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The Gyroscopic Theory of Electromagnetic Radiation

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***Abstract*. In 1873, Scottish physicist James Clerk Maxwell proposed the plane wave theory of electromagnetic radiation, whereby mutually perpendicular oscillating electric and magnetic fields propagate at the speed of light, in phase with each other and perpendicular to the propagation direction. Meanwhile, since Maxwell's curl equations imply that the electric and magnetic fields in an electromagnetic wave are actually out of phase by ninety degrees, this discrepancy will now be investigated.**

Transverse Elasticity and Displacement Current

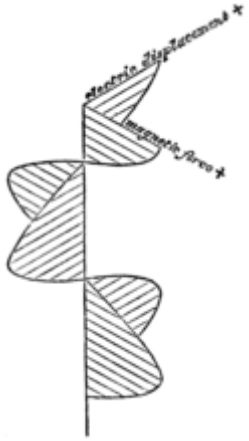

Fig. 66/67 from Maxwell's 1873 Treatise. For magnified version, see page 7.

I. Regarding the well-known illustration of an electromagnetic wave as two mutually perpendicular sine waves in the electric, **E**, and magnetic, **B**, fields, and both mutually perpendicular to the propagation direction, it is generally assumed that James Clerk Maxwell derived this idea from his electromagnetic theory of light. Well, the picture does indeed follow from the sinusoidal solutions to the electromagnetic wave equations that were derived by Maxwell, but that doesn't mean that the sinusoidal solutions themselves represent the full picture. If we simply assume the diagram, Fig. 66/67 above, as being the full picture, then the sinusoidal solutions do follow, and vice-versa, but to do so leads to a discrepancy with respect to the curl equations with which Maxwell derived the electromagnetic wave equations in the first place. These curl equations, when analysed directly, tell us that **E** and **B** are actually out of phase in time and space by ninety degrees, when in an oscillating context.

In Parts I and II of his 1861 paper, ***"On Physical Lines of Force"***, **[1]**, Maxwell physically constructed the magnetic field from a sea of tiny aethereal vortices, and from this context he then explained both magnetic force and

electromagnetic induction. Meanwhile, in Part III of this same paper, Maxwell's sea of vortices morphed into a dielectric sea and he linked the dielectric constant to the transverse elasticity. After applying this linkage to Newton's equation for the speed of a wave in an elastic solid, he numerically linked this speed to the ratio between electromagnetic units and electrostatic units. Meanwhile this speed had been identified with the speed of light in 1857 by Gustav Kirchhoff, [2], while Kirchhoff in turn was basing this observation on the results of the famous experiment carried out in 1855 by Weber and Kohlrausch, in which they discharged a Leyden jar to Earth through a conducting wire, [3].

It was this sequence of reasoning that led Maxwell to believe that light waves are transverse waves in the same medium that is the cause of electric and magnetic phenomena, and he conceived the concept of displacement current in connection with dielectric polarization in space. Ironically therefore, Maxwell ignored his vortex sea theory when it came to guessing the physical nature of electromagnetic waves. Years later though, somebody else who remains unknown invoked the involvement of vortices to explain the physical nature of electromagnetic waves. A summary of their explanation is recorded in the 1937 Encyclopaedia Britannica article, ***"Ether (in physics)"***. In connection with the speed of light, the article says, [4],

Possible Structure. −, "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 same order of magnitude as the vortex or circulation speed"

While it is unlikely that this medium is actually incompressible, the wave displacement mechanism will however be fine-grained angular in nature and will not therefore hinge on whether the medium is compressible or not.

Time-Varying Electromagnetic Induction

II. It was in Maxwell's 1865 paper, ***"A Dynamical Theory of the Electromagnetic Field"***, [5], where he actually first derived the electromagnetic wave equation in **B**, by which time, but without actually highlighting the fact, he had altered the concept of displacement current by replacing the electrostatic **E** field of linear polarization with the **E** field that is associated with time-varying EM induction. Meanwhile, immediately after the derivation of this electromagnetic wave equation, Maxwell stated that the direction of magnetization of the magnetic disturbance lies in the plane of the wave, but this

conclusion only followed because the derivation began on that condition from the outset.

The Plane Wave Solutions

III. In Maxwell's 1873 Treatise, **[6]**, in *Chapter XX* entitled, *"Electromagnetic Theory of Light"*, Maxwell continues with his long-standing assumption that electromagnetic waves are plane waves, with the **A**, **B**, and **E**, fields lying in the plane of the wave. This is the chapter where Fig.66/67 above appears. A particularly interesting feature in this derivation of the electromagnetic wave equations is the way that Maxwell imposes the plane wave restriction into the equation $\nabla\times\mathbf{A} = \mathbf{B}$, leading to the modified equation **(13)**, which is the starting equation in the analysis. But in doing so, he loses the vortex relationship that is implied by the full equation. In the full equation, **A** and **B** are in phase, but by applying it to the dynamic state in connection with a wave, and then restricting the spatial differentiation to the propagation axis while ignoring all components of **A** and **B** that are not perpendicular to the propagation axis, the remaining perpendicular components of **A** and **B** will now be out of phase with each other by ninety degrees in the context of a sinusoidal wave. Meanwhile the electric force, **E**, in the wave, arises from time-varying EM induction, and since $\mathbf{E} = -\partial\mathbf{A}/\partial t$, then in general, **E** and **A**, (and hence **E** and **B**), will be out of phase by ninety degrees. But based on the plane wave restriction, their perpendicular components will now be in phase with each other.

We cannot however assume that the plane wave solutions represent the full physical picture. They ignore the involvement of vortices in the electromagnetic wave-carrying medium.

Conclusion - The Vortex Solution

IV. It is here proposed that an electromagnetic wave is a propagated fine-grained precession through a sea of tiny aethereal vortices, with the precession axis being perpendicular to both **B** and the propagation direction. The wave propagation mechanism is therefore independent of the already existing orientation of the vortices within the prevailing background steady state magnetic field alignment. Then, in order to account for the dielectric property of this wave-carrying medium, it is proposed that the vortices are dipolar, each containing a sink (electron) and a source (positron) in mutual orbit with each other, and with their circumferential speeds equal to the speed of light, **[7]**, **[8]**. The momentum within an electromagnetic wave is then explained by aether (electric fluid) swirling at the speed of light from the positron of one vortex to the electron of its immediate neighbour along the line of propagation as the wave passes through. Electron-positron pair annihilation never actually happens as such. When it appears to have happened, what has really occurred is that a

liberated electron and positron have bonded back into the vortex sea while releasing two gamma ray pulses. This released energy is analogous with the latent heat of fusion that we observe in the case of ponderable matter, **[9]**, **[10]**.

Fig. 66/67 is therefore only a two-dimensional shadow, in the *xy*-plane, of what is actually taking place, and indeed neither **E** nor **B** should be crossing into the negative quadrant. The **E** field is in fact the propagating causal force, always positive, and acting tangentially or axially on the vortices, hence causing a torque. This torque propagates through the sea of vortices, causing them to precess, and so the graph should really look like a case of full-wave rectification, with neither a negative **E** nor a negative **B** being involved. In order to illustrate this mechanism with reference to Fig. 66/67, consider the particular case in which an electromagnetic ray is perpendicular to the prevailing background magnetic field, such that **B** will be perpendicular to the propagation axis when in the undisturbed state. As the wave passes through, **E** will force **B** to tumble/precess about an axis perpendicular to the propagation direction and to itself. As it tumbles, **B** will increase in magnitude, but as in the way that rotational motion can be converted to linear simple harmonic motion in a shadow, **B** will appear to reduce down to its minimum in Fig. 66/67, since the perpendicular component of **B** will be vanishing. The same argument holds for any initial orientation of **B**, except that the time phase of **B** will be different in each case, with respect to Fig. 66/67. And note, that while **E** reduces to zero during every cycle, **B** only reduces to a minimum steady state value.

Meanwhile, the full equation, $\nabla\times\mathbf{A} = \mathbf{B}$, tells us that **A** is a circulating momentum and that **B** is a vorticity, and hence **B** represents fine-grained kinetic energy. Equation $\nabla\times\mathbf{A} = \mathbf{B}$ also tells us that **A** and **B** are in phase with each other, and so if we fix the coordinates within the body of the vortices rather than only considering a two-dimensional projection of the precessions, this will bring the phase relationship, as between **E** and **B**, into line with the standard position that a force and a kinetic energy in an oscillating system are always out of phase with each other by ninety degrees. **E** and **B** will therefore be out of phase with each other by ninety degrees when the full vortex picture is considered.

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For an English translation by Professor A.K.T. Assis, see chapters 6 and 7 in this link, and especially page 179 regarding mentions about the speed of light.
https://www.ifi.unicamp.br/~assis/Weber-in-English-Vol-3.pdf
Prof. A.K.T Assis has also written an excellent summary of this work in an article entitled ***"On the First Electromagnetic Measurement of the Velocity of Light by Wilhelm Weber and Rudolf Kohlrausch"***,
https://www.ifi.unicamp.br/~assis/Weber-Kohlrausch(2003).pdf
Weber and Kohlrausch further wrote a short precis of their paper, and this can be found in Poggendorf's Annalen, vol. XCIX, pp. 10-25. An English translation of this precis is presented in the appendix at the end of Prof. Assis's paper.
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"All space, according to the younger 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."

Summary

In an electromagnetic wave, the electric field, $\mathbf{E} = -\partial\mathbf{A}/\partial t$, is the propagating force. It acts tangentially/axially on the tiny rotating electron-positron dipoles that fill all of space and which make up the electromagnetic wave-carrying medium. This results in a torque which causes the vortices to precess about an axis that is perpendicular to both the direction of propagation and to the magnetic field, **B**, and as in the case of a gyroscope, the precession axis will also be perpendicular to the torque axis.

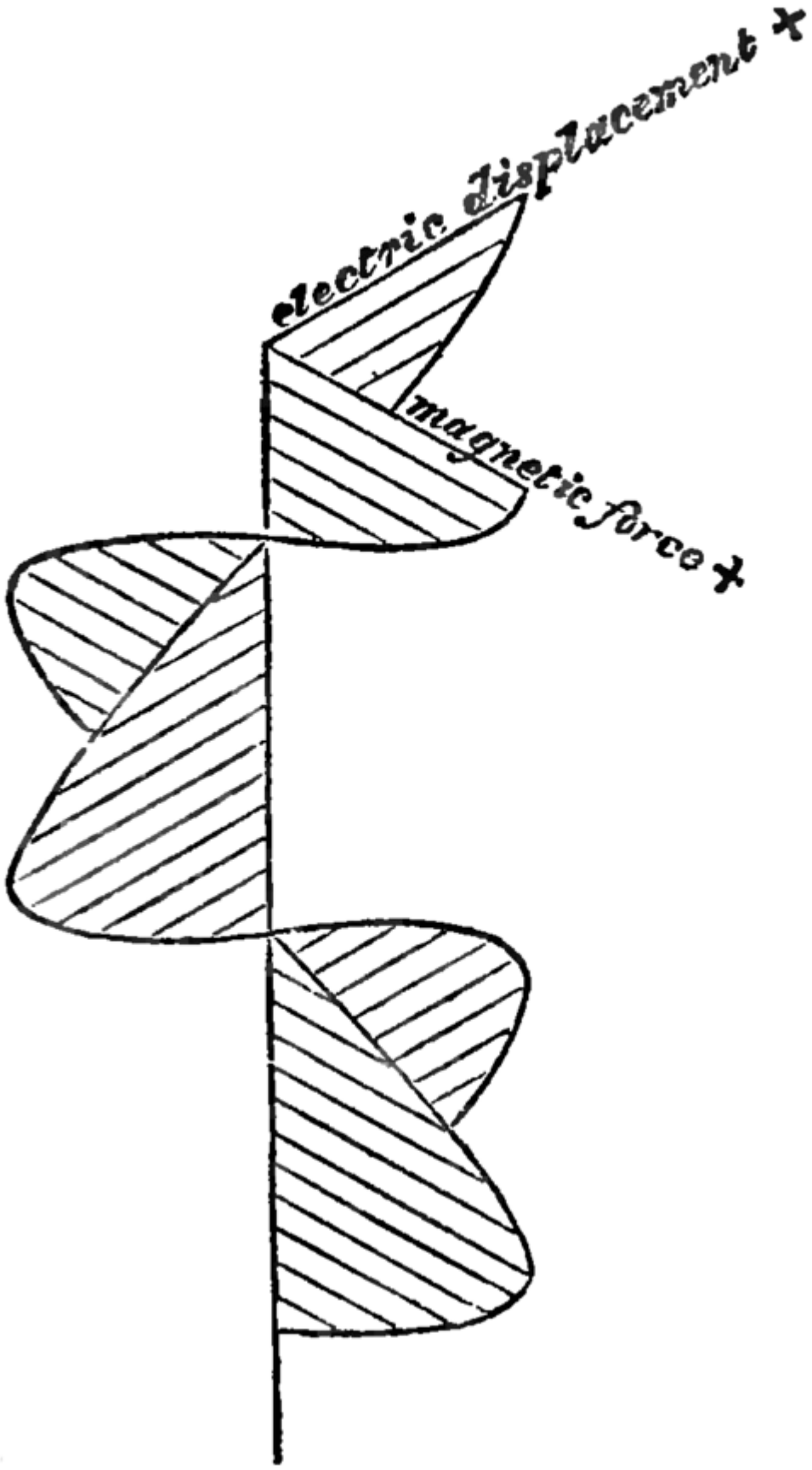
Meanwhile, the equation $\nabla\times\mathbf{A} = \mathbf{B}$ fits within the vortices such that **A** is the circumferential momentum, while the magnetic field **B** is simply the vorticity. If *z* is the propagation axis, we can always orientate the picture such that **B** will be rotating in the *yz*-plane about an axis in the *zx*-plane. As such, it doesn't matter at what angle a ray of electromagnetic radiation crosses the prevailing background magnetic field. If we take a starting point in time, then **B** will be pointing in the *y* direction in the case of a ray that is perpendicular to the prevailing magnetic field, and it will begin to rotate in the *yz*-plane at the moment when the **E** force strikes. In the case of a ray that is parallel to the background magnetic field, **B** will begin parallel to the *z* axis. This principle then extends to all propagation angles in between the perpendicular case and the parallel case.

As the vortices precess, electric fluid (aether) emerges from the positron source of one vortex and swirls across and into the electron sink of its immediate neighbour. This is the basis of the wave's momentum which is observed as radiation pressure. Meanwhile, the speed of this wave-like electric fluid flow is determined by the circumferential speed of the vortices, which is the speed of light.

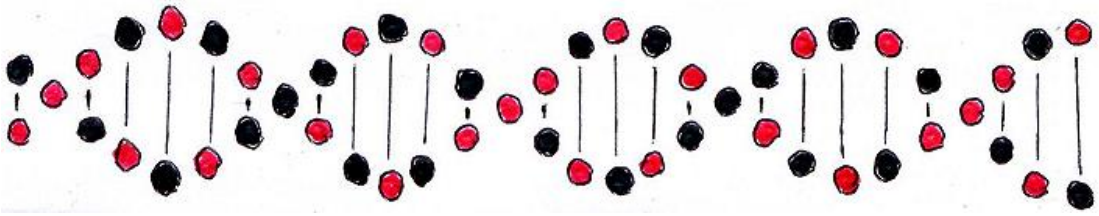
In the case of the steady state background magnetic field, where the vortices are undisturbed, no net electric fluid passes between neighbouring vortices. The vortices must be precessing in order to facilitate a net fluid exchange. In the steady state, the vortices are aligned in a double helix arrangement such that an electrostatic tension prevails along the magnetic lines of force. This is due to the electrostatic attraction between the electrons and positrons, the rotating dipoles being mutually aligned along their rotation axes.

This is the basis of magnetic attraction between unlike magnetic poles. Meanwhile a centrifugal pressure emanates in the equatorial plane of the vortices as they strive to dilate but are all hemmed in by each other, [11]. This is the basis of magnetic repulsion between like-magnetic poles, since in this case, the two sets of magnetic field lines push sideways against each other.

Fig. 66/67 from Maxwell's 1873 Treatise



The Steady State



The figure above portrays a single magnetic field line comprised of a double helix of rotating electron-positron dipoles. The vertical lines marked in the diagram represent the equatorial planes of these dipolar vortices, and due to centrifugal force and the fact that the aether (electric fluid) can't pass through itself, then, ***when in the steady state***, no electric fluid crosses between the electrons and positrons at right angles to the field lines. In the axial direction, however, there is a mutually cancelling bi-directional flow. A ray of light can, however, cross such magnetic lines of force at any angle. The precession of the vortices, when in the dynamic state, allows for the electric fluid to pass between neighbouring vortices at any angle, irrespective of their default alignment when in the steady state, and it is this net flow of electric fluid that constitutes electromagnetic radiation. Electromagnetic radiation is therefore a relay of tiny electric currents in space, and these electric currents are what gives rise to radiation pressure.