This is the magnitude of the potential energy of the electron. This value divided by the radius of the orbit would give the magnitude of the force shown above.

What must be decided at this point is what will be the first trial length of the photon? Then also, what corresponding division of the potential energy is carried by an individual photon? There is only one fundamental physical representation of length; therefore, until the results suggest otherwise, it is reasonable to assume the length of a photon and the length of the radius of the first energy level of an atom to be the same.

I will make this assumption for my starting point. I substitute the appropriate values into the second form of the force equation given above:

$$f_\xi = \frac{\Delta E}{\Delta x} = \frac{4.35x10^{-18}\, joules}{5.28x10^{-11}\, meter} = 8.28x10^{-8}\, newtons$$

Whether or not the denominator is the true length of a photon will be made clear in later calculations where the length of the photon is critical to giving correct known results.

The assumption made is that there is a single photon that has been emitted by the proton. At a particular instant of time, its length reaches from the proton to the electron. This assumption is only for the purposes of introducing a concept. It does not preclude the possibility that many photons may be arriving and departing at anytime. This more general treatment is not being addressed at this time.

The primary purpose of this exercise is to assume a reasonable beginning value for the length of a photon. If the length of a photon can be determined, then its value, divided by the speed of light, will yield the time of passage of a photon passing a given point. This value would be a fundamental constant with primary importance in physics.

I want to show a relationship between the photon and the energy that is transferred from one particle to the other. The complete nature of stored energy in a photon cannot be defined until mass is defined in terms of distance and time. For this reason, I will simplify the problem and treat the whole incremental value of energy involved as just stored energy.

I will solve for this energy increment by assuming it to be stored in a single photon traveling between the electron and the proton of a hydrogen atom. It is commonly known that the electron is accelerating toward the proton even though its radius of orbit does not change. The acceleration of the electron is given by:

$$\frac{dv_{er}}{dt} = \frac{v_{eT}^2}{r}$$

The left side denotes the radial acceleration of the electron. The right side denotes the square of the tangential velocity of the electron divided by the radius of orbit. I solve for the change in velocity:

$$dv_{er} = v_{eT}^2 \frac{dt}{r}$$

The radius is also the length of the photon, and the increment of time is the time of passage for the photon. Therefore:

$$\frac{r}{dt} = \frac{dx_c}{dt_c} = v_c$$

Substituting:

$$dv_{er} = \frac{v_{eT}^2}{v_c}$$

For this example, the common reference of measurement is the universal increment of time dt_C. I can, therefore, use equations analogous to those developed for the acceleration due to gravity. For measurements of acceleration:

$$dv_{er} = dv_c$$

Substituting this into the equation above:

$$dv_c = \frac{v_{eT}^2}{v_c}$$

Rearranging:

$$v_c dv_c = v_{eT}^2$$

Multiplying by the mass of the electron yields an equality of energies:

$$m_e v_c dv_c = m_e v_{eT}^2$$

The energy term on the left is an expression of photon energy. The expression on the right is the potential energy of the electron. This equation says: A photon moving between the electron and proton and holding the electron in orbit carries the potential electrical energy necessary to accomplish this. Why do we not observe photons to be emitted by the orbiting electron? The assumed answer is that when the electron is in a stable orbit, the photons involved in holding it there are passed back and forth between the electron and proton only. They do not leave the atom. This situation allows for a new approach to interpreting electric charge.

Electric Charge

The electron and proton of the hydrogen atom are said to be equally and oppositely charged. They carry the fundamental constant called electric charge with them. The magnitude of this value appears empirically to be the same for both. The current explanation of electric charge is given by electric field theory. It is normally said that a charged particle radiates an electric field away from it at the speed of light. Theoretically, for a particle that has always existed, this field is never ending. It is in existence over the size of the universe.

Since there is no empirical evidence for the substance of an electric field, its existence is only an assumption. This new theory does not use the electric field model. There is only the variation of the speed of light. Electromagnetic effects must then be derived from the variable speed of light. For all the variables and constants used in electromagnetic field theory, there needs to be a physical explanation arising naturally from the variation of the speed of light.

The first challenge is to explain the fundamental constant nature of the effect we call electric charge. I will not be distinguishing between opposite polarities at this time. The origin of opposite polarities needs to await the definition of mass. The source of the fundamental constant electric charge, however, can be identified at this time. The formula for electric force is:

$$f_{\xi} = \frac{qq}{4\pi\varepsilon r^2}$$

The letter q represents the electric charge. The example problem I am using to analyze electromagnetic effects is the hydrogen atom. The letters qq, therefore, represent the electric charge of an electron and a proton. These values are empirically determined to be of the same magnitude but to have opposite signs.

It is necessary to pursue an introductory explanation of the nature of the fundamental property of electric charge as it can be ascertained within the parameters of this new theory. Electromagnetic field theory does not provide a definition for electric charge. It is empirically determined and, therefore, it is a given. It is explained through its effects.

Since there is no empirical evidence for the substance of anything defined as a field, I need to see if this new theory can give a clear physical meaning to the origin of the phenomenon identified as electric charge. The empirical value of q is:

$$q = 1.602x10^{-19}\ coulombs$$

This value is a fundamental constant, and I should expect it to reappear as such in this new theory. The only fundamental constant I have identified for this new theory is the time period for a photon to pass a given point.

The example problem I am using is the hydrogen atom, and I have assumed the radius of the first orbit, or energy level, might be the length of a photon. This is only an assumption, but I will see if it can help to provide some useful predictions. I will use this assumption to determine a value for the increment of time required for a photon to pass a given point. This time period can be calculated to a good approximation by using the known value for the speed of light.

This theory defines the velocity of light by the expression:

$$v_c \cong \frac{\Delta x_c}{\Delta t_c}$$

The value for the increment of time in the denominator on the right side is this fundamental time period. It is also the normal increment of time I will use throughout this theory. Time is the companion to all events. This universal measure of time will be used to unify the theory.

It was Einstein's use of time dilation that allowed the theory of relativity to be applied to almost all physical events without deriving their direct physical connection. For this new theory time will again help to connect almost all physical events. However, because this increment of time has a clear physical meaning it will also help to provide the physical connections for almost all events.

The value of this increment of time can be calculated to a good approximation using:

$$\Delta t_c \cong \frac{\Delta x_c}{v_c}$$

Substituting the measured value for the speed of light, and the Bohr radius for the length of a photon gives:

$$\Delta t_c \cong \frac{5.28x10^{-11}\, meters}{2.998x10^{8}\, \frac{meters}{second}} = 1.76x10^{-19}\, seconds$$

The magnitude of the fundamental increment of time is very close to the magnitude of q. In fact, if the radius of the orbit for a hydrogen atom is assumed to be approximately:

$$\Delta x_c = 5.0x10^{-11}\, meters$$

As is indicated by empirical evidence, then:

$$\Delta t_c = 1.67x10^{-19}\, seconds$$

The coincidence of the magnitudes of the two fundamental constants grows curiously stronger. This gives cause to wonder if they are the same phenomenon. This may seem very strange to try to equate one value having the units of coulombs to another value having the units of seconds. However, a coulomb is a high level artificial unit. A guiding principle of this new theory is: A physical quantity is not properly defined until it can be explained in units of time and/or distance.

The existence of electric charge is a theoretical assumption without a physical explanation. No one knows what electric charge is. The fundamental increment of time used in this theory has a clear physical explanation. If this period of time is the real origin of the concept of electric charge then it will help and not hurt to use it in the derivation of electromagnetic effects. If the units of seconds are wrong, then the units will not match and the results will be nonsense.

I will use the fundamental increment of time in place of electric charge. It was for this reason that I did not use polarities with electric charge. Time cannot have polarities. Polarity will later be identified as a property of mass. Mass is not just a neutral resistance to force. Mass causes positive and negative variations of the speed of light. This positive and negative variation is the cause of polarity.

Electric Permittivity

The common formula for electric force contains two quantities that have not had clear physical explanations. The charge q represents an unknown nature. Also, the permittivity is only understood as a part of k, the constant of proportionality for the formula. However, since permittivity does vary, then k is not a true constant of proportionality. It might then be possible to establish k as having a physical relationship to electric force.

I wish to determine an expression for permittivity using the variables of this theory. It will be an interim expression to serve in place of the final expression that will be defined as a part of the development of my analogy to electromagnetic field theory. The reason for this interim step is that I can use it to demonstrate the physical origin of the fine structure constant.

I will use the formula for force to help form the expression for permittivity. I also use the fundamental increment of time in the place of electric charge. If this step is valid, then a crucial block to achieving a unified theory will have been removed.

The example will deal with electromagnetic effects of the hydrogen atom. The use of the hydrogen atom example allows me to conduct the derivations of electromagnetic effects as they might apply to a single photon. The formula for electric force is:

$$f_{\xi} = \frac{qq}{4\pi\varepsilon r^2}$$

As explained above, I substitute the fundamental increment of time for electric charge. For atomic dimensions, it cannot be approximated as a differential quantity. Therefore:

$$f_\xi = \frac{\Delta t_c \Delta t_c}{4\pi\varepsilon r^2}$$

Force is also generally defined as:

$$f = \frac{\Delta E_K}{\Delta x}$$

For this new theory, and for this example, this formula takes the form:

$$f_\xi = \frac{m_e v_c \Delta v_c}{\Delta x_c}$$

Setting the two expressions for force equal to each other gives:

$$\frac{m_e v_c \Delta v_c}{\Delta x_c} = \frac{\Delta t_c \Delta t_c}{4\pi\varepsilon r^2}$$

For the first energy level of the hydrogen atom:

$$r = \Delta r = \Delta x_c$$

The subscript c is used to denote this increment of length is specifically the length of a photon. Substituting:

$$\frac{m_e v_c \Delta v_c}{\Delta x_c} = \frac{\Delta t_c \Delta t_c}{4\pi\varepsilon \Delta x_c^2}$$

Simplifying:

$$m_e v_c \Delta v_c = \frac{\Delta t_c \Delta t_c}{4\pi\varepsilon \Delta x_c}$$

For convenience, I replace the left side with the appropriate energy symbol:

$$E_{Kc} = \frac{\Delta t_c^2}{4\pi\varepsilon \Delta x_c}$$

The subscript c on the left-hand side denotes this quantity of energy to be the increment of kinetic energy carried by the photon. Solving for permittivity:

$$\varepsilon = \frac{\Delta t_c^2}{4\pi E_{Kc}\Delta x_c} = \frac{\Delta t_c}{4\pi E_{Kc}C}$$

Multiplying by unity:

$$\varepsilon = \left(\frac{\Delta x_c}{\Delta x_c}\right)\left(\frac{\Delta t_c}{4\pi E_{Kc}C}\right) = \frac{\Delta x_c}{4\pi E_{Kc}C^2}$$

Yielding:

$$\varepsilon = \frac{1}{4\pi f_{\xi H1}C^2}$$

Where, *H1* represents the first energy level of the hydrogen atom. The proportionality constant of the electric force equation is:

$$k = \frac{1}{4\pi\varepsilon}$$

Substituting the expression for permittivity into this equation:

$$k = \frac{1}{4\pi \frac{1}{4\pi f_{\xi H1}C^2}} = f_{\xi H1}C^2$$

The proportionality constant of the Coulomb electric force equation is equal to the product of the increment of force carried by the photon and the speed of light squared. The force is that which applies to an electron in the hydrogen-atom's first energy level.

Fine Structure Constant

The magnitude of the fine structure constant is the ratio of the speed of an electron in the first energy level of a hydrogen atom to the speed of light. What is of great interest about it are the values that make up its definition. It contains constants that come from electromagnetic theory, relativity theory and quantum theory. I have previously redefined some of these constants using expressions from this new theory.

I will demonstrate how these new interpretations offer a clear, simple physical origin to the fine structure constant. The standard formula defining the fine structure constant is:

$$\alpha = \frac{2\pi k e^2}{hC}$$

And in this theory is:

$$\alpha = \frac{2\pi k e^2}{h v_c}$$

Where, e is electron charge. I have previously redefined each expression on the right side with the exception of h or Planck's constant. For the purposes of this section, I will use Planck's constant as it would normally be used. With the exception of Planck's constant, I substitute expressions from this new theory for the constants contained in the equation. The expression I derived for k is:

$$k = f_{\xi H1} C^2 = \frac{E_{Kc}}{\Delta x_c} C^2 = \frac{E_{Kc}}{\Delta x_c} \frac{\Delta x_c^2}{\Delta t_c^2} = E_{Kc} \frac{\Delta x_c}{\Delta t_c^2}$$

The expression for e is:

$$e = \Delta t_c$$

Therefore:

$$k e^2 = E_{Kc} \frac{\Delta x_c}{\Delta t_c^2} \Delta t_c^2 = E_{Kc} \Delta x_c$$

My definition of the velocity of light is:

$$C = \frac{\Delta x_c}{\Delta t_c}$$

The normal use of h is:

$$h = \frac{E_{Kc}}{\omega}$$

This says: The energy of a photon divided by its corresponding frequency is equal to Planck's constant. Substituting all of the above expressions into the equation for the fine structure constant gives:

$$\alpha = \frac{2\pi k e^2}{hC} = \frac{2\pi k e^2}{h v_c} = \frac{2\pi E_{Kc} \Delta x_c}{\frac{E_{Kc}}{\omega} \frac{\Delta x_c}{\Delta t_c}}$$

Simplification yields:

$$\alpha = 2\pi \omega \Delta t_c$$

This suggests that the fine structure constant may be a measure of a specific angle in radians of something moving in a circular or sinusoidal motion for the period of time required for a photon to be emitted. Since the fine structure constant appears to relate in some direct way to the properties of the hydrogen atom, then I might expect the use of my theory to produce a result pertaining directly to the hydrogen atom.

The frequency of this motion can be calculated from the above result. Solving for frequency:

$$\omega = \frac{\alpha}{2\pi\Delta t_c}$$

Substituting the appropriate values:

$$\omega = \frac{7.299x10^{-3}}{2\pi(1.602x10^{-19}\, second)} = 7.25x10^{15}\, sec^{-1}$$

This answer is close to the frequency of the electron that is orbiting in the first energy level of the hydrogen atom. Most significantly, I made a radical change to the units of electric charge; however, the units that appear in this result fit properly. It leads to the interpretation that the fine structure constant is the angle in radians moved by the electron during the time required for a photon to be released. The angle, in radians, is the distance the electron has moved divided by the radius of the orbit:

$$\alpha = \frac{\Delta x_{pe}}{\Delta x_c}$$

Dividing the numerator and denominator by the fundamental increment of time:

$$\alpha = \frac{\frac{\Delta x_{pe}}{\Delta t_c}}{\frac{\Delta x_c}{\Delta t_c}} = \frac{v_p}{v_c}$$

The units of this result also fit properly. The result shows that the distances traveled by the electron and the photon, during the fundamental increment of time, are relevant to the origin of the fine structure constant. It is in agreement with the initial assumption that the radius of the first energy level of the hydrogen atom is equal to the length of a photon. I chose to manipulate the known definition of the fine structure constant, because it adds credibility to this interpretation.

Magnetic Permeability

It is known through empirical evidence that there is a direct connection between the existence of a varying electric field and the existence of a varying magnetic field. The varying electric field is credited with bringing into existence the varying magnetic field. The magnitude and behavior of the varying magnetic field are functions of the varying electric field. The varying magnetic field is said to then, in turn, cause the varying electric field. In other words the electric field and magnetic field are said to be continuously producing each other as both move through a given distance.

The relationship between the electric and magnetic fields will be described later. For now, it is the known relationship between electrical permittivity and magnetic permeability which is of specific interest. Electrical permittivity is related to the proportionality constant of the electrical force equation. Magnetic permeability is related to the proportionality constant of the magnetic force equation. It is known, in the case of electromagnetic radiation, that the two are related to each other by the formula:

$$\frac{1}{\mu\varepsilon} = C^2$$

Or, for this theory:

$$\frac{1}{\mu\varepsilon} = v_c^2$$

Solving for permeability:

$$\mu = \frac{1}{\varepsilon v_c^2}$$

I have derived:

$$\varepsilon = \frac{1}{4\pi\, f_{\xi H1}\, v_c^2}$$

Substituting this gives:

$$\mu = \frac{4\pi\, f_{\xi H1} v_c^2}{v_c^2} = 4\pi\, f_{\xi H1}$$

This equation says permeability is a function of the force felt by an electron in the first energy level of the hydrogen atom.

I postponed my derivation of electromagnetism for the purpose of first introducing the concept of electric charge as the fundamental increment of time. This was necessary in order to properly use this increment of time in the differential equations that make up this analysis. I will next derive equations showing the connection between my definitions of photon momentum and photon energy to electromagnetic theory.

ORIGIN OF ELECTROMAGNETIC RADIATION

Electromagnetic radiation is a phenomenon physics associates with particles of light called photons. However, the particles of charged matter are the sources for all electromagnetic photons. The properties of the charged particles, in general, give rise to the properties of the emitted photons. Therefore, the mathematics describing the properties of photons should be translatable into expressions using the properties of the charged particles that emitted them.

Varying Electric Field

The fundamental properties which are of principal use in describing particles are: mass, velocity, and rate of change of velocity. The rate of change of velocity can be measured with respect to either time or distance. Two very useful higher-level properties are energy and momentum. These two properties are complex forms of the fundamental properties of mass and velocity.

It is commonly accepted that energy and momentum are qualities applicable to both material particles and photons. I will use these properties to derive equations analogous to electromagnetic field theory. For convenience in comparing mathematical expressions from electromagnetic field theory with analogous expressions from this theory, I will take the liberty of using differential instead of incremental expressions in the following analysis.

Since photons are themselves incremental and not so small as to be defined by differential values, this approach is not entirely correct. However, the true incremental values are of sufficiently small size so that, for macroscopic purposes, using this approach loses nothing of significance. The benefit gained will be clarity when showing correlation to electromagnetic field theory.

I will now derive equations for this new theory to describe the effects attributed to electromagnetic fields. Force can be expressed as a function of a change in energy:

$$f = \frac{dE}{dx_p}$$

The force can also be expressed as a function of a change in momentum:

$$f = \frac{dP}{dt}$$

Combining these two expressions:

$$\frac{dE}{dx_p} = \frac{dP}{dt}$$

This formula has a form similar to this one from electromagnetic field theory:

$$\frac{d\xi}{dx} = \mu\frac{dH}{dt}$$

And since:

$$B = \mu H$$

I compare it also with:

$$\frac{d\xi}{dx} = \frac{dB}{dt}$$

The similarity in form between this formula and the one above expressed in terms of energy and momentum is striking. I will show there is an indirect connection. Before I can show this, I will develop new formulas that will account for electromagnetic effects. It is known:

$$f = q\xi$$

That can be rewritten, for this new theory, as:

$$f = \xi dt_c$$

Solving for the electric field gives:

$$\xi = \frac{f}{dt_c}$$

And since:

$$f = \frac{dP}{dt_c}$$

I can write:

$$\xi = \frac{d^2P}{dt_c^2}$$

This formula suggests our concept of electric field is equivalent to the second derivative of the emitting particle's momentum with respect to time. Taking the derivative of the electric field with respect to time yields:

$$\frac{d\xi}{dt_c} = \frac{d^3P}{dt_c^3}$$

I have presented this formula because it, along with three others to be derived next, begins the process of expressing the phenomenon described by electromagnetic field equations in terms of the properties of the emitting particle. I will now derive the three other equations. Returning to the equation:

$$\xi = \frac{f}{dt_c}$$

I can substitute:

$$f = \frac{dE}{dx_p}$$

Making the substitution:

$$\xi = \frac{d^2E}{dx_p dt_c}$$

Taking the derivative of the electric field with respect to time:

$$\frac{d\xi}{dt_c} = \frac{d^3E}{dx_p dt_c^2}$$

This is the second equation that I will be using for the purpose expressed above. The remaining two equations are:

$$\frac{d\xi}{dx_s} = \frac{d^3P}{dx_s dt_c^2}$$

And:

$$\frac{d\xi}{dx_s} = \frac{d^3E}{dt_c dx_s dx_p}$$

These two equations result from taking the derivative of the electric field with respect to distance. In the first case I take the derivative of the electric field where it is expressed as a function of particle momentum. In the second case, I take the derivative of the electric field where it is expressed as a function of energy.

The increment of distance used in taking the derivative cannot be the same increment of distance the particle moved during the same increment of time. This new increment of distance has to do with observing the motion of photons after they have been emitted from the particle. The increment of distance is not yet a specific value. It represents a moving observer making measurements of the motion of photons as they move away from their source.

Also, the incremental change of distance cannot be equal to the length of a photon. In that case the observer would necessarily be moving at the speed of light. The observer would be traveling at the same speed as the photons. The observer could not then detect a change in the motion or even orientation of the photons with respect to time.

The observer also cannot be standing still or there could be no change observed with respect to distance. Therefore, the observer is assumed to have a magnitude of velocity between zero and the speed of light, and is moving in the same direction as the photons. Further development of electromagnetic effects will offer an interesting identity for the observer’s magnitude of velocity.

The work of Maxwell has been interpreted to prove the existence and the uniting of a varying electric field and a varying magnetic field. He produced equations that are credited with fundamentally defining electromagnetic radiation effects. I will now derive analogous equations from this new theory.

Definition of Electric Field

The equations I will derive are not just symbolic substitutes adding nothing to Maxwell's discoveries. The very first step in this derivation goes to the heart of separating the results of this theory from electromagnetic field theory. The electric field is defined as:

$$\xi = \frac{f}{q}$$

I will use this equation as it applies to a force caused by a single charged particle. Since I am seeking to form equations using concepts developed for this theory, I substitute:

$$q = dt_c$$

In this theory, the fundamental quantity of electric charge is actually the fundamental time period for passage of a photon:

$$\xi = \frac{f}{dt_c}$$

With this substitution, I separate the work that follows from any theoretical connection with electromagnetic field theory. The resulting equations will be analogous in form, but will have interpretations very different from field theory.

Electric Field Varying With Distance

I now proceed to derive electromagnetic equations analogous to the Maxwell equations. Since force can in general be expressed as:

$$f = \frac{dE}{dx_p}$$

Then I can substitute this definition into the electric field equation given above:

$$\xi = \frac{d^2E}{dx_p dt_c}$$

Taking the derivative with respect to an increment of distance which a photon would move during a fundamental increment of time:

$$\frac{d\xi}{dx_c} = \frac{d^3E}{dx_c dx_p dt_c}$$

I want to convert this equation into a form analogous to the Maxwell equation:

$$\frac{d\xi}{dx} = \mu \frac{dH}{dt}$$

I begin with:

$$dE = v_p dP$$

I change the incremental length of distance of particle motion to a measure of photon motion. I do this by multiplying the right side by unity:

$$dE = \frac{v_c}{v_c} v_p dP$$

Or:

$$dE = \frac{dx_c}{dt_c} \frac{v_p}{v_c} \, dP$$

Rearranging terms:

$$\frac{dE}{dx_c} = \frac{v_p}{v_c} \frac{dP}{dt_c}$$

I will change this equation, using its left side as a guide, into the form shown above on the right side of my expression for the electric field varying with distance. I rewrite it as:

$$\frac{dE}{dx_c} = \frac{dx_p}{dt_c} \frac{1}{v_c} \frac{dP}{dt_c}$$

Rearranging:

$$\frac{d^2E}{dx_c dx_p} = \frac{1}{v_c} \frac{d^2P}{dt_c^2}$$

Multiplying by particle velocity:

$$v_p \, \frac{d^2E}{dx_c dx_p} = \frac{v_p}{v_c} \frac{d^2P}{dt_c^2}$$

Or:

$$\frac{dx_p}{dt_c} \frac{d^2E}{dx_c dx_p} = \frac{v_p}{v_c} \frac{d^2P}{dt_c^2}$$

Rearranging:

$$\frac{d^3E}{dx_c dx_p dt_c} = \frac{v_p}{v_c} \frac{d^3P}{dx_p dt_c^2}$$

I submit that this equation is analogous to the Maxwell equation given above. In order to see this more clearly, I will manipulate its form. I have previously derived:

$$\frac{d\xi}{dx_c} = \frac{d^3E}{dx_c dx_p dt_c}$$

Substituting this into the equation above:

$$\frac{d\xi}{dx_c} = \frac{v_p}{v_c}\frac{d^3P}{dx_p dt_c^2}$$

Rewriting this equation:

$$\frac{d\xi}{dx_c} = \frac{v_p}{v_c}\frac{d}{dt}\left(\frac{d^2P}{dx_p dt_c}\right)$$

Comparing this result to Maxwell's:

$$\frac{d\xi}{dx} = \mu\frac{dH}{dt}$$

The magnetic field is seen to be a function of the emitting particle's changing momentum:

$$H = \frac{d^2P}{dx_p dt_c}$$

Of special interest, by analogy, it is suggested the physical basis for magnetic permeability is represented here by:

$$\mu = \frac{v_p}{v_c}$$

The magnetic permeability is a ratio of the magnitudes of two velocities. One is the velocity of light and the other was introduced as the velocity of an observer moving in the same direction as the photons, but with an unspecified magnitude. Its appearance as part of magnetic permeability indicates it is not just any magnitude. Its magnitude is fixed according to the measured permeability of a particular substance.

Interpreting Magnetic Permeability

The equation for magnetic permeability contains a particle velocity that must be explained. Clearly this velocity cannot be a variable representing an observer's velocity in general. It must have a specific magnitude. This magnitude can easily be calculated:

$$v_p = \mu v_c$$

Substituting the appropriate values:

$$v_p = \left(12.6x10^{-7}\frac{newton \cdot second^2}{coulomb^2}\right)\left(2.998x10^8\frac{meters}{second}\right)$$

Solving and assigning the units of velocity:

$$v_p = 378\ \frac{meters}{second}$$

I stated at the beginning of this work that all units of action must be reducible to some combination of distance and time. I will shortly show that the units for the work above are correct. I have already replaced the units of seconds for coulombs. I still need to redefine the units of newtons with units from this theory. The answer above gives a clue to what is to come.

The magnitude of v_p for magnetic permeability is approximately the speed of sound. I anticipate that it is representative of the speed of sound in air. I will shortly achieve more accuracy by using the speed of sound in a solid. For this reason I will identify v_p as v_s:

$$\mu = \frac{v_s}{v_c}$$

It may seem strange to relate the speed of sound to the speed of light; however, the speed of sound must have a physical cause. In this theory all physical cause is somehow related to the nature of light. I will be offering a physical interpretation of this result. What has been accomplished is to show that a physical relationship between the speed of light and the speed of sound could become established by this theory.

Interpreting Electric Permittivity

The solution for magnetic permeability allows for a quick solution of electrical permittivity. It is known:

$$v_c = \frac{1}{(\mu\varepsilon)^{\frac{1}{2}}}$$

Or:

$$v_c^2 = \frac{1}{\mu\varepsilon}$$

Solving for electrical permittivity:

$$\varepsilon = \frac{1}{\mu v_c^2}$$

I have a suggested identity for magnetic permeability of:

$$\mu = \frac{v_s}{v_c}$$

Substituting:

$$\varepsilon = \frac{v_c}{v_s v_c^2}$$

Or:

$$\varepsilon = \frac{1}{v_s v_c}$$

This result suggests electrical permittivity is inversely proportional to the product of the speed of light and a speed approximately that of sound. I will interpret this result shortly.

Electromagnetism and the Speed of Sound

There is a related equation I wish to offer at this time. It gives another representation of this particle velocity in a form spanning this new theory and electromagnetic theory. I use the equation:

$$\frac{d\xi}{dx_c} = \frac{v_s}{v_c}\frac{d}{dt_c}\left(\frac{d^2P}{dx_p dt_c}\right) = \frac{v_s}{v_c}\frac{dH}{dt_c}$$

Or:

$$\frac{d\xi}{dx_c} = \frac{dt_c}{dx_c} v_s \frac{dH}{dt_c}$$

Simplifying:

$$d\xi = v_s\, dH$$

Solving for v_s:

$$v_s = \frac{d\xi}{dH}$$

This says the speed of sound is the rate of change of the electric field with respect to the magnetic field. In electromagnetic field theory, there is nothing moving at the speed of sound. What then is the origin of a relationship between the speed of sound and electromagnetic radiation? Since electromagnetic radiation consists of discrete photons that are carrying increments of energy given to them by an accelerating particle, then I can look back to the emitting particle for an answer.

I have derived for this theory analogous expressions for both the electric field and magnetic field of electromagnetic theory. I will use these to trace the speed of sound back to the emitting particle. The definition of the electric field of a single photon is:

$$\xi_c = \frac{d^2 E_p}{dx_p dt_c}$$

And, this theory's definition of the magnetic field of a single photon is:

$$H_c = \frac{d^2 P_p}{dx_p dt_c}$$

I substitute these two expressions into the formula for the speed of sound:

$$v_s = \frac{\xi_c}{H_c} = \frac{\frac{d^2 E_p}{dx_p dt_c}}{\frac{d^2 P_p}{dx_p dt_c}} = \frac{dE_p}{dP_p}$$

So, the photon's increment of electric field divided by its increment of magnetic field is equal to the rate of change of the kinetic energy of the emitting particle with respect to the rate of change of the momentum of the particle. Furthermore, they are both equal to the speed of sound:

$$\frac{\xi_c}{H_c} = \frac{dE_p}{dP_p} = v_s$$

I want to extend the meaning of this formula directly to the emitting particle. It is known an incremental change of kinetic energy of the particle is given by:

$$dE_p = m_e v_p dv_p$$

And an incremental change of momentum of the particle is given by:

$$dP_p = m_e dv_p$$

Dividing the first by the second:

$$\frac{dE_p}{dP_p} = v_p$$