic wave equations. Time-varying electromagnetic induction is also involved in this derivation and so it is proposed that the elastic solid constitutes a dense sea of rotating electron-positron dipoles. The fine-grained rotation supplies the inertial characteristics that are involved in magnetic induction. It is further proposed that an electron constitutes a sink in the fundamental electric fluid, known as *the aether*, while a positron constitutes an aether source. As such, each rotating electron-positron dipole constitutes a dipolar vortex, suggesting a correspondence with the molecular vortices mentioned in Maxwell's 1861 paper ***"On Physical Lines of Force"***, [2]. In a steady state magnetic field, these rotating electron-positron dipoles will align in a double helix fashion such that their rotation axes trace out the magnetic lines of force. A positronium orbit does not self-annihilate as is commonly believed, but rather, the electron and the positron merely bond into the already existing background dielectric solid. This medium, rather than causing friction to inertial motion, is actually the medium which is the root cause of the inertial forces to begin with.

Appendix A

The gradient of the scalar product of two vectors can be expanded by the standard vector identity,

$$\nabla(\mathbf{A}\cdot\mathbf{v}) = \mathbf{A}\times(\nabla\times\mathbf{v}) + \mathbf{v}\times(\nabla\times\mathbf{A}) + (\mathbf{A}\cdot\nabla)\mathbf{v} + (\mathbf{v}\cdot\nabla)\mathbf{A} \qquad (1A)$$

Let us consider only the vector **A** to be a vector field. If **v** represents arbitrary particle motion, the first and the third terms on the right-hand side of equation **(1A)** will vanish, and from the relationship $\nabla\times\mathbf{A} = \mathbf{B}$, we will obtain,

$$\nabla(\mathbf{A}\cdot\mathbf{v}) = \mathbf{v}\times\mathbf{B} + (\mathbf{v}\cdot\nabla)\mathbf{A} \qquad (2A)$$

Hence,

$$(\mathbf{v}\cdot\nabla)\mathbf{A} = -\mathbf{v}\times\mathbf{B} + \nabla(\mathbf{A}\cdot\mathbf{v}) \qquad (3A)$$

Since,

$$d\mathbf{A}/dt = \partial\mathbf{A}/\partial t + (\mathbf{v}\cdot\nabla)\mathbf{A} \qquad (4A)$$

it then follows that,

$$d\mathbf{A}/dt = \partial\mathbf{A}/\partial t - \mathbf{v}\times\mathbf{B} + \nabla(\mathbf{A}\cdot\mathbf{v}) \qquad (5A)$$

Appendix B

The curl of the vector product of two vectors can be expanded by the standard vector identity,

$$\nabla\times(\mathbf{v}\times\mathbf{B}) = \mathbf{v}(\nabla\cdot\mathbf{B}) - \mathbf{B}(\nabla\cdot\mathbf{v}) + (\mathbf{B}\cdot\nabla)\mathbf{v} - (\mathbf{v}\cdot\nabla)\mathbf{B} \qquad (1B)$$

Let us consider only the vector **B** to be a vector field. If **v** represents arbitrary particle motion, the second and the third terms on the right-hand side of equation **(1B)** will vanish. If we consider the vector **B** to be solenoidal, the first term on the right-hand side will also vanish due to the fact that the divergence of **B** will be zero.

Hence,

$$\nabla \times (\mathbf{v} \times \mathbf{B}) = - (\mathbf{v} \cdot \nabla)\mathbf{B} \qquad \text{(2B)}$$

Appendix C

Let us consider the two force terms which appear as parts 3 and 4 on the right-hand side of Eq. (5) in Part I of Maxwell's 1861 paper, [2]. The quantities α, β, and γ which appear in Eq. (5) are terms that depend on the magnitude of the circumferential velocity of the vortices. They are referred to as *'Magnetic Field Intensity'*. In modern notation, we would use the vector $\mathbf{H}$ when referring to this quantity, and by comparison with Maxwell's analysis we would be considering $\mathbf{H}$ to be the vorticity of $\mathbf{v}$. From Eq. (5), we can see that,

$$\mathbf{F}/\text{volume} = \mu \mathbf{v} \times (\nabla \times \mathbf{v}) \qquad \text{(1C)}$$

where,

$$\nabla \times \mathbf{v} = \text{vorticity} \qquad \text{(2C)}$$

In the case of a rotating electron-positron dipole, the vorticity will be equal to $2\boldsymbol{\omega}$, where $\boldsymbol{\omega}$ is the angular velocity. With μ being taken to mean inertial mass density, we can immediately see the connection with,

$$\mathbf{F} = 2m\mathbf{v} \times \boldsymbol{\omega} \qquad \textbf{(Coriolis Force)} \qquad \text{(3C)}$$

If we define the magnetic flux density vector $\mathbf{B}$ as,

$$\mathbf{B} = \mu \mathbf{v} \qquad \text{(4C)}$$

it would then appear as if $\mathbf{B}$ represents a magnetic analogy to the electric current equation,

$$\mathbf{J} = \rho \mathbf{v} \qquad \text{(5C)}$$

Let us now substitute equation (**4C**) into equation (**1C**). This leads to,

$$\mathbf{F}/\text{volume} = \mathbf{B} \times (\nabla \times \mathbf{B}/\mu) \qquad \text{(6C)}$$

Comparing with Ampère's Circuital Law, and substituting equation (**5C**), we obtain,

$$\mathbf{F}/\text{volume} = \mathbf{B} \times \rho \mathbf{v} \qquad \text{(7C)}$$

This is exactly the same as,

$$\mathbf{E} = -\mathbf{v} \times \mathbf{B} \qquad \text{(8C)}$$

Maxwell's Eq. (5) concerns the force on a current carrying wire in a magnetic field. In the form shown at equation **(8C)** it appears in Eq. (77) in part II of the same paper, but this time it refers to the electromotive force that drives a current in a wire that is moving in a magnetic field. In both cases, it is the same force, acting in a different context. Although nowadays credited to Lorentz, it in fact first appeared in Maxwell's papers many years earlier.

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In relation to the speed of light, it says in the section entitled, "*POSSIBLE STRUCTURE.__ The question arises as to what that velocity can be due to. The most probable surmise or guess at present is that the ether is a perfectly incompressible continuous fluid, in a state of fine-grained vortex motion, circulating with that same enormous speed. For it has been partly, though as yet incompletely, shown that such a vortex fluid would transmit waves of the same general nature as light waves _i.e., periodic disturbances across the line of propagation_ and would transmit them at a rate of the order of magnitude as the vortex or circulation speed--"*
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"Long ago he (mankind) recognized that all perceptible matter comes from a primary substance, of a tenuity beyond conception and filling all space - the Akasha or luminiferous ether - which is acted upon by the life-giving Prana or creative force, calling into existence, in never ending cycles, all things and phenomena. The primary substance, thrown into infinitesimal whirls of prodigious velocity, becomes gross matter; the force subsiding, the motion ceases and matter disappears, reverting to the primary substance".
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