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Maxwell's Original Equations

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Abstract:- Although Maxwell's most important equations had already appeared throughout his seminal paper entitled ***"On Physical Lines of Force"*** **[1]**, which was written in 1861, it was not until 1864 that Maxwell created a distinct listing of ***eight*** equations in his follow up paper known as ***"A Dynamical Theory of the Electromagnetic Field"*** **[2]**. This was in a section headed as '*General Equations of the Electromagnetic Field'*. While Maxwell refers to ***twenty*** equations at the end of this section, there are in fact only eight equations as such. Maxwell arrives at the figure of twenty because he splits six of these equations into their three Cartesian components. Maxwell's eight original equations,

$$\mathbf{J}_{\mathbf{total}} = \mathbf{J}_{\mathbf{conduction}} + \partial \mathbf{D}/\partial t \qquad \textbf{(A)}$$
$$\nabla\times\mathbf{A} = \mu\mathbf{H} \qquad \textbf{(B)}$$
$$\nabla\times\mathbf{H} = \mathbf{J}_{\mathbf{total}} \qquad \textbf{(C)}$$
$$\mathbf{E} = \mu\mathbf{v}\times\mathbf{H} - \partial\mathbf{A}/\partial t - \nabla\psi \qquad \textbf{(D)}$$
$$\mathbf{D} = \varepsilon\mathbf{E} \qquad \textbf{(E)}$$
$$\mathbf{E} = R\mathbf{J}_{\mathbf{conduction}} \qquad \textbf{(F)}$$
$$\nabla\cdot\mathbf{D} = \rho \qquad \textbf{(G)}$$
$$\nabla\cdot\mathbf{J} + \partial\rho/\partial t = 0 \qquad \textbf{(H)}$$

will be discussed in depth in individual sections throughout this paper.

Displacement Current

I. The first in the list of eight equations appearing in Maxwell's 1865 paper **[2]** is,

$$\mathbf{J}_{\text{total}} = \mathbf{J}_{\text{conduction}} + \partial\mathbf{D}/\partial t \qquad \textbf{(Total Electric Current)} \qquad \textbf{(A)}$$

It is a statement to the extent that the total electric current is the sum of the conduction current and the *'displacement current'*. Maxwell believed that the electromagnetic wave propagation mechanism involves a physical displacement, **D**, in an elastic solid, and he conceived of displacement current, $\partial\mathbf{D}/\partial t$, in relation to this displacement mechanism. Maxwell then added $\partial\mathbf{D}/\partial t$ to Ampère's circuital law as an extra term, as at equation (112) in his 1861 paper **[1]**. Maxwell seems to have misidentified the physical displacement mechanism in electromagnetic radiation with linear polarization in a dielectric, and this misidentification has resulted in the phenomenon being mis-associated with electric capacitor circuits. Electromagnetic waves however propagate sideways from an electric current, so we therefore require an alternative explanation for the displacement mechanism that is not confined to the space between the plates of a capacitor, and it is most unlikely that we would ever wish to sum such an alternative form of displacement current together with a conduction current in the same equation. It is argued in ***"Displacement Current in the Two Gauges"***, **[3]**, that the displacement current that is used in the derivation of the electromagnetic wave equations is actually a special case of the conduction current itself. It's a transverse current relative to the tiny molecular vortices that Maxwell believed to fill all of space, and it's such that its divergence is always zero.

The confusion became exacerbated in the twentieth century when the aether was dropped from physics altogether.

The Fly-Wheel Equation

II. Maxwell's second equation appeared as equation (55) in Part II of the 1861 paper, and it exposes the fine-grained rotational nature of the magnetic field. Maxwell identified Faraday's *'electrotonic state'* with a vector **A** which he called the *'electromagnetic momentum'*. The vector **A** relates to the magnetic intensity, **H**, through the curl equation,

$$\nabla\times\mathbf{A} = \mu\mathbf{H} \qquad \textbf{(Magnetic Force)} \qquad \textbf{(B)}$$

The vector **A** is the momentum of free electricity per unit volume, and so in principle it is the same thing as the vector **J** that is used to denote electric current density. It's only the context that differs. The vector **A** is used in the context of the fine-grained circular flow within a magnetic field, and so it must correspond to Maxwell's displacement current. The coefficient of magnetic induction, μ, is closely related to mass density and it would appear to play the role of *'moment of inertia'* in the magnetic field. According to Maxwell in 1861, the electrotonic state corresponds to ***"the impulse which would act on the axle of a wheel in a machine if the actual velocity were suddenly given to the***

driving wheel, the machine being previously at rest.” He expands upon this fly-wheel analogy in his 1865 paper **[2]**, in sections (24) and (25).

Since the divergence of a curl is always zero, equation **(B)** can be used to derive the equation $\nabla\cdot\mathbf{H} = 0$, which is equation (56) in Maxwell’s 1861 paper, and which appears as an alternative to equation **(B)** in modern listings of Maxwell’s equations.

Ampère’s Circuital Law

III. In Part I of his 1861 paper, Maxwell proposed the existence of a sea of molecular vortices which are composed of a fluid-like aether. Maxwell’s third equation is derived hydrodynamically, and it appears as equation (9) in Part I,

$$\nabla\times\mathbf{H} = \mathbf{J} \qquad \textbf{(Electric Current)} \qquad \textbf{(C)}$$

In Part II of the same paper, Maxwell added electric particles to his aethereal vortices. These particles circled around the edge of the vortices and acted as idler wheels. If we apply equation **(C)** to a single vortex, the vector **J** becomes the electromagnetic momentum vector **A**. Equations **(B)** and **(C)** together point us to an aethereal sea in which closed solenoidal circuits of vortex axes (magnetic lines of force) are interlocked with fine-grained circulations of electric particles ‡. Vector **A** is therefore the displacement current in the sea of molecular vortices.

Part III of Maxwell’s 1861 paper deals with the elasticity of the sea of vortices. At the beginning of Part III, Maxwell says,

“In the first part of this paper I have shown how the forces acting between magnets, electric currents, and matter capable of magnetic induction may be accounted for on the hypothesis of the magnetic field being occupied with innumerable vortices of revolving matter, their axes coinciding with the direction of the magnetic force at every point of the field. The <u>centrifugal force</u> of these vortices produces pressures distributed in such a way that the final effect is a force identical in direction and magnitude with that which we observe.” James Clerk Maxwell, 1861

The magnetic intensity **H** therefore represents an angular momentum or a vorticity. Maxwell further says in the same part,

“I conceived the rotating matter to be the substance of certain cells, divided from each other by cell-walls composed of particles which are very small compared with the cells, and that it is by the motions of these particles, and

their tangential action on the substance in the cells, that the rotation is communicated from one cell to another.” James Clerk Maxwell, 1861

‡*When equation **(C)** is applied on the large scale, electric current is a solenoidal flow of aether in which a conducting wire acts like a pipe. The pressure of the flowing aether causes it to leak tangentially into the surrounding sea of tiny vortices, causing the vortices to angularly accelerate and to align solenoidally around the circuit, hence resulting in a magnetic field.*

The Lorentz Force

IV. Maxwell’s fourth equation originally appeared as equation (77) in Part II of his 1861 paper, and it takes the form,

$$\mathbf{E} = \mu\mathbf{v}\times\mathbf{H} - \partial\mathbf{A}/\partial t - \nabla\psi \qquad \textbf{(Electromotive Force)} \qquad \textbf{(D)}$$

Maxwell referred to **E** as *‘electromotive force’*, but it actually corresponds more closely to the modern day *‘electric field’* or *‘force per unit charge’*, and not to the modern-day electromotive force which is in fact a voltage. This distinction in terminology is however insignificant as regards the main purpose. The first of the three terms on the right-hand side, $\mathbf{E_C} = \mu\mathbf{v}\times\mathbf{H}$, is the *compound centrifugal force* (Coriolis force) which acts on an element of electric current that is moving with velocity **v** in a magnetic field, where **v** is measured relative to the sea of molecular vortices. The solenoidal alignment of the tiny vortices causes a differential centrifugal pressure to act on either side of the element when it is moving at right angles to the rotation axes of the vortices, and this causes a deflection in the path of motion. The second term involves the electromagnetic momentum **A**, nowadays referred to as the *magnetic vector potential*. This term, $\mathbf{E_K} = -\partial\mathbf{A}/\partial t$, is the circumferential force acting on the vortices which appeared as equation (58) in the 1861 paper and which is tied up with time-varying electromagnetic induction and with the displacement mechanism in electromagnetic radiation.

If we accept that $\mathbf{J} = +\varepsilon\partial\mathbf{E_K}/\partial t$ is equivalent to **A** in the context, then the second term on the right-hand side of equation **(D)** leads us to the simple harmonic relationship, $\mathbf{A} = -\varepsilon\partial^2\mathbf{A}/\partial t^2$, for the circumferential momentum in the tiny vortices. In Part VI of his 1865 paper, Maxwell uses displacement current in conjunction with equations **(B)** and **(C)** in order to derive the electromagnetic wave equation in **H** **[2]**. Equation **(B)** introduces the density of the wave carrying medium, while equation **(C)** introduces the elasticity factor through the displacement current. Since displacement current, **A**, is transverse to the tiny vortices, then we are dealing with fine-grained rotational elasticity. We can therefore deduce that Maxwell’s displacement current was ideally supposed to be connected with a fine-grained angular displacement in the tiny molecular vortices. In a steady state magnetic field, the displacement current is ubiquitous as a fine-grained localized circulation, but in the dynamic state where $\partial \mathbf{A}/\partial t$ is non-zero, the tiny vortices angularly accelerate and decelerate while pressurized aether overflows from vortex to vortex. This fine-grained vortex flow of aether constitutes electromagnetic radiation and its momentum is maintained on the principle of the fly-wheel **[4]**.

Finally, the third term in equation **(D)** is just the electrostatic term $\mathbf{E_S}$, where ψ refers to the electrostatic potential. If we take the curl of equation **(D)** in its entirety, we end up with $\nabla\times\mathbf{E}_{total} = -d\mathbf{B}/dt$, which is unfamiliar because of the total time derivative. If however we ignore the $\mu\mathbf{v}\times\mathbf{H}$ term in equation **(D)**, since it is not used in the derivation of the electromagnetic wave equation, and then take the curl, we end up with the familiar partial time derivative form, $\nabla\times\mathbf{E_K} = -\partial\mathbf{B}/\partial t$. Heaviside referred to this partial time derivative curl equation as *'Faraday's Law'*. Strictly speaking, it is not exactly Faraday's law because it doesn't cover for the convective aspect of electromagnetic induction that is described by the $\mu\mathbf{v}\times\mathbf{H}$ term. The equation $\nabla\times\mathbf{E_K} = -\partial\mathbf{B}/\partial t$ appeared as equation (54) in Maxwell's 1861 paper, and it also appears in the modern listings of four Maxwell's equations. Interestingly, because these modern listings don't cover for the $\mu\mathbf{v}\times\mathbf{H}$ force, they have to be supplemented by Maxwell's equation **(D)** from the original list. And even more interesting still is the fact that Maxwell's original equation **(D)** is introduced in modern textbooks, under the misnomer of ***'The Lorentz Force'***, as being something extra that is lacking in Maxwell's equations, and which is needed as an extra equation to compliment Maxwell's equations, in order to make the set complete, as if it had never been one of Maxwell's equations in the first place! Maxwell in fact derived the so-called Lorentz force when Lorentz was only eight years old.

The reason for the name *'Lorentz force'* is because when we apply a Lorentz transformation to the sum $\partial\mathbf{A}/\partial t - \nabla\psi$, we obtain $\mu\mathbf{v}\times\mathbf{H}$, which means that the Lorentz aether theory must be using Maxwell's sea of aether vortices as its physical rest frame. It is also important to note that the actual *Lorentz factor* itself, also known as the *gamma factor*, $\gamma = 1/\sqrt{(1 - v^2/c^2)}$, plays no role in the connection between Maxwell and Lorentz. The bridge that connects Maxwell with Lorentz is exclusively due to the *beta factor*, v/c, which originates in Weber's Force Law of 1846 **[5]**. This is a very important fact to note since it debunks the widely held notion that Einstein's special theory of relativity is rooted in Maxwell's equations. The *gamma factor* serves a bridge between Lorentz and Einstein, and it's a bridge that should never have been crossed, but it's the beta factor which serves as the bridge between Maxwell and Lorentz. In respect of the beta factor aspect, a Lorentz transformation acts in a similar manner to how the Coriolis force, which is what $\mu\mathbf{v}\times\mathbf{H}$ actually is, is produced by the double differentiation of a radial position vector that is expressed in polar coordinates. These transformations first produce a curl and then a cross product, and this aspect of a Lorentz transformation is observable at laboratory speeds, and it has got nothing to do with the gamma factor. It's not a so-called relativistic effect as is often claimed by relativists.

When Einstein foolishly cast out the aether in 1905, he pulled the rug from below the entire operation.

Elasticity, Dielectric Constant, and Permittivity

V. Maxwell's fifth equation is the equation of electric elasticity which first appeared in the preamble of Part III of his 1861 paper and then again at equation (105) in the same part. In 1864, the negative sign was officially removed, and it appeared in the form,

$$\mathbf{D} = \varepsilon\mathbf{E} \qquad \textbf{(Electric Elasticity Equation)} \qquad \textbf{(E)}$$

In Part II of the 1861 paper, Maxwell added electric particles to the tiny vortices that featured in Part I. These electric particles moved around the circumference of the vortices and acted as idler wheels. In Part III, the sea of molecular vortices along with the accompanying idler wheel electric particles morphed into an elastic dielectric solid. The electric permittivity, ε, is related to the elasticity of the dielectric solid although it should be noted that Maxwell actually used a dielectric constant which is inversely related to the permittivity. The elasticity constant is central to electromagnetic radiation, since through the 1855 Weber-Kohlrausch experiment [5], it introduces the speed of light.

Knowing that Newton's equation for the speed of a wave in an elastic solid involves the ratio of transverse elasticity to density, Maxwell was able to equate this ratio to the ratio of the dielectric constant to the coefficient of magnetic induction. Maxwell then showed that the ratio of the dielectric constant to the coefficient of magnetic induction was equivalent to the ratio of electrostatic units of electricity to electromagnetic units of electricity, this ratio being closely related to the directly measured speed of light. In 1855 Weber and Kohlrausch, by discharging a Leyden jar, equivalent to a modern-day capacitor, had shown that the ratio of electrostatic units to electrodynamic units was numerically equal to $c\sqrt{2}$, and in 1861, Maxwell made the conversion from electrodynamic units to electromagnetic units. Maxwell was therefore able to insert a numerical result into Newton's equation and hence conclude that waves in the luminiferous medium travel at the speed of light, and that hence light must be a transverse undulation in the same medium that is the cause of electric and magnetic phenomena. In his own words he stated,

"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" James Clerk Maxwell, 1861

In establishing this fact, Maxwell had inadvertently demonstrated at equation (132) in his 1861 paper, that Newton's equation for the speed of a wave in the luminiferous medium is equivalent to the famous equation $\mathbf{E} = mc^2$ that is normally attributed to Albert Einstein. This Newton-Maxwell equation, wrongly attributed to Einstein more that forty years later, can alternatively be written as the well-known equation $c^2 = 1/\mu\varepsilon$. It should always be remembered though that Maxwell in turn obtained the numerical values from the 1855 experiment of Weber and Kohlrausch. It is often wrongly assumed that the numerical value of the speed of light itself fell out of Maxwell's theoretical manipulations. This is not so. The genius of Maxwell's theoretical work was in exposing the physical significance of the 1855 Weber-Kohlrausch result by using Newton's equation in relation to a dielectric solid.

Ohm's Law

VI. Maxwell's sixth equation is Ohm's law,

$\mathbf{E} = R\mathbf{J}_{\text{conduction}}$ **(Ohm's Law)** **(F)**

where R is the specific resistance referred to unit volume. Ohm's law is an equation which is of interest in electric circuit theory, but it holds no interest value in terms of the connection between the electric current and the magnetic field.

Gauss's Law

VII. Maxwell's seventh equation appeared as equation (115) in his 1861 paper,

$\nabla\cdot\mathbf{D} = \rho$ **(Gauss's Law)** **(G)**

Gauss's law is an equation of aether hydrodynamics and the quantity ρ is the density of *'free electricity'*. Free electricity can only mean *the aether,* alternatively known as the *electric fluid*. While the aether itself behaves like a fluid, the luminiferous medium in its totality is a solid that is comprised of densely packed aether vortices, and this can lead to it also exhibiting fluid characteristics such as when ponderable matter is passing through it. The repulsive electromagnetic forces and the inertial forces are based on the centrifugal pressure that exists between neighbouring vortices as they press against each other while striving to dilate **[6]**. Gauss's law deals with the flow of aether into and out of sources and sinks which we call positive and negative particles.

Maxwell knew that gravitational field lines must involve a lateral pressure as is the case between two repelling like magnetic poles, but he failed to realize that this pressure in the gravitational field is actually the inverse cube law centrifugal repulsive pressure as opposed to the inverse square law gravitational attractive tension.

The Equation of Continuity

VIII. Maxwell's eighth equation, number (113) in his 1861 paper,

$\nabla\cdot\mathbf{J} + \partial\rho/\partial t = 0$ **(Equation of Continuity)** **(H)**

is the equation of continuity, which like equation **(G)** *(Gauss's law)*, is another equation of hydrodynamics.

Magnetization and Linear Polarization

IX. Maxwell's papers of 1861 and 1865 make no explicit mention of the concept of electric charge. Maxwell talks about *'free electricity'* and *'electrification'*. By free electricity, it would appear that he is talking about a fluid-like aethereal substance that corresponds to the vitreous electric fluid of Franklin, Watson, and DuFay, and it would appear that when Maxwell is talking about the density of free electricity that he is talking about a quantity which corresponds very closely to the modern concept of electric charge. Charge would therefore appear to be aether pressure and aether tension. Such a hydrodynamical approach to charge enables us to explain how net charge enters an electric circuit when it is switched on, as like water coming from a tap. An actual substance enters the circuit from the outside.

If Maxwell's aethereal vortices are dipolar, each comprised of an aether sink (electron) and an aether source (positron), magnetic charge can then be understood as electrostatic charge channelled along a double helix **[7]**. On knowing this, nobody is going to be asking questions like *'why can we not find magnetic monopoles?'* The magnetic equation $\nabla\cdot\mathbf{H} = 0$ describes the solenoidal nature of the lines traced out by the rotation axes of neighbouring vortices. This equation is simply Gauss's law for bi-directional aether flow, and magnetic charge is simply the electrostatic tension along the magnetic lines of force. There are no magnetic monopoles. We are dealing with cylindrical symmetry. There are only electric monopoles, and in a magnetic field, positive electric monopoles and negative electric monopoles exist in equal numbers, leading to overall electric neutrality. It is the double helix alignment of positive and negative electric monopoles that is the secret of magnetic charge in relation to magnetic attraction, and the magnitude of the magnetic attractive force will depend on the concentration of magnetic lines of force, and hence it will depend on the magnetic flux density, **B**, which is equal to μ**H**. Magnetization is something that is connected with wireless telegraphy. It is a fine-grained rotational effect associated with the angular acceleration of the molecular vortices that fill all of space. Electromagnetic waves radiate outwards from the side of a changing electric current. The tiny vortices in the magnetized state are acting like fly-wheels.

Linear polarization on the other hand is slightly more complicated and it involves the dipolar nature of the molecular vortices **[8]**. When, in Part III of his 1861 paper, Maxwell first established the connection between the speed of light and the elasticity of the luminiferous medium, he did so on the basis of linear polarization in a dielectric solid. This elasticity was then later transferred into the electromagnetic wave equation that he derived in his 1865 paper **[2]**. Maxwell had now applied the linear elasticity of a dielectric to a theory of magnetism that was based on the rotational elasticity of vortices and fly-wheels. It might be argued that this was a force-fit. Linear elasticity in a dielectric can however be reconciled with rotational elasticity if the constituent dipoles are rotating. This is because the polarizing electric field will cause a torque to act on the rotating dipoles. This would suggest that the electric permittivity of the luminiferous medium applies equally to the elasticity of linear polarization and to magnetization, as in both cases the elasticity is transverse and rotational. In the case of a capacitor, the linear polarization between the plates will result in the rotating dipoles precessing, and this will prevent a magnetic field from forming, whereas in the case of a conduction current where the electrostatic field is at right angles to a magnetic field, this will enhance the magnetic field. This is where magnetization and linear polarization converge, as occurs in electromagnetic radiation.

Conclusion

X. The electromagnetic wave propagation mechanism depends upon the existence of a sea of tiny molecular vortices pervading all of space, as advocated by James Clerk Maxwell in 1861. Maxwell's equations were derived using hydrodynamics and elasticity based on the existence of such a physical medium, and these equations therefore cease to have any meaning in physics once this medium is removed. Weber and Kohlrausch first made the connection between electromagnetism and the speed of light in 1855 by discharging a Leyden jar (capacitor) and measuring the ratio of electrostatic to electrodynamic units of electricity [4]. The significance of Maxwell's original papers is that they connect light with an all-pervading elastic solid which enables the electromagnetic induction mechanism to operate throughout all of space. It is generally forgotten that the equation $c^2 = 1/\mu\varepsilon$ follows from the 1855 Weber-Kohlrausch experiment and not from Maxwell's equations themselves. Maxwell connected this equation with Newton's equation for the speed of a wave in an elastic solid, hence inadvertently showing its equivalence to $\mathbf{E} = mc^2$, but unless we numerically establish the electric permittivity experimentally using a discharging capacitor, we can have no basis whatsoever to assume the existence of an equation of the form $c^2 = 1/\mu\varepsilon$.

Unfortunately, Maxwell didn't distinguish clearly enough between the rotational magnetization mechanism on the one hand, and the linear polarization mechanism on the other hand, in relation to the physical nature of the displacement that is involved in electromagnetic radiation. Had he done so, he would have realized that the magnetic vector potential, **A**, that he linked to Faraday's *electrotonic state*, is in fact his famous displacement current.

Nevertheless, Maxwell's original works are pioneering works of enormous value which pointed us in the right direction, and any shortcomings within these works pale into insignificance when compared with the major error that followed in Maxwell's wake. Had Lorentz simply used Maxwell's sea of molecular vortices as the physical justification for the *beta factor* aspect of the Lorentz transformations, then everything would have been fine. We would have had a rest frame within which the transformations are rooted. But in 1905, Einstein cast out the aether and destroyed any rationale behind the entire operation. In fact, Einstein removed the entire floor of the universe. We then ended up in an absurd world of relativity where two clocks can both tick slower than each other, and where electromagnetic waves can propagate in a pure vacuum without the need for any physical displacement mechanism.

Since 1983, the situation has degenerated even further still. The speed of light is now a defined quantity rather than a measured quantity, and the equation $c^2 = 1/\mu\varepsilon$ has become a meaningless conversion formula without any enquiry as to its physical origins. Hence the physical elasticity *(electric permittivity ε)* that is connected with the electromagnetic wave propagation mechanism has been eaten up by one big mathematical tautology, and to make matters worse, those supporting Einstein's theories of relativity have the audacity to claim that these theories are a natural consequence of Maxwell's work, when in fact Maxwell and Einstein were not even remotely working along the same lines. Maxwell is quite clear about the fact that the $\mu\mathbf{v}\times\mathbf{H}$ force is a centrifugal force *(more precisely a compound centrifugal force (Coriolis force))*, and that the velocity, **v**, is measured relative to the physical medium for the propagation of light.

Modern physics is languishing in a totally misguided relativity-based paradigm in which physicists have been brainwashed into believing that neither centrifugal force nor the aether exist **[9]**. This problem could be solved to a large degree by adopting the Lorentz aether theory in conjunction with Maxwell's sea of molecular vortices.

References

[1] Clerk-Maxwell, J., ***"On Physical Lines of Force"***, Philosophical Magazine, Volume XXI, Fourth Series, London, (1861)
http://vacuum-physics.com/Maxwell/maxwell_oplf.pdf

[2] Clerk-Maxwell, J., ***"A Dynamical Theory of the Electromagnetic Field"***, Philos. Trans. Roy. Soc. London **155**, pp 459-512 (1865). Abstract: Proceedings of the Royal Society of London 13, pp. 531--536 (1864). The original eight Maxwell's equations are found in the link below in Part III entitled *'General Equations of the Electromagnetic Field'* which begins on page 480,
http://www.zpenergy.com/downloads/Maxwell_1864_3.pdf
Maxwell's derivation of the electromagnetic wave equation is found in the link below in Part VI entitled *'Electromagnetic Theory of Light'* which begins on page 497,
http://www.zpenergy.com/downloads/Maxwell_1864_4.pdf

[3] Tombe, F.D., ***"Displacement Current in the Two Gauges"*** (2021)
https://www.gsjournal.net/Science-Journals/Research%20Papers-Mathematical%20Physics/Download/8948

[4] Lodge, Sir Oliver, ***"Ether (in physics)"***, Encyclopaedia Britannica, Fourteenth Edition, Volume 8, Pages 751-755, (1937)
http://gsjournal.net/Science-Journals/Historical%20PapersMechanics%20/%20Electrodynamics/Download/4105
In relation to the speed of light, *"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"*

[5] Tombe, F.D., ***"The 1855 Weber-Kohlrausch Experiment"***, (2019)
http://gsjournal.net/Science-Journals/Research%20Papers-Mathematical%20Physics/Download/6314

[6] Whittaker, E.T., ***"A History of the Theories of Aether and Electricity"***, Chapter 4, pages 100-102, (1910)
"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."

[7] Tombe, F.D., ***"The Double Helix and the Electron-Positron Aether"*** (2017)
https://www.researchgate.net/publication/319914395_The_Double_Helix_and_the_Electron-Positron_Aether

[8] Tombe, F.D., ***“Cable Telegraphy and Poynting’s Theorem”***, (2019)
https://www.researchgate.net/publication/334654102_Cable_Telegraphy_and_Poynting's_Theorem

[9] Tombe, F.D., ***“The Rattleback and the Gyroscopic Force”***, (2010)
https://www.researchgate.net/publication/299287781_The_Rattleback_and_the_Gyroscopic_Force