The Double Helix Theory of the Magnetic Field

(An Interpretation of Maxwell's 1861 Paper 'On Physical Lines of Force')

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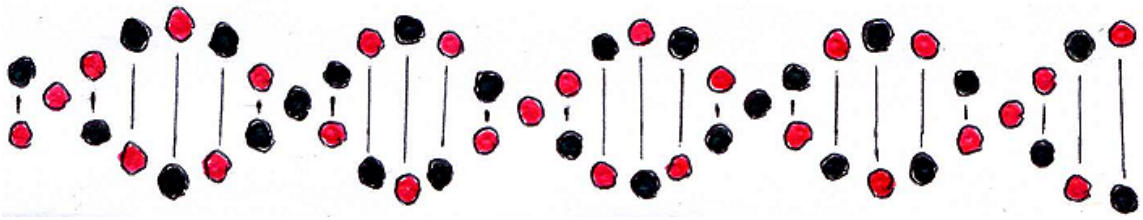
15th February 2006, Philippine Islands
(18th December 2008 Amendment, Cebu City)

Abstract. Maxwell's 1861 paper 'On Physical Lines of Force' is interpreted. An improvement is proposed that involves replacing his molecular vortices with rotating electron-positron dipoles. These dipoles will each comprise of an electron and a positron undergoing a mutual orbit. Electromagnetism is then explained in terms of an electric sea in which magnetic lines of force are physically comprised of helical springs created out of rotating electron-positron dipoles. The electron-positron dipoles are bonded together in a double helix pattern and the resulting helical springs form elliptical or circular solenoidal hoops around an electric current circuit or a bar magnet.



James Clerk-Maxwell published his paper 'On Physical Lines of Force' in 1861 in the Philosophical Magazine [1].

http://vacuum-physics.com/Maxwell/maxwell_oplf.pdf

The Interpretation

I. In part I of his 1861 paper 'On Physical Lines of Force' [1], Maxwell discusses how when the north pole of a bar magnet is brought close to the south pole of another bar magnet, that the lines of magnetic force will flow directly across from one magnet to the other. He also discusses how when two like magnetic poles are brought together, that the lines of magnetic force will spread away from each other. Maxwell takes this to indicate that the magnetic force of attraction between two bar magnets is caused by a tension in the lines of force and he therefore suggests that magnetic repulsion arises from a pressure. In an attempt to explain these phenomena, he conceives the idea of a sea of molecular vortices mutually aligned in their axial planes and all rotating in the same direction such

that a centrifugal pressure exists in the equatorial plane. A magnetic line of force is therefore a single column of vortices aligned along their axes of rotation.

He seeks to justify his proposal by introducing hydrodynamical equations in which the square of the circumferential velocity of the vortices determines the pressure differential between the equatorial and the axial planes in the vortex sea. In doing so, equation (1) in Maxwell's paper gives us a relationship between density and magnetic permeability μ which proves to be of ultimate importance when he carries this result forward into Isaac Newton's 'speed of sound' equation (132) in part III and uses it to determine the fact that transverse waves in the vortex sea propagate at the speed of light.

Maxwell's hydrodynamical approach in part I leads to equation (5) in which the right hand side contains the components of magnetic force. Maxwell then tries to physically reconcile the components of equation (5) with his molecular vortex model. The first component on the right hand side of equation (5) is interpreted in connection with the axial tension in the magnetic lines of force. Maxwell uses the principle of superimposition to explain why a bar magnet that is placed in an external magnetic field aligns itself with that field. He demonstrates how the superimposition principle leads to a differential axial tension in his vortex columns, and how this gives rise to a torque which rotates the bar magnet into line with the external magnetic field. At equation (21), Maxwell demonstrates that the primary source of this axial tension must obey an inverse square law and he states that this has already been shown by Coulomb.

The second component on the right hand side of equation (5) carries the centrifugal force associated with the square of the circumferential velocity of his molecular vortices. He uses this component to account for magnetic force on unmagnetized materials. This would appear to be the "Archimedes' Principle" of Magnetism. It could be inferred from what he says that paramagnetic materials contain within them a vortex sea which is denser than that which pervades outside of matter, whereas diamagnetic materials contain within them a vortex sea which is less dense than that which pervades outside of matter.

Maxwell uses the third and fourth components on the right hand side of equation (5) to explain the magnetic force on a current carrying wire. These two components are essentially the convective component of the Lorentz force,

$\mathbf{F} = \mathbf{v} \times \mathbf{H}$ (Convective Component of the Lorentz Force) (1)

(see **Appendix A** for a discussion on equation **(1)**)

(Note that Maxwell didn't use the quantity electric charge q)

Nowadays the convective component of the Lorentz force is indeed used to explain the force on a current carrying wire despite the fact that it would seem to fail to account for the potential energy associated with attraction or repulsion. If **v** and **H** are independent of each other and if the **H** field is constant, then the $\mathbf{F} = \mathbf{v} \times \mathbf{H}$ force should act only to change the direction of a moving particle. Kinetic energy should remain conserved. Interestingly, Maxwell connects this expression with the centrifugal force acting in the equatorial plane of his molecular vortices. He explains how magnetic lines of force from an external source hook around a current carrying wire and how the centrifugal pressure

in the equatorial plane of his vortices pushes the wire from behind. Maxwell actually considers the complete superimposed magnetic field picture, whereas modern scientists ignore the magnetic field that is generated by the current carrying wire itself. Maxwell's physical explanation is undoubtedly correct since centrifugal force is an irrotational force that possesses an associated potential energy **A**.**v**, where **A** is the magnetic vector potential. The **F** = **v**X**H** force may indeed be a fine-grained centrifugal force when it applies to the force on a current carrying wire because in that case the **v** and the **H** would not be independent of each other. The current in the wire which is directly related to **v** will determine the final superimposed value of **H**. See 'The General Convective Force' at,

http://www.wbabin.net/science/tombe41.pdf

Maxwell also uses the third and fourth parts on the right hand side of equation (5) to derive Ampère's Circuital Law at equation (9). This is particularly interesting since it shows that a magnetic field can be caused by a solenoidal circulation of pure aether without referring to electrical particles.

The fifth part on the right hand side of equation (5) is merely a statement to the extent that a hydrostatic pressure gradient gives rise to a force.

So Maxwell uses equation (5) to connect magnetic force to the Coulomb force, the centrifugal force, and to aether pressure gradient. He does not connect any of the terms in equation (5) to electromagnetic induction.

Maxwell finishes part I by deriving the equation for the force acting between two long straight current carrying wires and showing that the force must be inversely proportional to the distance between the wires.

In part II, Maxwell introduces electrical particles in order to stabilize the vortices and to link the vortices to the current in electric wires. He derives Ampère's Circuital Law for a second time at equation (33), but this time using an alternative particle dynamics method.

He then returns once again to hydrodynamics and calculates the kinetic energy in the vortex sea due to the rotational motion of the molecular vortices. He obtains the energy per unit volume at equation (45) which corresponds to the modern day expression for energy density in a magnetic field $1/(2\mu).\mathbf{B}^2$.

From this expression for magnetic energy density, he derives Faraday's law of electromagnetic induction at equation (54), the vorticity equation curl **A** = **B** at equation (55), the solenoidal equation div **B** = 0 at equation (56), and the electric force equation **E** = d**A**/dt at equation (58). The importance of equation (58) is that he has identified a vector **A** as a fundamental momentum quantity from which the electromotive force can be determined, and he believes this vector to correspond to what Faraday called the *electrotonic state*.

There are two aspects to electromagnetic induction. There is induction in a static wire in a time varying magnetic field, and there is induction in a moving wire in a static magnetic field. In relation to the former, Maxwell returns to particle dynamics and gives an explanation in which the vortex cells behave like flywheels storing rotational kinetic energy. He sees applied electric current as acting like a driving belt alongside the flywheels/vortices and imparting a force given by d**A**/dt where **A** is a momentum, and he sees electromagnetic induction as the reverse of this process.

Maxwell once again returns to hydrodynamics in order to attempt a general solution for the phenomenon of electromagnetic induction. This leads him to what is essentially the Lorentz Force at equation (77) (see **Appendix A**) in which he links the irrotational Coulomb force component to aether tension. Equation (77) appears to be reasonably similar in its content to equation (5) but it contains the additional $-\partial\mathbf{A}/\partial t$ term associated with his physical explanation for the time varying aspect of electromagnetic induction described above, whereas equation (5) contains two centrifugal force terms. Equation (77) also contains an $\mathbf{E} = \mathbf{v}\mathrm{X}\mathbf{B}$ term in the likeness of the $\mathbf{F} = \mathbf{v}\mathrm{X}\mathbf{H}$ term in equation (5), but it is doubtful that it will refer to a centrifugal force in this case. This $\mathbf{E} = \mathbf{v}\mathrm{X}\mathbf{B}$ term refers to cases of electromagnetic induction in which the wire is moving through a magnetic field.

Maxwell attempts to give a physical explanation for this aspect of electromagnetic induction. Maxwell uses an argument in which the motion of the wire will create a differential pressure in front of the wire as compared to behind the wire. This in turn will lead to a differential circumferential velocity in the vortices in front of the wire as compared to behind the wire resulting in a net electromotive force in the wire and a resistive force acting against the wire's motion. This will supposedly cause a current to flow in the wire. See section **IV** below on the Coriolis force.

In part III, Maxwell considers the elasticity of the vortex sea. Equation (105) is the equation of simple harmonic motion in a form that involves the dielectric constant as the elastic constant. Using elasticity theory, Maxwell links the dielectric constant to the transverse elasticity at equation (108) for the case of a perfect solid.

From equation (105), Maxwell derives the displacement current equation at (111) which he then combines with the hydrodynamical equation of continuity to obtain Gauss's law at equation (115). At this point it seems that Maxwell, who never specifically mentions electric charge, is treating aether density in the same manner as electric charge is treated in modern textbooks. From Gauss's law, Maxwell then derives Coulomb's law at equation (127) by devolving the variable aether density to the inverse square law and effectively making charge become a constant for a point object. From this he is able to link the dielectric constant with the ratio of electromagnetic units to electrostatic units on the basis that magnetic permeability μ is unity in electromagnetic units.

Equation (132) is an Isaac Newton equation from classical wave mechanics (see **Appendix B**) that links wave speed in an elastic medium with density and transverse elasticity. Taking magnetic permeability μ to be unity, Maxwell substitutes permeability for density, and dielectric constant for transverse elasticity into equation (132). In 1856, Weber and Kohlrausch calculated the ratio between the electrostatic and the electromagnetic units. Maxwell uses this result and links it to the dielectric constant in equation (132). He obtains a figure which is very close to the velocity of light in air as determined by Fizeau.

This result should have left nobody in any doubt that light is a transverse electromagnetic wave in an elastic solid. On discovering this result, Maxwell states *" - - - we can scarcely*

avoid the inference that light consists in the transverse undulations of the same medium which is the cause of electric and magnetic phenomena - - - "

In part IV, Maxwell considers Ampère's Circuital Law and states that *"The same mathematical connexion is found between other sets of phenomena in physical science"*. He later concludes *" It appears from all these instances that the connexion between magnetism and electricity has the same mathematical form as that between certain pairs of phenomena, of which one has a* linear *and the other a* rotatory *character."*

Maxwell goes on to point out that *"The magnetic state, however is characterized by a well-marked rotatory phenomenon discovered by Faraday − the rotation of the plane of polarized light when transmitted along the lines of magnetic force"*. Maxwell concludes that this rotation is being caused by the rotation of the vortices themselves.

Maxwell's Displacement Current

II. It will be shown below in section **VI** that in part III of his 1861 paper, Maxwell derives displacement current using a form of the equation for simple harmonic motion. Maxwell sees displacement current as a self restoring elastic phenomenon that arises when his vortex cells are undergoing distortion. Displacement current appears as equation (111) in Maxwell's 1861 paper, and as equation **(11)** in section **VI** below. In modern day notation, it is given by the equation,

$$\mathbf{J} = -\varepsilon \partial \mathbf{E}/\partial t \qquad \textbf{(Displacement Current)} \qquad \textbf{(2)}$$

where ε is the electrical permittivity, which is inversely related to the transverse elasticity of the vortex sea. The negative sign arises from its origins in simple harmonic motion. Maxwell showed that the **E** vector in equation **(2)** can be satisfied by Gauss's law. This can be seen if we take the divergence of both sides of equation **(2)** and then apply the equation of continuity, which is equation (113) in Maxwell's 1861 part III,

$$\text{div}\ \mathbf{J} = -\partial \rho/\partial t \qquad \textbf{(Equation of Continuity)} \qquad \textbf{(3)}$$

This yields Gauss's law which appears as equation (115) and is written in modern day vector notation as,

$$\text{div}\ \mathbf{E} = \rho/\varepsilon \qquad \textbf{(Gauss's Law of Electrostatics)} \qquad \textbf{(4)}$$

In modern day textbooks, Ampère's circuital law (equations (9) and (33) in Maxwell's 1861 paper) is usually considered in the case of the electric current causing the magnetic field. When it is applied to an electromagnetically induced current, we must reverse the sign and it will look like this,

$$\text{curl } \mathbf{B} = -\mu\mathbf{J} \qquad \textbf{(Ampère's Circuital Law for Induction)} \qquad \textbf{(5)}$$

where μ is magnetic permeability, which is related to the density of the vortex sea. Substituting the displacement current equation **(2)**, into equation **(5),** we obtain what is effectively Maxwell's law of electromagnetic induction, even if Maxwell never considered it to be such,

$$\text{curl } \mathbf{B} = +\mu\varepsilon\partial\mathbf{E}/\partial t \quad \textbf{(Maxwell's Law of Electromagnetic Induction)} \quad \textbf{(6)}$$

Equation **(6)** can be combined with Faraday's law of electromagnetic induction (which is equation (54) in Maxwell's 1861 paper),

$$\text{curl } \mathbf{E} = -d\mathbf{B}/dt \quad \textbf{(Faraday's Law of Electromagnetic Induction)} \quad \textbf{(7)}$$

and the result is a wave equation with a propagation speed equal to the speed of light,

$$\partial^2\mathbf{E}/\partial x^2 = 1/c^2.\partial^2\mathbf{E}/\partial t^2 \qquad \textbf{(Electromagnetic Wave Equation)} \qquad \textbf{(8)}$$

A particular solution to equation **(8)** is that $\mathbf{E} = -\partial\mathbf{A}/\partial t$. This solution would be in agreement with Faraday's law of electromagnetic induction at equation **(7)**. From the contents of **Appendix A** we can deduce that the convective component of the Lorentz force has been dropped from Faraday's law for the purposes of deriving equation **(8)**. This means that the electromagnetic wave equation must be referenced to a physical medium with respect to which the **v** in **v**X**B** is referenced. This totally undermines Einstein's claim that *"The principle of the constancy of the velocity of light is of course contained in Maxwell's equations"* which appears in the footnote of Einstein's addendum of 27th September 1905 entitled 'Does the Inertia of a Body depend on its Energy-Content?'. See,

http://www.fourmilab.ch/etexts/einstein/E_mc2/www/

In part III of his 1861 paper, Maxwell uses Newton's equation for the speed of sound to show that electromagnetic waves are transverse disturbances in an elastic solid. Maxwell uses the concept of electric displacement and then establishes the ratio of transverse elasticity to density and substitutes the result into Newton's speed of sound equation (132). This method is never dealt with in modern textbooks as it has been totally swept under the carpet despite the fact that it was the jewel in the crown of Maxwell's career.

Modern textbooks demonstrate the link between light and magnetism by using the 'displacement current' approach to derive the electromagnetic wave equation. The displacement current approach was first used by Maxwell in his 1865 paper 'A Dynamical Theory of the Electromagnetic Field' [2].

Nowadays displacement current itself is derived in such a way as to conceal the need to have a dielectric medium pervading throughout space, yet it is arrant nonsense to try to suggest that displacement current can occur in the absence of a dielectric medium. The

dielectric medium is necessary to give physical meaning to displacement current. Displacement current carries with it a transverse elasticity and this implies the existence of a dielectric medium. Displacement current and Ampère's circuital law combine together to give the electromagnetic wave equation and so it is absolutely imperative that we have a physical particulate dielectric medium to act as the carrier of the electromagnetic waves. (Kirchhoff [3], the father of cable telegraphy, derived what was essentially equation **(8)** in 1857 without using the concept of displacement current, although he did use mathematical ingredients in the form of Poisson's equation and the equation of continuity of charge that can make up the same mathematical form as the displacement current.)

It is clear that the luminiferous medium must be a sea of particles on a scale that is many orders of magnitude smaller than atomic and molecular matter. The obvious choice for what these particles ought to be is electrons and positrons as these are the only stable pairs of particles on that scale which are known to exist. Maxwell said in part II of his 1861 paper in the paragraph following equation (34), *"It appears therefore that, according to our hypothesis, an electric current is represented by the transference of the moveable particles interposed between the neighbouring vortices - - -".*

More recently Dr. Menahem Simhony has proved beyond any doubt that a physical medium of electrons and positrons pervades what we customarily accept to be the vacuum, and his theory comes from within the discipline of solid state physics, and is totally independent of the discipline of electromagnetism. You can read more about Dr. Simhony's theory in this web link,

http://web.archive.org/web/20040606235138/www.word1.co.il/physics/mass.htm

Dr. Simhony has essentially shown that the equation $E = mc^2$ is an equation from classical wave mechanics (see **Appendix B**) and that it applies to ion pair production in a salt crystal, with E representing ion binding energy and c being equal to bulk wave velocity. Simhony applies this equation to the 1932 Carl Anderson electron pair production experiment and shows that the Gamma rays are merely liberating electrons and positrons from their bonds and that as such, a background electron-positron medium is a very real physical thing.

The Dipole and the Vortex Sea

III. It will now be proposed that Maxwell's molecular vortices are rotating electron-positron dipoles which enclose an aethereal vortex within them. These dipoles will each comprise of an electron and a positron in a mutual orbit. The axis of rotation of one of these orbits will be perpendicular to the line joining the electron to the positron. It will be proposed that if a randomly arranged sea of electrons and positrons is created, it will eventually settle into an equilibrium state dictated by the fundamental inter-particle force laws. This equilibrium state will take the form of a sea of rotating electron-positron

dipoles. The aethereal vortices within these dipoles will be explained at the end of this section and again in more detail in section **IV**. The dipoles will all have the same diameter in the equilibrium state and the magnitude of this diameter will be determined by the initial energy conditions at creation. When a magnetic field exists, these dipoles will be aligned along their axial plane and will all be rotating in the same direction as each other. In the axial direction, the irrotational Coulomb force will create a tension and the reason why the columns of dipoles will not collapse under this axial tension is because they are solenoidal and will form closed elliptical or circular hoops, and because the bonds between neighbouring dipole columns will be repulsive, due to centrifugal pressure in the equatorial plane.

Due to very high mutual tangential velocities, the particles that would normally attract each other in the equatorial plane under the Coulomb force will not be linearly accelerated together along their lines of connection. This is a fundamental fact of classical central force orbital theory and it is the reason why the Moon doesn't fall to the Earth. The Moon orbits the Earth but it is not linearly accelerated along its line of contact with the Earth. This argument can be isolated for the special case of two particles acting under a mutually attractive inverse square law in circumstances in which they have exceeded their mutual escape velocity. In this situation the prescribed orbit will be hyperbolic and if we resolve the mutual linear acceleration along the line of connection between the two particles, we will actually obtain a repulsion.

Stability and equilibrium within the magnetized vortex sea will be maintained by a balancing of the axial Coulomb tension within the vortex hoops, and the centrifugal repulsion in the equatorial plane that is acting between the vortex hoops. The axial tension within a column (hoop) can be regulated by the relative orbital phase of immediately neighbouring dipoles. The situation of maximum attraction within a column (hoop) will occur when the dipoles are aligned anti-parallel to each other with every electron having a positron immediately below and above it. The axial tension can be reduced either by increasing the distance between neighbouring dipoles in the axial direction, or by increasing the distance between the actual electrons and positrons of neighbouring dipoles by changing the relative angular displacement between the neighbouring dipoles up and down the axial direction. The latter method would render the column of dipoles into a double helix pattern. See figure 1 below,

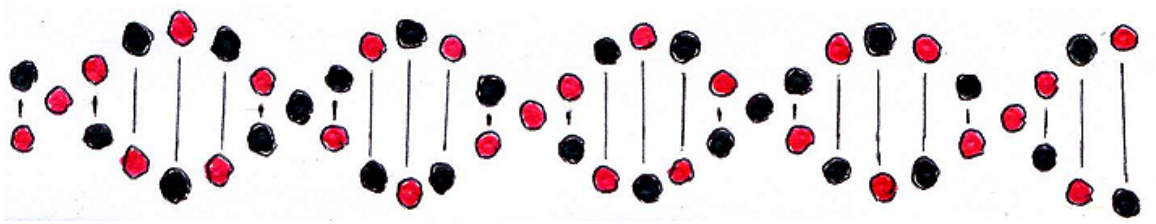


Figure 1. A close-up view of a single magnetic line of force. The electrons are shown in red and the positrons are shown in black. The double helix is rotating about its axis with a prodigious angular speed and the rotation axis represents the magnetic field vector H. The diagram is not to scale as the relative dimensions remain unknown.

This would suggest that the physical interpretation of a magnetic line of force is that of a narrow solenoidal tubular vortex driven by mutually orbiting electron-positron dipoles that are arranged in a double helix pattern, and that axial tension can be regulated by changing the number of turns per unit length within the double helix. We will call the number of turns per unit length the 'Helix Angle'. The equatorial pressure can be regulated by increasing or by decreasing the vorticity of the dipoles. If we increase the vorticity, the repulsion between the helical columns will increase, and to balance this, the axial tension within the helical columns will increase by virtue of these helical columns tending to straighten out, by reducing their helix angle, as like in the stretching of a helical spring. In fact it would seem that a magnetic line of force actually is a helical spring. When such a degree of similarity exists, it is usually an indication that the exact same principle is in operation. In this case, when the helical spring becomes totally relaxed, it will disintegrate into an amorphous sea.

The electric vortex sea will be a solenoidally bonded solid. The actual geometrical lines of magnetic force when analysed at microscopic level will be the electrostatic lines of force within the double helix vortex columns. These lines of force will exhibit two major trends. One trend will be a helical axial trend connecting the actual dipoles in the columns. As it is a tension, it will have no resultant average direction, but it will approximate to the position of the macroscopic magnetic lines of force. The other trend will be that of the rotating lines of force passing across the equatorial plane between the electrons and positrons within each dipole. This rotational aspect takes us directly to the ultimate question of what exactly the vortex consists of. Whatever the physical interpretation is, we have a rotating field within the dipoles, and we will now return to the subject of the convective component of the Lorentz force as it arises in electromagnetic induction. The convective component of the Lorentz force is velocity dependent and the velocity is undoubtedly measured relative to the vortex sea. The only parallel in nature to the convective component of the Lorentz force is the Coriolis force which requires a rotating frame of reference. The Coriolis force, just like the centrifugal force, is believed by modern scientists to always be a fictitious force. Nevertheless, Maxwell has already successfully used the centrifugal force in his analysis of magnetism. Might the $\mathbf{E} = \mathbf{v}\mathrm{X}\mathbf{B}$ force be a fine-grained Coriolis force in electromagnetism? Let us take a closer look at the Coriolis force.

The Coriolis Force

IV. The Coriolis force is a force that modern scientists believe to only exist in a rotating frame of reference. It is a velocity dependent force and it acts at right angles to the direction of motion. It takes the form,

$$\mathbf{F} = \mathbf{v} \times 2m\omega \qquad \textbf{(Coriolis Force)} \qquad (9)$$

with **v** referring to the velocity of a particle relative to the rotating frame of reference, m referring to its inertial mass, and **ω** referring to the angular velocity of the rotating frame of reference. It is mathematically identical to the convective component of the Lorentz force when **v** and **H** are independent of each other.

The very fact that rotation occurs at all implies the existence of a very definite frame of reference. In the case of gravity, this special frame of reference appears to be fixed relative to the background stars. We have something that sits stationary relative to the background stars, even though the background stars are not actually fixed and only appear to be fixed in our time scale. That something must therefore occupy a kind of average universal rest position from which we measure the concept of rotation.

The mystery of the convective component of the Lorentz force dictates that we seriously have to consider that the very space itself inside a rotating dipole is in a state of rotation. It's not simply a matter of geometrical lines of force rotating. Something very real must be there and in a state of rotation such as to generate a fine-grain Coriolis force. Whatever it is, Maxwell acknowledged its existence, and in part I of his 1861 paper he used fluid dynamics and vorticity to successfully calculate the precise mathematical theory of magnetic force. Just as Maxwell's concept of displacement current means that we cannot deny the existence of an electron-positron dielectric, so also does his molecular vortex theory mean that we cannot deny that a very real medium of some kind exists in the space between the electrons and positrons and possibly constitutes an extension of both that connects them together. This medium would of course have to be the aether. In order to avoid a confusion of terminologies, we shall refer to the sea of electron-positron dipoles as 'The Electric Sea', and consider it not to be the aether but rather to be just another physical medium on a much smaller scale than atomic and molecular matter. Both the aether and the electric sea are missing from modern day physics textbooks yet they combine and interact with each other to bring about the entire theory of electromagnetism. The interaction of the aether with the electric sea leads to Maxwell's vortex sea. We can now understand that the velocity term in the convective component of the Lorentz force is primarily measured relative to the aether, but that in electromagnetism it will be measured relative to the electric sea since the electric sea contains the rotating aethereal vortices within it.

If there only exists one aether, that would tend to suggest that gravity and negative electricity are the same thing. This in turn would imply that negative charges attract each other and that our corner of the universe has got a net negative charge. If this is not so, then we must have a separate aether for both gravity and electrostatics which is a highly unlikely state of affairs.

The Coriolis force, just like the centrifugal force must be a fundamental aethereal based force and an extension of both Coulomb's law of electrostatics and Newton's law of gravity. In fact Coulomb's law of electrostatics and Newton's law of gravitation may well be the same law. The aether vortices in the dipoles are to all intents and purposes rotating space. A magnetic field is therefore equivalent to a region of rotating space on the large scale. It is a true rotational field in the hydrodynamical sense. A charged particle moving

in a magnetic field will experience a real Coriolis force. The Coriolis force lies at the root of the convective component of the Lorentz force when it applies to electromagnetic induction. A wire moving through a magnetic field experiences a flow of electric sea around it which generates a Coriolis force.

The Helical Spring Theory of Magnetism

V. Consider the situation in which the rotating electron-positron dipoles are randomly aligned in an amorphous sea and imagine a single rotating dipole adjacent to a current carrying wire. At certain orientations of the dipole, the current in the wire will experience a Coriolis force due to the aether vortex. An equilibrium will be reached due to the combined effect of the centrifugal force and the gyroscopic effect of the Coriolis force, such that the wire will lie in the equatorial plane of the dipole. In a sea of such dipoles, the axes of the vortex columns will form closed hoops around the wire. In the steady state there will be equilibrium, and hence there will be no transfer of energy between the current in the wire and the surrounding vortex sea. In the dynamic state, if the current in the wire is accelerating, the tangential interaction with the surrounding sea should induce an angular acceleration $\partial\mathbf{A}/\partial t$ in the sea. This will cause kinetic energy to be transferred from the current in the wire, into the electric sea.

This in turn will put the angularly displaced dipoles out of equilibrium with the surrounding sea, and this excess energy will be transmitted through the sea as transverse electromagnetic waves of angular acceleration. When the steady state is reached, we will have an overall increase in vorticity which constitutes a magnetic field. In the steady state, the axial tension will have increased by virtue of the helix angle having decreased, as like in the stretching of a helical spring. We might say that in a magnetic field, space is filled with miniature microscopic helical springs that close on themselves in elliptical or circular solenoidal hoops. A current carrying wire will be surrounded by these vortex hoops, and when the current increases, the vortices will end up spinning faster and the hoops will tighten up. The dipoles will store this extra rotational kinetic energy like flywheels and when the current is switched off, these flywheels will yield their excess rotational kinetic energy back into the wire again giving the current a final surge forwards. This final surge is usually interpreted in terms of 'back E.M.F.' and Lenz's law.

In part I of the 1861 paper, Maxwell shows how the force acting on a current carrying wire could be accounted for in terms of a centrifugal pressure in the equatorial plane of the vortices. The above considerations have shown us how such an equatorial pressure will be accompanied by an axial tension in the lines of force. When we extend this principle to the force acting between two electrical current circuits, we get a picture of Ampère's force law in terms of closed hoops of helical springs, wrapped around two closed loops of electric current, and pulling them together with a combination of axial tension and centrifugal equatorial pressure.

Faraday's law of electromagnetic induction can arise when a static secondary wire is placed in a time varying magnetic field. In this situation, current electrons in the primary wire are yielding some of their kinetic energy to the dipoles (flywheels) in the surrounding sea. While the driving current is varying in time, the vortex sea will be continually seeking to establish a new equilibrium by transmitting transverse electromagnetic radiation in the form of propagating angular acceleration. If we introduce a closed loop of secondary wire into the vicinity, it will act as a pressure outlet and an electric current will be induced in this secondary wire by the reverse process.

In the dynamic state when magnetic field patterns are changing, individual dipoles will be realigning and swapping their partners in the axial plane.

Displacement Current and the Electric Dipole

VI. There is no subject that is more relevant to the controversy of Einstein's special theory of relativity, than the subject of Maxwell's 'Displacement Current'. Maxwell's displacement current is central to the derivation of the electromagnetic wave equation, and it is the key to the nature of light. Displacement current first appeared in Maxwell's 1861 paper 'On Physical Lines of Force'. It appeared in the early stages of part III of this much neglected classical archive.

Maxwell introduced the concept of displacement current in connection with the tangential displacement of the 'particles of electricity' that formed a constituent part of his vortex cells. Maxwell introduced these electrical particles in part II of his paper in order to account for the stability his sea of vortices, and in order to connect these vortices to electric current.

In part III of his 1861 paper, Maxwell likens a single molecular vortex cell to an elastic sphere. He then introduces an equation that has got all the hallmarks of the equation for simple harmonic motion,

$$R = -4\pi E^2 h \qquad \textbf{(10)}$$

where R is electromotive force, E is dielectric constant, and h is displacement. It is this equation from which Maxwell derives displacement current by dividing by time,

$$dR/dt = -4\pi E^2 r \qquad \textbf{(Displacement Current)} \qquad \textbf{(11)}$$

where r is the value of the electric current due to displacement and defined by,

$$r = dh/dt \qquad \textbf{(12)}$$

We now need to reconcile simple harmonic motion with the fundamental forces that act between electrons and positrons. If we put a static electron and a static positron side by

side, they will attract each other, but there will be absolutely no question whatsoever of simple harmonic motion occurring. We need to find a dynamic situation involving electrons and positrons, from which we can obtain a simple harmonic motion out of the fundamental forces.

Maxwell may already have provided the key to this problem by emphasizing the fact that he was considering tangential motion as opposed to radial motion, when considering the displacement of his electrical particles. Tangential motion suggests that the centrifugal force is involved. A rotating electron-positron dipole in which the collapsing effect of the Coulomb force is cancelled out by the repulsive effect of the centrifugal force, could be considered as being representative of the elastic sphere, and hence the molecular vortex cell. Maxwell's Displacement current is a one dimensional phenomenon. If we resolve the motion of the electron and the positron within a single rotating dipole along one axis in the equatorial plane, we will have an alternating electric current satisfying the conditions of simple harmonic motion. This reconciles the mathematical link between electric current and simple harmonic motion at microscopic level.

It has been traditional to physically interpret displacement current in connection with linear polarization, separation of charges, and the storage of potential energy $(\varepsilon/2).\mathbf{E}^2$. In this way, we can easily visualize displacement current as a real current. There is a problem however as regards how such a displacement current between the plates of a capacitor might induce the necessary rotational $\partial\mathbf{A}/\partial t$ force for the purposes of inducing a magnetic field. There is also a problem as regards how an electric current in a wire could induce such a linear displacement current laterally in order to account for the displacement current term that is implicit in electromagnetic radiation. These matters are dealt with in 'Equilibrium in the Electric Circuit' at,

http://www.wbabin.net/science/tombe32.pdf

where it is suggested that electric current is ultimately a flow of pure aether, and in 'The Unification of Electricity and Magnetism' at,

http://www.wbabin.net/science/tombe3.pdf

where it is suggested that the mathematical term representing displacement as used in electromagnetic radiation does not actually refer to linear polarization current, but rather to a related phenomenon at right angles to it called angular displacement current.

Michelson-Morley and the Entrained Electric Sea

VII. The Earth's gravity should entrain the electric sea with the Earth's orbital motion around the Sun, and the Sun's gravity should render this entrained gravitosphere region into the distinctive long tailed shape that we can see in the Earth's magnetosphere. The Michelson-Morley experiment of 1887 confirms the fact that the electric sea is entrained

with the Earth as the Earth orbits the Sun. The Earth and the extended region of electric sea which constitutes the gravitosphere, move as one, just like the yolk of an egg and the surrounding egg white.

It was Dr. Carl Zapffe who first pointed out the obvious link between the magnetosphere and the entrained region of magneto-luminiferous medium [4], although he did not suggest that the gravitosphere boundary may be a lot higher up than the magnetosheath. See,

http://www.wbabin.net/science/ricker24.pdf
http://www.wbabin.net/science/rickerint.pdf

The entrainment principle was first advocated by George Stokes in 1845. Stokes' aether drag theory was discounted on the grounds that the situation at the boundary would make a solid 'aether' unsuitable, and that a liquid 'aether' couldn't support transverse waves. The argument ensued that whatever this mysterious 'aether' was comprised of, it would have to possess both solid and liquid characteristics.

These objections are however overcome by the bonding mechanism in the electric sea. The shear lines in the electric sea at the boundary where the Sun's gravity gives way to the Earth's gravity will always be in the axial plane of the magnetic field lines and will hence be cushioned like a hovercraft due to centrifugal repulsion pressure. See 'Electrostatic Repulsion and Aether Pressure' at,

http://www.wbabin.net/science/tombe44.pdf

and also 'Aether causes anti-Friction in the Planetary Orbits' at,

http://www.wbabin.net/science/tombe21.pdf

Another objection to the Stokes' aether drag model relates to the phenomenon of stellar aberration. It is said that stellar aberration would not occur as it is observed if the Stokes model were to apply. However, there is absolutely no reason at all to make this assertion if we are dealing with an absolute cut off boundary between the Earth's gravitosphere and the heliosphere. The 30km/sec motion of the Earth's gravitosphere relative to the heliosphere will lead to stellar aberration at the boundary as is the case when any two moving objects collide. Lunar aberration on the other hand is not observed. This is fully in line with the fact that the Moon is entirely within the Earth's gravitosphere region.

The Earth's Magnetic Field

VIII. Although the electric sea is entrained with a planetary body that is undergoing translational motion, it seems that this is not so for rotational motion.

The electric sea contains dipoles that are on a scale of magnitude of the order of the wavelength of gamma rays. We know this because it is gamma rays that can split these dipoles apart. As such, the electric sea should have absolutely no difficulty in passing through atomic and molecular matter, just as water passes through a basket. The fact that the planets entrain the electric sea due to gravity is because the shear lines at the gravitational boundaries offer even less resistance than would be the case if the electric sea were to pass right through the planets.

With rotational motion, the situation is different. In this case it is easier for the electric sea to remain static while a body rotates than for a large region of electric sea to rotate with that body. We know this to be true by virtue of the fact that the **v**X**B** component of magnetic force is not invoked when a magnet rotates. The Michelson-Gale experiment of 1925 provides yet further evidence that the electric sea is not entrained with the Earth in its diurnal motion.

Although the electric sea does not rotate with a magnet, the magnetic field itself does rotate. The rotating magnetic field is of course a wave motion through the electric sea and the magnitude of this wave motion is a sinusoidal function of the angle between the magnetic axis and the rotational axis. Hence in the special case in which the rotational axis is aligned with the magnetic axis, we can detect no rotation of the magnetic field.

For complex situations such as water running through pipes as in Fizeau's 1851 experiment in which he showed that the speed of light varied up and down stream in a column of liquid, we might expect partial entrainment of the electric sea.

See the web links below for the follow up conclusions,

The Unification of Electricity and Magnetism
http://www.wbabin.net/science/tombe3.pdf

The Coriolis Force in Maxwell's Equations
http://www.wbabin.net/science/tombe4.pdf

Gravitation and the Gyroscopic Force
http://www.wbabin.net/science/tombe5.pdf

Gravity Reversal and Atomic Bonding
http://www.wbabin.net/science/tombe6.pdf

The Link between Electric Current and Magnetic Field
http://www.wbabin.net/science/tombe7.pdf

The Richness and Quality of the Electron-Positron Dipole
http://www.wbabin.net/science/tombe8.pdf

The DNA of Electromagnetic Radiation
http://www.wbabin.net/science/tombe9.pdf

Archimedes' Principle in the Electric Sea
http://www.wbabin.net/science/tombe11.pdf

The Aether and the Electric Sea
http://www.wbabin.net/science/tombe12.pdf

Earnshaw's Theorem and Magnetic Levitation
http://www.wbabin.net/science/tombe13.pdf

E=mc² and Maxwell's Fifth Equation
http://www.wbabin.net/science/tombe14.pdf

The Unification of Gravity and Magnetism
http://www.wbabin.net/science/tombe15.pdf

E = **v**X**B** and Maxwell's Fourth Equation
http://www.wbabin.net/science/tombe16.pdf

Rotating Magnetic Fields in the Electric Sea
http://www.wbabin.net/science/tombe17.pdf

The Connection between Gravity and Light
http://www.wbabin.net/science/tombe18.pdf

Rotational and Irrotational Forces
http://www.wbabin.net/science/tombe19.pdf

The Expansion Chamber Theory of the Magnetic Field
http://www.wbabin.net/science/tombe20.pdf

Aether causes anti-Friction in the Planetary Orbits
http://www.wbabin.net/science/tombe21.pdf

Cyclones and the Earth's Magnetic Field
http://www.wbabin.net/science/tombe22.pdf

The Archimedes' Screw in the Electric Sea
http://www.wbabin.net/science/tombe23.pdf

The Speed of Light varies with Magnetic Flux Density
http://www.wbabin.net/science/tombe24.pdf

Vitreous Electricity and Centrifugal Potential Energy
http://www.wbabin.net/science/tombe25.pdf

The Four Kinds of Electric Charge
http://www.wbabin.net/science/tombe26.pdf

Electrical Arcing and Action-at-a-Distance
http://www.wbabin.net/science/tombe27.pdf

A Solenoidal Double Helix of Sinks and Sources
http://www.wbabin.net/science/tombe28.pdf

Bernoulli's Principle and the Theory of Flight
http://www.wbabin.net/science/tombe29.pdf

Turbulence, Vorticity and the Coriolis Force
http://www.wbabin.net/science/tombe30.pdf

Lightning and the Gravitational Capacitor
http://www.wbabin.net/science/tombe31.pdf

Equilibrium in the Electric Circuit
http://www.wbabin.net/science/tombe32.pdf

Saturn exhibits Spin-Induced Magnetism
http://www.wbabin.net/science/tombe33.pdf

Bernoulli's Principle and the AC Transformer
http://www.wbabin.net/science/tombe35.pdf

Inertia is Centrifugal Force
http://www.wbabin.net/science/tombe36.pdf

Fundamental Torque and the Rattleback
http://www.wbabin.net/science/tombe37.pdf

The Aether in Rigid Body Collisions
http://www.wbabin.net/science/tombe38.pdf

Centrifugal Pressure in the Aether
http://www.wbabin.net/science/tombe39.pdf

Negative Mass and the Gravity Sink
http://www.wbabin.net/science/tombe40.pdf

The General Convective Force
http://www.wbabin.net/science/tombe41.pdf

Centrifugal Force in the Electric Circuit
http://www.wbabin.net/science/tombe42.pdf

The Cause of Centrifugal Force
http://www.wbabin.net/science/tombe43.pdf

Electrostatic Repulsion and Aether Pressure
http://www.wbabin.net/science/tombe44.pdf

The Coriolis Force and the Screw
http://www.wbabin.net/science/tombe45.pdf

Displacement Current
http://www.wbabin.net/science/tombe47.pdf

Displacement Current 2
http://www.wbabin.net/science/tombe48.pdf

The Telegraphy Equation
http://www.wbabin.net/science/tombe49.pdf

Bernoulli's Principle in the Antenna
http://www.wbabin.net/science/tombe50.pdf

Wave/Particle Duality in Electromagnetic Radiation
http://www.wbabin.net/science/tombe51.pdf

Wave/Particle Duality in Cathode Rays
http://www.wbabin.net/science/tombe52.pdf

Cathode Rays, Gravity, and Electromagnetic Radiation
http://www.wbabin.net/science/tombe53.pdf

Tangential Force - The Equilibrium Shifter
http://www.wbabin.net/science/tombe54.pdf

The Cause of Coriolis Force
http://www.wbabin.net/science/tombe55.pdf

Electromagnetism and the Rolling Wheel
http://www.wbabin.net/science/tombe56.pdf

The Key that Winds Up the Universe
http://www.wbabin.net/science/tombe57.pdf

Kepler's Law of Areal Velocity in Cyclones
http://www.wbabin.net/science/tombe58.pdf

The Rotationally Elastic Sponge
http://www.wbabin.net/science/tombe59.pdf

The Superimposition of Radiation and Gravity
http://www.wbabin.net/science/tombe60.pdf

Inertial Mass, Charge, and Inertia
http://www.wbabin.net/science/tombe61.pdf

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http://www.zpenergy.com/downloads/Maxwell_1864_1.pdf
http://www.zpenergy.com/downloads/Maxwell_1864_2.pdf
http://www.zpenergy.com/downloads/Maxwell_1864_3.pdf
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An interesting interpretation of Kirchhoff's 1857 paper can be viewed on this web link,
http://www.ifi.unicamp.br/~assis/Apeiron-V19-p19-25(1994).pdf

[4] Zapffe, Dr. Carl.A., "The fivefold hypothetical structure underlying time dilation and the special theory of relativity", Indian Journal of Theoretical Physics, Volume 26, No.2, pp.103-122 (1978)

[5] Arden Barker (Monitek@aol.com) has independently advocated a sea of electron-positron dipoles for the purposes of the propagation of electromagnetic radiation.

[6] Dr. Allen Rothwarf wrote 'An Aether Model of the Universe' in 1998 in which he envisaged the aether to comprise of electrons and positrons. See,
http://arxiv.org/abs/astro-ph/0703280

Appendix A (The Lorentz Force)

It is generally unknown that equation (77) in Maxwell's 1861 paper, is in fact the Lorentz force. Maxwell derived this equation long before Lorentz did.

It is customary to write the Lorentz force in the form,

$$\mathbf{F} = q(-\text{grad}\psi - \partial\mathbf{A}/\partial t + \mathbf{v}\text{X}\mathbf{B}) \qquad \textbf{(1A)}$$

The $\partial\mathbf{A}/\partial t$ term is referred to as the 'local aspect', and it represents that angular acceleration aspect of Faraday's law of electromagnetic induction which is generated by a time varying magnetic field on a static charge, and covered by the equation,

$$\text{curl}\ \mathbf{E} = -\partial\mathbf{B}/\partial t \qquad \textbf{(2A)}$$

The vector **A** is known as magnetic vector potential and satisfies the vorticity equation,

$$\text{curl}\ \mathbf{A} = \mathbf{B} \qquad \textbf{(The Vorticity Equation)} \qquad \textbf{(3A)}$$

The gradψ term represents the gradient of the electrostatic potential and it satisfies the irrotational relationship,

$$\text{curl grad}\psi = 0 \qquad \textbf{(4A)}$$

Dividing equation **(1A)** by q we obtain,

$$\mathbf{E} = (-\text{grad}\psi - \partial\mathbf{A}/\partial t + \mathbf{v}\text{X}\mathbf{B}) \qquad \textbf{(5A)}$$

Taking the curl we get,

$$\text{curl}\ \mathbf{E} = -\partial\mathbf{B}/\partial t - (\mathbf{v}.\text{grad})\mathbf{B} = -d\mathbf{B}/dt \qquad \textbf{(6A)}$$

Equation **(6A)** corresponds to equation **(7)** in the main article. We see how the **v**X**B** term is the 'convective aspect' and how it justifies the use of total time derivatives in Faraday's law of electromagnetic induction.

Appendix B ($\mathbf{E = mc^2}$)

Dr. Menahem Simhony has brought our attention to the fact that $E = mc^2$ is an equation which arises out of classical wave mechanics and which relates wave propagation speed in an elastic medium to the binding energy in that medium. In actual fact, $E = mc^2$ is a variation of Isaac Newton's equation for the speed of sound, which appears as equation (132) in part III of Maxwell's 1861 paper. Maxwell uses it to calculate the speed of light.

To illustrate the connection between $\mathbf{E} = mc^2$ and Newton's speed of sound equation, here is a simple demonstration using the equation for wave speed in a vibrating string. Wave speed is given by the equation,

$$c^2 = T/\rho \qquad \textbf{(1B)}$$

in which T is tension per unit length, c is wave speed, and ρ is equal to mass per unit length. This multiplies across to become,

$$mc^2 = \text{Force x Distance} = \text{Energy} \qquad \textbf{(2B)}$$

In electromagnetic theory, the velocity c in $\mathbf{E} = mc^2$ is a function of the vortex sea. It is a macroscopic phenomenon, whereas the $\mathbf{E}$ term is a microscopic phenomenon that refers to the binding energy between the electrons and positrons in the sea. We will now try to extract the equation $\mathbf{E} = mc^2$ from the electromagnetic wave equation,

$$\partial^2\mathbf{E}/\partial x^2 = 1/c^2.\partial^2\mathbf{E}/\partial t^2 \qquad \textbf{(Electromagnetic Wave Equation)} \qquad \textbf{(3B)}$$

by considering simultaneously both the macroscopic and the microscopic scales. The electromagnetic wave equation **(3B)** is a macroscopic phenomenon, and **E** is a second time derivative of displacement **y** multiplied by mass and divided by charge. The sinusoidal solution for **E** tells us that the displacement **y** will also therefore have the same form of equation,

$$\partial^2\mathbf{y}/\partial x^2 = 1/c^2.\partial^2\mathbf{y}/\partial t^2 \qquad \textbf{(4B)}$$

Now let us consider the microscopic level in which we are examining a disturbance due to a Gamma ray that is ejecting an electron from its orbit with a positron. Multiplying across by m for the mass of the electron we obtain,

$$mc^2.\ \partial^2\mathbf{y}/\partial x^2 = m\partial^2\mathbf{y}/\partial t^2 = \text{Force} \qquad \textbf{(5B)}$$

Integrating with respect to x we get,

$$mc^2.\ \partial\mathbf{y}/\partial x = \text{Energy} + \text{Constant of Integration} \qquad \textbf{(6B)}$$

$\partial\mathbf{y}/\partial x$ will be unity since position and displacement are the same thing in this microscopic scenario. Hence,

$$E = mc^2 + \text{Constant of Integration} \qquad \textbf{(7B)}$$

The constant of integration is a consequence of trying to simplify a multi-particle problem into a two particle problem. We have just carried out a qualitative treatment which cannot yield the correct numerical value, but it does tell us that the famous expression $\mathbf{E} = mc^2$ is rooted in Maxwell's sea of molecular vortices.