

Cargo Cult Science – Electromagnetic Wave Fundamentals

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Abstract – Electromagnetic fundamentals are being tagged herein as *cargo cult science* because they are based upon incomplete information. The scientific community assumes it has a correct grasp of electromagnetic fundamentals even though Maxwell, Hertz and contemporary scientists have not identified some of the basic characteristics of the electromagnetic wave phenomenon. Maxwell did not know of the existence of electrons when he developed his equations describing the characteristics of electromagnetic waves, but he was aware of the existence of charged particles and action at a distance. An error made early in the study of electromagnetic waves, and ignored to this day, has compromised scientists understanding of electromagnetic characteristics and other physical laws.

I. Introduction

Richard Feynman introduced the term *cargo cult science* to the 1974 graduation class of the California Institute of Technology. Cargo cult science is a process that gives the appearance of the scientific method. The actions performed that created the term *cargo cult* were the result of conclusions based upon *incomplete information*.

In the early days of research on electric and magnetic phenomenon it was noted that charged particles could influence each other at a distance. This was before the electron was discovered and before Heinrich Hertz demonstrated that electromagnetic (EM) waves propagated through the air just as light does.

In 1864, James Clerk Maxwell published his equations describing EM waves in a paper titled, “A Dynamical Theory of the Electromagnetic Field.” In the paper, Maxwell mentioned the possibility of particles acting at a distance. He stated, “The mechanical difficulties, however, which are involved in the assumption of particles acting at a distance with forces which depend on their velocities are such as to prevent me from considering this theory as an ultimate one, though it may have been, and may yet be useful in leading to the coordination of phenomena.” Maxwell had developed his theory using Quaternion mathematics, and computers were not available to facilitate their calculations. It is not known how Maxwell's decision impacted the accuracy of his equations. In 1876, Maxwell prepared a paper titled, “On Action at a Distance,” which appeared in Vol. VII the *Proceedings of the Royal Institution of Great Britain*.

“Maxwell's equations are of great generality. They apply to all charge and current densities, whether static or time-dependent. Together, they describe the dynamical behaviour of the electromagnetic field. Each of Maxwell's equations is a local equation, relating field quantities at each point in space and at each instant in time, so all trace of instantaneous action at a distance has been eliminated.” [1] When Einstein could not identify any known process that could account for the seemingly instantaneous action at a distance, he referred to it as *spooky action at a distance*.

It would have been difficult to convince anyone that EM waves, other than light, were propagating throughout the Universe until 1940. In 1932, Karl Jansky reported on the presence of static of “extraterrestrial origin.” [2] Jansky had articles on that subject in *Nature* and *Popular Astronomy* in 1933. In the 1930s, static was an undesirable noise that could occur at all frequencies on an AM radio. Grote Reber, using his home built parabolic antenna and receivers, had articles published which identified signals coming from space and he used the proper astronomical terms for their locations, as he was a radio engineer and amateur astronomer.[3-4]

In Eddington's 1926 “The Internal Constitution of Stars,” Chapter XI, Section 203, he dismissed

“... that there is some subtle radiation traversing space which the star picks up.” Later in that section, Eddington stated that the variability of stars had to be the result of internal actions “deep in the interior of the star.” Because of Eddington's position, contemporary astronomers will not even consider that ultra-ultra-low-frequency (UULF) EM waves that can influence stars even exist. The well established multi-year cyclic events associated with sunspots, and the angle they appear on the Sun's surface, supports the presence of UULF EM waves coming from the direction of the center of our galaxy. [5]

It would have been difficult for the earlier scientists to consider the purpose for the existence of EM waves until it was known that they were pervasive throughout the universe. Even after that was known, it did not seem to interest the scientific community to address “what is the fundamental purpose for the existence of EM waves?” Multiple issues are in the following sections that address the incomplete information that are related to EM fundamentals.

II. Fundamentals of Discovery – Electromagnetic Waves

A number of steps are taken in the process of scientific discovery and each type of discovery has distinct differences. There are a host of industrial actions that have to be achieved before some discoveries can proceed, such as having iron, copper wire, glassware, optical glass, etc.

For the discovery of the EM phenomenon, it started with the study of iron being attracted to magnetite and cloth materials being attracted or repelled to amber, *ēlektron* in Greek. These two phenomenon were eventually linked when a current in a wire deflected a compass needle, a small magnet. The phenomena were mathematically linked by Maxwell. Hertz demonstrated that EM waves propagated through the air just as light. After Hertz had published his results, he responded to a question as to what his discovery was good for. His response, “It's of no use whatsoever this is just an experiment that proves Maestro Maxwell was right—we just have these mysterious electromagnetic waves that we cannot see with the naked eye. But they are there.”

If readers think this shallow thinking is something that could only happen in the 1800s, they haven't read about the quasi-crystal debacle that started in 1982 that overturned a century of settled science when the Nobel Prize for Chemistry was awarded in 2011.[6] The same shallow thinking is alive and well into the 21st century.

Scientists have determined the characteristics of the medium in which EM waves seem to traverse unimpeded, that of a vacuum, and these characteristics are described as electromagnetic permittivity and permeability. These characteristics were measured in a vacuum on the Earth's surface. The Scientific Authority Structure (SAS) has concluded, without measurement, that space beyond the Earth's surface, closer to the Sun or beyond the solar system, has precisely the same characteristics.

III. Basic Mathematics of Electromagnetic Waves

Identifying the fundamental characteristics of EM waves was started by efforts to identify the speed of light in 1676, which was long before it was recognized that light was an EM wave. The Thomas Young experiment of 1801 suggested light was a wave. The relationship between EM frequency, wavelength and the speed of light was established as an algebraic relationship, $c=\lambda f$, where c represents the speed of light, λ as wavelength, and f as frequency. Unknown to mathematicians and scientists, that relationship can be represented by a geometric relationship, a pair of right triangles. This relationship was published in IEEE Potentials in 2011 titled, “A Methodology to Define Physical Constants Using Mathematical Constants.”[7]

One of the significant resultants obtained from the *Methodology* is that the speed of light can be mathematically defined and that in the paired triangles at 45° the speed of light and a particular EM frequency have the same numeric value. Every physicist is familiar with that frequency in SI units.[8] The *Methodology* identified what are termed *intrinsic units*.

IV. Intrinsic Units

The *Methodology* is emulating the familiar algebraic formula $c=\lambda f$ expressed in a geometric form using a pair of right triangles. The triangles use two different dimensions that each by themselves have one meaning, but when coupled to a third dimension have a different meaning. The two basic dimensions are wavelength, with the dimension of length, and cycle with the dimension of radian. When coupled to a third dimension, a unit of time, the paired geometric relationship can emulate the algebraic form $c=\lambda f$. The unit of time for the geometric pair is the angle of a right triangle. With one common leg of each triangle held as a constant, varying the angle alters the equivalent dimensions of the two triangles equally. The *Methodology* was presented in its form to be familiar to electrical engineers. The frequency triangle could be expressed as radians rather than frequency. There is just one angle where the two legs of a right triangle are equal.

The *Methodology* paper revealed that a mathematically derived numeric value for the speed of light has the same numeric value as a specific frequency of EM radiation. However, the units of measure have to be expressed in *intrinsic* units, that are mathematically derived, not the man-made System International (SI) values. In the *Methodology*, the speed of light or frequency is expressed as the product of an irrational and transcendental number, $2\pi\sqrt{2}$. This is a mathematically useful form in comparison to the current SI numeric value for the speed of light.

Einstein would have known about the existence of the EM frequency that is a key value in the *Methodology*. It was detected coming from space in 1951, ref (8).

The ability of an object as small as an atom to produce an EM frequency with a wavelength of just over 21 cm indicates we have not identified the real structure of the most basic atom. The structure might have a form that functions as a three dimensional fractal antenna with an E8 or more complex geometry.

One conclusion reached concerning the *Methodology* was, “Every intelligent species in the universe, after having identified the *intrinsic* units revealed by the mathematics of the triangle pair, would have established a set of scientific units of measure based upon those units.”

The primary opposition to such a set of units will come from the *metrology bureaucracies*, but in reality, *intrinsic* units simplifies their current efforts to fit various Earth measurements into forms that can be properly expressed mathematically in physical law equations. There has been considerable mathematical legerdemain used in an attempt to mathematically *fit* the current numeric value of c into physical law equations.

V. The Electron

The electron is considerably more complex than what was known about charged particles in the early 1800s. The electron has a negative electric field, a magnetic moment and spin. Einstein stated in his later years, “I would like to know what an electron is.” If an electron could be isolated from all other electrons and other objects, it might appear as a point charge to a sensor that can respond to just its charge. It appears reasonable to suspect that when an electron comes into existence, its field influence, with spin and magnetic moment, eventually spreads to all other electrons and objects that are influenced by a potential charge with spin and a magnetic moment.

The Yagi-Uda antenna is an assemblage of electrons in a set of conductors. Depending upon the sizes and spatial orientation of the conductors, the electrons in the conductors interact with EM waves in such a manner that a sensor point on one of the conductors in the assembly will produce a higher potential output from an EM wave of a particular frequency when the structure is aligned toward the source of the wave. Changing the dimension of any of the conductors influences the response at the sensor point.

The electrons in the conductor assembly are interacting in a complex manner. It suggests that the EM field surrounding an electron has a configuration very unlike that surrounding an object or particle that has just a positive or negative charge. We can assume that the potential charge, magnetic moment and spin of electrons are influencing the manner in how a Yagi-Uda antenna responds to an external EM wave. We currently have *incomplete* information on how these various electron characteristics cause that type antenna to respond in the manner that it does.

It takes energy in some form to produce the electric field, spin and related magnetic moment of an electron. Where does the electron obtain that energy and does it have a frequency?

VI. Conductor Field-to-Field Coupling

In a pair of wire conductors, when a voltage potential is applied at one end the response at the other end appears to be instantaneous. It has been determined that actual electron movement in a wire, termed electron drift, is very slow. All the electrons became closely interconnected field-to-field (FTF) when the wire was created. FTF coupling has an extended reach beyond that of mechanical coupling. In a wire, FTF coupling is contiguous from one end to the other even when a current is not flowing within.

Those that have measured the actual time current is measured at the end a significant distance from the end where a potential difference is applied are considered misinformed if they state the reaction time was faster than the propagation velocity for the speed of light. The SAS does not allow any deviation from its authorized scientific viewpoint of “normal science.” Normal science states that the speed of influence between electrons in a wire cannot be faster than the speed of light. Why this is stated is not understood, because what is being measured is not the propagation speed of an EM wave, it is an already established coupling at a distance through electric fields.

Once a group of electrons have become grouped into a long term association, it appears they develop an association that has a period of latency. This could explain why an electron removed from a group association will respond to changes to electrons in the original group. Electrons need to be removed from a group and then determine how long they still associate with the group. You cannot remove an electron from a group faster than the propagation velocity of the fields that accompany electrons and these fields have had an extended period of time to extend their influence to wherever the electron is moved to.

It is necessary to consider that every electric field has an intrinsic coupling with every nearby field and these are coupled to other nearby fields, and on and on. We present electric and magnetic field strength by vectors that have a finite length but they are actually coupled to other field vectors, FTF, to infinity. If the field vectors are properly aligned, it can be expected that the influence would be more pronounced. The process by which an electric or magnetic field connects to each other has a *signature* that is the result of all the interconnections. Once we understand how they really interconnect we will not need to describe action at a distance as spooky.

VII. EM Wave Polarity

Transverse polarity occurs when the direction of the EM oscillations, plus and minus peaks of both the electric and magnetic fields, are at 90° to the direction of propagation. The electric and magnetic fields are at 90° to each other. Their spatial polarity can be at any angle or constantly rotating relative to the direction of propagation and can have clockwise or counterclockwise rotation.

Many consider that the polarity of EM waves is settled science even when it is not known what mechanism produces an EM wave with transverse polarity. In 2014, an email was sent to a recently retired Los Alamos National Laboratory (LANL) nuclear physicist with the following question, “Does the magnetic moment of electrons and ions influence the polarity of propagating EM waves?” The

answer, “I’m afraid that I know of no studies that address your question. Sorry, I couldn’t be of more help.”[9]

Since EM waves do not require a medium in which to propagate, this suggests there is no reason why these waves cannot have a polarization that is in the direction of propagation. Optical researchers are producing light waves that have longitudinal components.[10]

VIII. Frequency of Electromagnetic Waves

For a phenomenon that can have a large number of event frequencies, it is desirable to identify the longest period of that phenomenon, its time duration, in order to have a starting point by which all subsequent values are referenced. Choosing the longest time period for a mechanical wave, such as tides, was relatively easy to do with the time measurement devices that were available several centuries ago. Hours, days, months and years were easy, but it took technical advancements before observers developed devices that could measure time accurately as minutes and much longer before they could reliably measure seconds.

After multiple periods of a wave are observed, it might be possible to identify the time duration of the longest period. This becomes a problem for EM waves because only recently have transmitters, receivers and associated antennas become available for frequencies just below 1 Hz, those used by magnetotelluric devices.

How did scientists establish that the longest period of an EM wave was 1 second? They didn’t. Basically, we have been saddled with an incorrect time period to define the longest period of an EM wave. Currently, man-made EM emissions are being produced with frequencies below 1 Hz. The actual extent of the EM spectrum below 1 Hz is not known. The failure to properly identify the lowest period an EM wave has resulted in astronomers and other scientists reaching conclusions about characteristics of our universe that are grossly in error. Since we do not know the size of the universe, we cannot calculate the longest possible EM wave that could exist. Using the concepts presented in the *Methodology* we can define the middle of the EM spectrum and then define all other frequencies below and above relative to that point. A paper titled, “Cycle One” discusses the issue.[11]

No one is attempting to detect the UULF waves with high energy values that are causing variable stars, such as our Sun. Grote Reber spent years trying to detect low frequency waves that might be coming from the cosmos in the frequency range of 1 to 2 MHz.

IX. Planck Constant Validity

The Planck constant is directly coupled to EM wave fundamentals. The Planck constant, $E=hf$, has a validity problem in two areas. The first problem is introduced by stating that a higher frequency will have a higher energy level than a lower frequency. This is true if each wavelength of every EM wave, irrespective of the number of wavelengths that fits within a period of 1 second, are produced at precisely the same energy level. It requires a higher potential to bring more charged particles into the process of producing an EM wave with a higher energy level. The Planck constant equation could be improved by adding another parameter, potential, which can be denoted by **p**. This would alter the Planck constant equation to $E = hpf$. However, since EM frequency is improperly defined, the Planck constant would not valid for any EM wave that has a period that is longer than one second. Instead of the energy level going down by one digit with each unit change in frequency, for frequencies of 1 Hz and above, it starts going down by one-tenth of a digit for frequencies just below 1 Hz, and it will become even more decimalized as wavelengths become longer and longer.

With distance, for pure transverse waves, the power level will drop by the square of the distance. To be able to make the statement that one signal source has more energy than another source, an accurate distance to both sources must be known. It must be known if the signal being received is

from the main-lobe or side-lobe of a source.

Planck produced his theory in 1915 when little was known about the various sources that can produce EM waves at different frequencies and that they could be coming from the cosmos.

X. Chirality, Spin, and Gravity

When certain types of processes in nature are so ubiquitous it is necessary to inquire if they are related. Chirality is a symmetry property and is often referred to as handedness. A right and left hand at 180° to each other appear as mirror images and can only touch point-to-point, but two identical right hands at 180° do not touch point-to-point and can merge together. When considering identical objects with a spin in the same direction, any two of these objects presented to each other at 180° could have a chiral relationship. How they respond at 180° depends upon their structure and whether it is a physical touching or EM field envelopment. If two EM waves with the same frequency are produced with cylindrical coordinates, and they have the same field with longitudinal polarity, they would produce an attractive chiral relationship EM FTF, plus to minus, when they are oriented 180° to each other. This FTF response is coupled to the source structures that produce the two waves. This is described in a paper titled, "The Helical Structure of the Electromagnetic Gravity Field." [12]

An EM wave that is produced as a helicoid with a longitudinal electric field could produce attractive fields that mimic the gravity effect, as all objects would present fields to each other at 180° . But the gravity of an object presents itself around an object as a spherical field and that would not be a simple helicoid field.

A longitudinally polarized electric field with spin and a finite radius will allow the exploitation of the FTF phenomenon for communications. The resulting field produced would be a helicoid with a longitudinal field vector. This would allow essentially instantaneous communications at planetary distances. For this reason alone, efforts need to be taken to identify what actually causes EM waves to have transverse polarity and if the causative factor can be modified to produce longitudinal polarity.

Scientists at the Los Alamos National Laboratory (LANL) were active participants in a project that produced EM waves with a partial circular component which was created by an active dielectric radiator that was a segment of a circle. [13] The following statement was made in the article. "Consequently, the intensity of the radiation at these angles was observed to decline more slowly with increasing distance from the source than would the emission from a conventional antenna." It would have been heretical for the authors to have stated that the radiation declined at $1/r$ rather than $1/r^2$. A conventional antenna was used to detect the signal.

The LANL article reveals we have no antenna-receiver systems that can properly identify that a source is producing EM radiation with spin. The LANL report was for a nearby spin source. If it had been from a distant spin source, what could be detected would depend upon distance and how far off the center-line the receiving antenna was from the center-line of the source radiation pattern.

XI. SI Units - Second and Ampere

The basis for SI units had its start in Napoleon's France. [14] Different areas of France had their own units of measure and this caused considerable difficulty in commerce as well as science. Napoleon intended to create a country-wide uniform system of units and French scientists at that time saw that it would be desirable to have a standard system of units applicable to every country. Maxwell was against having the physical size of the French meter as the standard for a scientific unit of length and this was noted in ref. (7).

Napoleon wanted to decimalize time divisions also, but he could not get a national consensus on his proposal. They kept the current second that is based upon $1/86,400$ seconds in a day, $60 \times 60 \times 24$, which then became the standard for the smallest unit of time. The second had been around a long time

before Napoleon tried to change it. The Ephemeris second, based upon the tropical year, gained prominence as the most accurate measurement for the time period of the second. Based upon the length of the tropical year in 1900, at a very specific time, the Ephemeris second was converted to 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom. This period was adopted in 1960. Leap seconds have to be added to the official clock time every so often because the 9,192,631,770 counts do not actually coincide with the Earth's slightly changing annual orbital period around the Sun. The second, one of the base units of scientific measure, is based upon the rotation time segment of a small planet in a galaxy of many millions of planets.

It has been known for a number of years that it was possible to produce EM waves that have frequencies below 1 Hz. One might think those that kept the units of measure standards would have been the first to question how the second was established as the time period for the longest EM wavelength. There are large bureaucracies associated with metrology and these organizations are very protective of their purpose and would consider it is best not to bring up an issue that was not caused by them and would be difficult to solve.

As noted in ref. (8), the duration of the unit of time, an intrinsic unit, where the frequency of the emission of the neutral hydrogen atom has the same value as the speed of light, has a different duration than the Earth second.

The ampere is considered a base unit of measure in SI units. The Ampere is involved in measurements of EM phenomenon, which is why it is included as an issue. The definition for the ampere follows: "The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per meter of length." [15] The value is directly dependent upon the newton, which is not a base unit of measure. It is not understood how the BIPM can establish a base unit of measure by basing it upon a measurement that is not a base unit of measure. Before the Newton was used it was "MKS unit of force," which had not been established as a base unit of measure.

XII. Michelson-Morley Experiment

The Michelson-Morley (M-M) experiment of 1887 claimed to prove that aether does not exist. The experiment is based upon the interpretation of the Greek word Aether (aether) and the interpretation of what *above* the celestial sphere actually meant. Aether is a reputed Greek god. The Greeks did not describe an aether wind, that was created within the minds of 1800s scientists. Two theories were formulated about the aether, one that it permeates the cosmos and all objects are moving through it or that large objects such as stars and planets drag the aether with them. If you chose the first assumption you can then state there must be an aether wind if the aether exists. There would be no wind if the second assumption was chosen. Additionally, it was assumed that the aether, if it existed, would influence the propagation of light waves. A major conclusion of the M-M experiment claimed to prove that light does not need a medium in which to propagate.

It is necessary to consider what individuals of that era actually knew about physical characteristics of the atmosphere, the structure of matter, and the existence of EM waves. What did *above* mean to scientists over a century ago? In 1839, physicist Carl Friederich Gauss suggested the existence of an electrically conducting region in the upper atmosphere. In 1887, Hertz demonstrated that EM waves could be produced artificially and that they propagated through the air just as light waves. Hertz did not report his discovery in writing until 1888. It was not until the early 1900s was it demonstrated that EM waves could skip (reflect) from the upper electrically conducting layer. It was not until 1940 that astronomers and other scientists were informed that EM waves other than light were coming from the cosmos.

It wasn't just the assumption that the aether did or did not exist, it had to be assumed that if it did exist it had to have some type of characteristic that had an effect on light waves. Since it was found that their experiment produced no effect on light waves it obviously proved that the aether did not exist. Why such a serial assumption was allowed is not understood. It is quite possible that the term aether had another meaning.

XIII. Dispersion Measure

Optical astronomers have had multiple centuries of observation to support their conclusions about the characteristics of the universe. With the development of infrared and ultraviolet sensors, optical astronomers have extended the spectrum they can examine, but it is a fraction of the EM spectrum being examined by radio astronomers. Radio astronomer observations did not begin until after 1940. However, radio astronomers have been able to exploit the knowledge obtained by physicists by using the atomic spectral emissions produced by various elements to identify characteristics of galactic objects hidden from optical astronomers.

After less than 40 years of observation, radio astronomers identified small changes in the frequency of spectral emissions of chemical elements from sources in our galaxy when they were in specific viewing directions. They were forced to conclude there were differing quantities of material between Earth and specific distant spectral emission sources within our galaxy. These materials are invisible to optical astronomers and do not cause detectable changes in the optical spectra for the relatively short distances within our galaxy as compared to distances between galaxies and clusters of galaxies at great distances.

Radio astronomers are continuing to catalog the specific viewing directions that exhibit slight frequency changes to atomic spectra and they apply a *dispersion measure* for these viewing directions. As better angular resolution radio wave antennas are developed, the dispersion measure values are being refined. Optical astronomers do not have equivalent dispersion measure values for any viewing direction, irrespective of distance. Optical astronomers dismiss there is anything in space between them and distance objects that is causing spectral changes at optical frequencies. They have concluded it can only be the motion of objects that is causing changes in the optical spectrum, a Doppler shift.

For optical astronomers, the Michelson-Morley experiment eliminated the presence of a pesky material that they cannot see from influencing their conclusions about the characteristics of the universe. Since this pesky material does not exist, it was possible for optical astronomers to conclude that clusters of galaxies produce gravity lensing rather than there being something in space within and surrounding galaxies that functions similar to an optical lens. Perhaps the Greek term aether was referring to the pesky little particles that radio astronomers have to consider that is causing spectral frequency changes. One might think that this pesky material might be more prevalent where there are concentrations of matter that form galaxies and within galaxies. Radio astronomers are expanding the dichotomy between their observations and those of optical astronomers.

Radio astronomers recently identified the physical size and altitude of what are termed *density ducts* that surround Earth, the plasma structures that produce *whistlers*. The density ducts are invisible to optical astronomers, but they were causing pointing errors to distant radio sources in our galaxy. Whistler type signals are detected from other planets in our solar system and even the moons of Jupiter, so it is reasonable to expect there are other plasma structures in our galaxy that are producing radio emissions, perhaps with unusual characteristics. The frequencies produced in these density ducts are dependent upon the strength of the magnetic field enveloping the plasma and the plasma density.

It is possible that our Sun is surrounded by its own density ducts. "The stagnation of this solar wind has continued through at least February 2011, marking a thick, previously unpredicted "transition zone" at the edge of our solar system." [16] It is reasonable to suspect our Sun is surrounded by its own density ducts in the area of the heliosheath, and they are enclosed by the Sun's magnetic field. The EM

frequencies produced therein could be significantly lower than those of *whistlers*.

XIV. Paradigm Paralysis

A paradigm is a consensus that has been reached by those that study the characteristics of a particular type of activity or process. In the physical sciences, a paradigm is something that has been determined to be absolutely indisputable. The basis for the paradigm is the accumulated knowledge set known at the time the paradigm was established. A contemporary paradigm gains stature because funding tends to be awarded to those who follow the paradigm, not those that challenge it.

Thomas S. Kuhn discussed paradigm shifts.[17] One issue Kuhn may not have considered is the presence of an error so egregious that it clouds the thinking of every one, starting in adolescence where they learn the meaning of words that have a technical basis. If not corrected, an error is carried forward in everybody's thinking and not just those of scientists. The egregious error is the manner in which EM wave frequency is defined. The error was memorialized and enhanced in 1960 when the SAS officially changed the EM wave frequency descriptor from cycles per second (cps) to Hz. The incorrect definition of EM wave frequency has had consequences.

It has to be recognized that the type of instruments used to establish a given paradigm could provide incomplete information. This was the case with quasicrystals. Dan Schechtman used a tunneling electron microscope to view quasi-crystals in 1982, but it was determined soon thereafter that larger sample sizes were needed before the patterns could to be viewed with x-ray crystallography equipment. Even after larger samples were provided and other scientists determined that quasi-crystals existed and they have a repeating mathematical basis, one of the *old guards* of the incomplete paradigm refused to accept the results to the day he died.[18]

We are experiencing a paradigm paralysis in the study of EM wave fundamentals and some related science fields because of the error made well over a century ago in determining the longest period of an EM wave, the basis for EM frequency. The lack of instruments to detect the presence of UULF EM waveforms coming from the cosmos aids in hiding the error.

The contemporary SAS is actually stifling the discovery process in the physical sciences. The *old guard* that controls the SAS aren't going to help prove what they believe to be an absolute fact is wrong. 'And Max Planck, surveying his own career in his Scientific Autobiography, sadly remarked "a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it." A new generation will have to find a way to salvage Planck's Constant, if it can be salvaged.

Paradigm paralysis can infect every scientific process, but it has a tendency to be more prevalent in those scientific endeavors that have an extended history where there are more old guardians of a paradigm.

XV. Cargo Cult Phenomenon

The cargo cult phenomenon mentioned by Feynman was the product of WWII. How the phenomenon is applicable to the scientific community was described in the fourth paragraph from the bottom of Feynman's 1974 commencement address.[19]

The primitive culture that developed their cargo cult ceremonies had, before the GI's appeared on their islands with cargo, spent most of their time acquiring food and maintaining dwellings for protection from inclement weather. The cargo provided all these essentials with less effort. The primitive tribe learned that emulating the proper control procedures resulted in the cargo returning, which was accompanied by tourists.

To the scientific community, cargo is equivalent to grants. If the proper procedures are followed grants will continue to come. As noted by Feynman in his 1974 commencement address, the actual

results do not matter.

It is difficult for the non-scientist not to be fooled by what is published in science articles because the material is presented authoritatively in a cryptic mathematical-science language that only scientists understand. Another mathematician-physicist and author, Arthur C. Clarke, provided a statement that is applicable to all primitive cultures, "Any sufficiently advanced technology is indistinguishable from magic."

Summary

There have been a variety of fundamental errors and omissions for well over a century that have inhibited our ability to properly understand the characteristics of the EM wave phenomenon.

The interpretation of the Greek word aether has influenced contemporary conclusions about EM waves and space in general.

It is easy to state that the purpose of EM waves is to transfer energy, but it is difficult to identify what is accomplished overall in every energy transfer process. If the universe can be considered a closed system, the law of conservation of energy can be applied.

It is important to know what a scientist did and not know at the time an important theory or conclusion was presented by that person. Maxwell knew he had a problem. Contemporary researchers have computers to assist in complex calculations, but none seem to think it is necessary to determine what effect action at a distance could have had on Maxwell's equations.

Maxwell and everyone thereafter has not identified the mechanism that causes seemingly instantaneous action at a distance. A charged particle, with or without spin, cannot be considered an isolated point source if it is a participant in action at a distance.

Action at a distance may not be instantaneous because we do not have the timing instruments to measure the delay at relatively short planetary distances. The precision of time measurement instruments need to be improved as suggested in ref. (7). The ultimate numeric precision would be limited only by our technological capability to calculate the value of $2\pi\sqrt{2}$ and apply it to a measurement device.

It is necessary to consider the influence that Newton, Maxwell, Einstein, Eddington and many others have had on those that studied their work and accepted their theories without factoring into their reasoning that these scientists did not know EM waves are propagating everywhere in space, did not know the mechanism that causes EM wave polarity and did not have sufficient information to consider the fundamental purpose for the existence of EM waves.

The true extent of the EM spectrum has been distorted by applying an incorrect time duration for the longest EM wave. The same action corrupts the Planck constant results below 1 Hz even if the constant was valid above that frequency.

The Michelson-Morley experiment has distorted the discovery process because the basic assumption was based upon incomplete information. The results have influenced astronomers conclusions about the characteristics of the universe.

Paradigm paralysis inhibits many scientists from challenging long accepted paradigms, because they know they will be punished. Professor Dan Shechtman experienced retribution and was labeled a *quasi scientist* for at least a decade.

Basic geometry, properly exploited as in the *Methodology*, identified a fundamental electromagnetic characteristic that was not readily discernible using other mathematical forms, that the speed of light and a specific EM frequency have the same numeric value, and that frequency is at the center of the EM spectrum defined by the triangle pair.

As for the existence of UULF EM waves, do not expect anything to change until someone actually builds a resonant-capacitive-inductor that can extract useful energy from one of these extremely high energy EM waves. 3-D printing could provide the tool to create the extremely high

density inductor-capacitor combination required to resonant with a UULF EM wave.

When the authorities of a culture, which might be scientific, civil or religious, do not periodically allow a critical examination of every scientific theory or process which is currently established as a fact, that culture will retain a primitive status for a long time.

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