ERRORS AND OMISSIONS IN THE CEM/EE MODEL

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ABSTRACT

Major errors exist in the classical electromagnetics/electrical engineering (CEM/EE) model, as pointed out by Feynman, Wheeler, Bunge, etc. The errors, implications, and a short history of the model's development and truncation are presented.

Whittaker proved that every EM field and potential is a set of ongoing *free* EM energy flows. However, with its source of potential energy flow connected as a load while physical current flows, the closed current loop circuit self-enforces Lorentz symmetry and kills its source. Lorentz regauging symmetry enforced on the model and circuitry *arbitrarily* excludes permissible asymmetric Maxwellian systems using free asymmetric regauging energy to provide COP >1.0 (overunity coefficient of performance). Rigorous proof that discarding the Lorentz condition produces energy-from-the-vacuum systems is given by Evans et al.[1], as also by Lehnert[2] and by Lehnert and Roy[3].

A replicable magnetic engine is presented with zeroed back mmf, exemplifying a COP > 1.0 nonequilibrium steady state (NESS) EM system analogous to a home heat pump. Adding clamped positive feedback provides a COP = ∞ system freely receiving all its input energy from asymmetrical regauging, analogous to a solar cell array power system.

As one benefit, the solution to the dark matter and dark energy problems arises from the corrections. Dark matter (Dirac sea hole currents) and dark energy (negative energy EM fields and potentials) can readily be evoked in circuits and systems on the laboratory bench, and their odd phenomenology explored and determined.

The flawed CEM/EE model should be corrected with highest priority. Asymmetric COP > 1.0 electrical power systems should be rapidly developed—resolving the escalating world energy crisis while dramatically reducing biospheric pollution, global warming, and the cost of energy.

FOREWORD

[1] M. W. Evans et al., "Classical Electrodynamics without the Lorentz Condition: Extracting Energy from the Vacuum," Physica Scripta, 61, 513-517 (2000).
[2] Lehnert, B., Physica Scripta 19, 204 (1996); — Optik 99, 113 (1995); — Dept. of Electron and Plasma Physics, Royal Institute of Technology, Stockholm, Sweden, TRITA-EPP-79-13 (1979); — *ibid*., TRITA-EPP-86-16 (1986).
[3] Lehnert, B. and S. Roy, Extended Electromagnetic Theory, World Scientific, Singapore, 1998.

The discussions in the paper show several very significant findings:

1. Contrary to orthodox view and teaching, COP>1.0 and COP = ∞ electrical power systems—using asymmetrical regauging and free input of excess energy by the environment to freely increase their potential energy for subsequent use in freely powering loads—are permitted by both physics and thermodynamics. They are permitted by the Maxwell-Heaviside theory prior to its Lorentz symmetrical regauging.
2. Such CEM/EE systems are and have been arbitrarily excluded in our standard electrical power engineering practice by (a) Lorentz's 1892 symmetrizing of the Maxwell-Heaviside equations, thus ***arbitrarily*** excluding the entire class of permissible ***asymmetric*** Maxwellian systems, and (b) the standard practice of building and using only that small class of Maxwellian circuits and systems that ***self-enforce*** Lorentz symmetry and COP<1.0 when the free regauging energy is utilized. These two actions have been raised to a scientific dogma welded in concrete and rigorously enforced.
3. A long list of falsities and flaws in the standard CEM/EE model has been pointed out by eminent scientists to no avail. For more than a century, our own scientific community has adamantly promulgated these known falsities, regardless of who pointed them out—***bringing scientific ethics itself into serious question***.
4. There is presently little or no movement at all in our scientific community to correct these glaring errors and practices. To the contrary, there is even stronger determination to keep right on promulgating and enforcing them, to the ever increasing detriment of humanity, the environment, and the ethics of science itself.
5. The source charge problem—key to self-powering, fuel-free electrical power systems—has been scrubbed from all the texts. There are no texts that discuss the ***implications*** of Lorentz's symmetrical regauging of the equations, or that discuss the ***ramifications*** of the self-enforced Lorentz symmetry of our standardized circuits. The continuing false use of force fields in space—a total contradiction even pointed out by Feynman in his three volumes of sophomore physics—is particularly inexplicable, as ***it is never explicitly stating that the potential energy of any EM system can be freely changed at will, either symmetrically or asymmetrically, and this is guaranteed by the gauge freedom axiom of quantum field theory***.
6. There is no "availability of energy" crisis and never has been. Instead, there is a continuing crisis of scientific mindset—accompanied by elevating Lorentz-symmetric equations and circuits to a universally accepted scientific dogma.
7. The energy crisis and much of the pollution of the biosphere, as well as the increasing contribution to global warming, can be rather quickly, cheaply, cleanly, and permanently solved, whenever our leading scientific organizations will undertake it. We speak of our great scientific organizations including the National Academy of Sciences, National Academy of Engineering, National Science Foundation, Department of Energy, the great National Laboratories, and our universities and many others.

This problem can easily be solved and corrected anytime the U.S. scientific community will allow the work and fund it, and not ruin the careers of scientists—particularly young

doctoral candidates and post doctoral scientists who try to work in this area. We therefore urge the leaders of the scientific community to take the strongest possible action to correct this inexplicable century-old scientific blunder and restore ethics to science.

ABSENCE OF FORCE IN MASS-FREE SPACE

To begin our thesis that the classical electromagnetics and electrical engineering (CEM/EE) contains many modeling errors, we open with a quotation from Mario Bunge:

> *"[I]t is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state."* (Bunge, 1967, p. 176).

One of the areas in sad state is the improper use of force and force fields, leading to real problems in the "definition" of force itself. Feynman states:

> *"[I]n dealing with force the tacit assumption is always made that the force is equal to zero unless some physical body is present… One of the most important characteristics of force is that it has a material origin, and this is not just a definition. …If you insist upon a precise definition of force, you will never get it."* (Feynman et al, 1964, Vol. 1, p. 12-2.

Feynman also explains that the EM field in space is force-free, and only has the *potential* to produce force when interacting with charged matter:

> *"[T]he existence of the positive charge, in some sense, distorts, or creates a 'condition' in space, so that when we put the negative charge in, it feels a force. This potentiality for producing a force is called an* electric field*."* (Feynman et al., 1964, Vol. 1, p. 2-4).

Classical electrodynamicists do not comply with Feynman's indication of nature. Quoting Jackson:

> *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."* (Jackson, 1975, p. 249).

Yet almost a century ago, Bjerknes—who had attended Poincaré's electrodynamics lectures in France and had personally assisted Hertz in Bonn for two years—clearly stated that these problems were recognized even then though unresolved, just as they are still unresolved today. Quoting Bjerknes:

> *"The idea of electric and magnetic fields of force was introduced by Faraday to avoid the mysterious idea of an action at a distance. After the victory which Maxwell's theory gained through the experiments of Hertz, the idea of these fields took its place among the most fruitful of theoretical physics. And yet if we ask, what is an electric or magnetic field of force? No one will be able to give a satisfactory answer. We have theories relating to these fields, but we have no idea whatever of what they are intrinsically, nor even the slightest idea of the path to follow in order to discover their true nature. Above all other problems which are related to fields of force, and which occupy investigators daily, we have, therefore, the problem of fields of force, namely, the problem of their true nature." … "What we know empirically of the dynamics of the electric or magnetic field is this: … bodies in the fields are acted upon by forces which may be calculated when we know the geometry of the field. Under the influence of these forces the bodies may take visible motions. But we have not the slightest*

> *idea of the hidden dynamics upon which these visible dynamic phenomena depend."* (Bjerknes, 1906).

Let us discuss these issues. Feynman points out that force is of material origin, and that the force is created upon a charged mass by the mass's ongoing interaction with a force-free "condition in space" (the force-free EM field in space). This can also be seen from the mechanical definition of force, given as $\mathbf{F} \equiv \mathbf{dp}/dt = d/dt(m\mathbf{v})$. As seen, mass is a *component* of force. This fact is not pointed out in either basic mechanics or Maxwell-Heaviside electrodynamics. Neither is it pointed out in electrical engineering. But it is true nonetheless. *Force and force fields rigorously exist only in mass systems. If there is no mass present, there is no force*.

Thus, contrary to CEM/EE textbooks, the EM field in space is not a *force* field at all, but—in a general relativistic view—it is a *precursor* force-free "altered condition of space itself", as pointed out by Feynman and many others. If one prefers the particle physics view, it is an "altered condition of the virtual particle flux of the active vacuum."

Then the ongoing interaction of the force-free precursor EM field in space with charged matter produces an ongoing EM *force field* in and on that charged matter.

This allows us to more accurately define force, perhaps overcoming Feynman's despair and also giving the solution to Bjerknes' bewilderment over the hidden dynamics concealed in the observation of forces and force changes. *Force is the ongoing interaction, with matter, of a precursor force-free field in space. Electromagnetic force is the ongoing reaction, with charged matter, of a precursor force free EM field in space*. The EM field in space is a precursor field of altered spacetime and altered virtual particle flux of the vacuum, without force. This field never appears in the CEM/EE model as such, because it was interpreted away by Faraday, Maxwell, and others who assumed the material ether. Thus matter was assumed everywhere, so that the EM field in space was logically assumed to be a force field in this thin etheric matter. CEM/EE still calculates the force field in space (in a material ether). Ironically, this means that electrical engineers never calculate the actual "force-free EM field in space", but only the force field effect—in charged matter—of the interaction of that EM field in space with that matter.

To clearly see how and where force appears, we examine the CEM/EE equation for force **F** of the static electric field—the very simple equation $\mathbf{F} = \mathbf{E}q$. The term q implicitly contains mass. Let us assume the situation where there does exist a field **E** in space (and it is of course the force-free precursor field). With the presence of charge q (containing mass), the equation $\mathbf{F} = \mathbf{E}q$ states that charge q interacts with the precursor **E** field, so that force **F** appears in and on charge q while that interaction is ongoing. Defining **E** itself as the force **F** produced on a unit point static charge is a non sequitur. That is defining the *cause* **E** as the effect **F** of its own interaction upon charged matter q. It illogically equates massless cause as mass effect.

If we now remove the charge q, then $q = 0$ while $\mathbf{E} \neq \mathbf{0}$. In that case $\mathbf{F} = \mathbf{0}$. Hence the precursor **E** can and does exist in space in the absence of charge q and force **F**. One also notes that, if $q \neq 0$ but $\mathbf{E} = \mathbf{0}$, then $\mathbf{F} = \mathbf{0}$. This means that the ongoing interaction of the massless **E**-field (the precursor **E**) with q is indeed required if **F** is to be nonzero.

It follows that *the primary forces of nature are not primary causes after all*. Instead, the force-free precursor fields that interact with matter to produce those forces are the primary causes.

This also is consistent with modern physics, e.g., in quantum field theory the force on a mass is due to the ongoing interaction of virtual particles with that mass. E.g., Aitchison states:

> *"Forces, in quantum field theory, are understood as being due to the exchange of virtual quanta..."* (Aitchison, 1985, p. 372).

Jackson admits that most classical electrodynamicists still erroneously assume an EM force field in space, but they also illogically assume that somehow it is nonobservable *(even though force is an observable!)* and so observable charged mass must be present to allow the interaction product of **E** and q, before **F** is observed. This notion assumes first that EM force exists in the absence of mass but is not observable, but then it becomes observable after interacting with charged matter. Jackson does admit that the field—as it exists in space—is nonobservable.

Thus Jackson clearly admits a major non sequitur but continues to neglect this falsity that has been propagated in CEM/EE for more than 100 years. The falsity is still taught to every electrical engineer and in every university. Extant CEM/EE texts detail the calculation of the force **E**-field in *charged matter*, and erroneously present it as a calculation of the **E**-field existing in *mass-free space*. This is a fundamental and far-reaching falsity in all present CEM/EE texts.

Basic mechanics also errs when it assumes a mass-free vector force in space, acting upon a separate mass. No such situation exists, simply from again examining $\mathbf{F} \equiv d/dt(m\mathbf{v})$. Substitute $m = 0$, and immediately $\mathbf{F} = \mathbf{0}$. As we stated, the mass m is actually a *component* of the force that is produced by the interaction of a vector force-free "condition in space" with that mass m. Thus the interacting vector entity (which exists alone in space prior to its interaction with q) *cannot be a force*. This error—failure to recognize that mass is a component of force—has been in basic mechanics for more than 300 years, and it continues to be propagated without objection and without correction.

SHORT HISTORY OF MAXWELL'S THEORY

Maxwell's original theory is 20 quaternion-like equations in 20 unknowns (Maxwell, 1865; Torrance, 1996). Maxwell and others assumed the material ether, so to them there was no point in the universe where mass was absent. Hence Maxwell's own EM fields in space are also erroneously *force fields in mass*—force fields in the material ether—which today we know is false because there is no observable ether (Michelson and Morley, 1886, 1887).

During Maxwell's own lifetime his theory did not gain its eventual great credence and prestige. Not until 1888 when Hertz (i) demonstrated the EM waves originally predicted by Maxwell (and by the subsequent Heaviside truncation), and (ii) measured their speed as the speed of light, did the Maxwell theory come into such prominence. That was nine years after Maxwell's death in 1879.

The first edition (Maxwell, 1873) of Maxwell's famous Treatise was published eight years after his fundamental 1865 paper and contains essentially the same theory. But other scientists and his own publisher harshly criticized Maxwell for employing Hamilton's quaternion algebra (Hamilton, 1853) which was deemed puzzling and incredibly complicated—and was bitterly hated.

With such criticism of his fledgling theory and of the very first edition of his Treatise, Maxwell then began intensely simplifying his own model and equations and reducing the complexity of his own theory. He had completed drastically curtailing about 80% of his own Treatise when he died in 1879 of stomach cancer. For the second edition of his Treatise (Maxwell, 1881) published two years after his death, that 80% of the first edition was replaced with Maxwell's own drastic simplification. Similarly the third edition (Maxwell, 1892) contained the same replacement, with added comments etc.

So the standard third edition of Maxwell's Treatise, widely available today and accepted as "Maxwell's original theory", is no such thing. It is a great simplification and reduction of his theory, and a pale shadow of the original.

Had the quaternion EM model remained, then the later theory of general relativity would almost certainly have been factored into quaternion form, thereby providing a complete unified field theory. Quoting Sachs:

> *"[T]he factorization of Einstein's field equations to the quaternion form fully unifies the gravitational and electromagnetic manifestations of interacting charged matter."* (Sachs, 1999, p. 123).

Following Maxwell's death, in the 1880s and 1890s several scientists (Heaviside, 1885-1887 and later; Gibbs, 1934; Hertz, 1887, 1893) ripped the quaternions apart, greatly truncating the theory and creating and using vector algebra in the process. This vector truncation was a greatly curtailed treatment of Maxwell's original quaternion theory, and together with Maxwell's own truncation it essentially spelled the end of Maxwell's quaternion EM theory. Barrett describes the result as follows:

> *"[T]he A field [for the potentials] was banished from playing the central role in Maxwell's theory and relegated to being a mathematical (but not physical) auxiliary. This banishment took place during the interpretation of Maxwell's theory... by Heaviside... and Hertz. The 'Maxwell theory' and 'Maxwell's equations' we know today are really the interpretation of Heaviside... Heaviside took the 20 equations of Maxwell and reduced them to the four now known as 'Maxwell's equations'."* (Barrett, 1993, p. 11).

What today are taught in university as "Maxwell's equations" are not that at all. They are actually Heaviside's greatly curtailed equations and Heaviside's notation—*as even further simplified and reduced by Lorentz* (Lorentz, 1892).

In 1892 Lorentz put the final *coup de grace* on Maxwell's theory, by symmetrically regauging (Jackson, 1999) the already watered down equations of Heaviside. That symmetrizing action arbitrarily discarded all *asymmetrical* Maxwell systems. A priori, Lorentz symmetrizing retains only those Maxwell systems that are freely and *symmetrically* regauged. It is implicitly assumed that a physical mechanism is present and enforcing Lorentz symmetry. We shall meet that subtle physical mechanism shortly.

The arbitrarily discarded asymmetric Maxwellian systems can have magnificent capabilities: Although the thermodynamic *efficiency*[1] of any system is always less than 100%, the rejected asymmetric systems nonetheless can exhibit an overunity *coefficient of performance*[2] (COP > 1.0) by use of asymmetric free EM regauging energy received from the active vacuum/spacetime environment. These asymmetric systems can function with COP > 1.0 analogously to the common home heat pump, or even at COP = ∞

analogously to a solar cell array power system, a windmill-driven power system, etc. All that is necessary is that the environment freely input most or all of the input energy required.

Every electrodynamicist already assumes free regauging, and thus assumes that the potential energy of a system can be changed freely and at will.[3] However, the electrodynamicist has been trained since Lorentz (Lorentz, 1892; Jackson, 1999) to insist that the system's potential energy must be "symmetrically" changed, so that the excess free energy can only be locked up as *stress of the system*, incapable of use to *freely* power loads. To power the loads, the symmetrical system must also cut off the environmental inflow of free potentialization energy as fast as it powers its losses and loads—which is *faster* than it powers its load.

When current is flowing in such *symmetrized* systems, half the free excitation energy is used to destroy the dipolarity of the source of potential, while the other half is dissipated to power the external circuit's losses and loads. To restore the dipolarity of the source, so that excitation potential energy again flows onto the circuit, the operator must input at least as much energy to again force the charges apart and remake the dipole, as was used to scatter the charges and destroy it. Hence the operator is always inputting more energy to restore the source dipole than the energy dissipated to do useful work in the load. In short, *the standard symmetrically regauged system self-enforces its own COP < 1.0*.

All asymmetrical Maxwellian systems having COP > 1.0 by energy from the vacuum were arbitrarily discarded by Lorentz's symmetrical regauging of the equations, *just to give simpler equations that were easier to solve algebraically*. If the two free excess force fields produced were deliberately made equal and opposite (thus forming a stress potential and a net zero force field resultant), the erroneous assumption was that the regauged system was "identical" to the previous unregauged system. Try standing between two equally pushing and opposing elephants, and compare that "symmetrically regauged" system to the same system with the elephants removed!

In truth, a system under increased physical stress is not identical to the same system with the stress removed, and it will not interact the same. Indeed, *stress relief* (as the current flows) will dissipate half the excess free stress energy to power the external circuit's losses and loads, and it will dissipate the other half of the excess free stress energy in destroying the source dipolarity of the system. Hence the insane symmetrically regauged system with the source of potential remaining connected as a load—while current is flowing and work is being done—will always destroy its own source faster than it powers its own useful loads.

But Lorentz's symmetrical regauging gave *much simpler equations*, particularly easier to solve algebraically. So to escape the tortuous use of numerical methods, the already dramatically reduced EM model of Heaviside, Gibbs, and Hertz was further fractionalized by Lorentz and only a small symmetrized (simpler) part was retained. *Lorentz unwittingly discarded all COP > 1.0 asymmetrically regauging Maxwellian systems, teaching everyone else to continue to do it since then!*

Nature and thermodynamics *do not* exclude asymmetric Maxwellian COP > 1.0 electrical power systems freely taking their excess energy from asymmetrical regauging and using that energy to power loads freely. Nonequilibrium thermodynamics could care less whether the COP > 1.0 NESS system freely receiving and using excess energy from

its active environment receives the usable energy in fluid, mechanical, or electromagnetic form. But the present CEM/EE model *arbitrarily* omits such EM systems, and it has since the 1890s and Lorentz's symmetrical regauging. Since the asymmetrically regauged solar cell array electrical power system taking its excess energy from the EM solar radiation from the environment is possible with its COP = ∞, then from the thermodynamics viewpoint asymmetrically regauged COP = ∞ electrical power systems taking their excess energy from the vacuum EM energy are feasible. What is important is that the energy be furnished in a form usable by the system. All usable EM energy already comes from the vacuum, via the source charges; hence obviously the use of any EM energy is already the use of EM energy from the vacuum. E.g., the solar radiation used by the solar cell array electrical power system comes from the active vacuum in the sun, interacting with the source charges there and resulting in continuous emission of "energy from the vacuum" by those charges in the sun.

By propagating a seriously flawed and sharply curtailed CEM/EE model and refusing to correct and update it for electrical power engineering, our own scientific community is responsible for the forced absence of *self-powering, fuel-free* electrical power systems taking their input energy freely from the active vacuum and curved spacetime via free asymmetrical regauging. The community also bears responsibility for a century-long delay in the progress of energy science, for the world energy crisis itself, for the pollution of the planet by use of dirty energy methods, and for the miserable economic state of many poor nations and peoples worldwide who cannot achieve the cheap energy necessary for a viable national economy and a decent standard of living.

The ethics and pathos of the situation cries out for immediate and strong corrective action by the scientific community.

LIST OF MAJOR FLAWS AND FALSITIES IN THE CEM/EE MODEL

The CEM/EE model contains many flaws and falsities. As a partial listing, the model assumes:

1. <u>*The material ether*</u>. This was falsified in 1887 (Michelson and Morley, 1886, 1887). Maxwell himself assumed this error, and the curtailed equations have never been corrected to eliminate their implicit material ether assumption.
2. <u>*Force fields in space*</u>. Force fields actually exist only in matter, per previous discussion. This falsity continues to be propagated and ignored, even though eminent scientists such as Feynman, Wheeler, and Bunge have pointed it out, including even in sophomore physics (Feynman et al., 1964, Vol. 1, p 2-4, 12-2).
3. <u>*A flat spacetime*</u>. This was falsified in 1916 by general relativity (Einstein, 1916). Whenever the energy density in an EM circuit or system changes, the energy density of spacetime (ST) also changes, constituting a change in the curvature of spacetime. This ST curvature then interacts back upon the system, producing free forces. It also interacts back upon the active vacuum, changing its virtual particle flux. With the reaction forces created in the mass by the curved ST interaction, then whether or not there are *net* free forces remaining in the system to do free work in loads depends upon whether the system is made symmetric or asymmetric in its receipt and application of the free regauging forces and the free regauging energy.

Nonetheless, the spacetime cannot be flat, if any symmetrical or asymmetrical forces at all exist in the CEM/EE system. Indeed, given a single charged particle in the universe, all spacetime is curved *a priori* as pointed out by Sachs. If the forces are symmetric, the *net* force resultant is zero, even though additional free forces have appeared in the system and are still there and are still acting on the system. With the force system having a resultant zero vector, the excess free EM regauging energy from the curved ST is locked up as a change in the *physical stress of the system* and cannot be dissipated *just* to perform free work. Instead, half will be used to destroy the dipolar source of potential, and the remaining half will be dissipated in the external circuit's losses and loads. If the net force resultant is *nonzero* (i.e., if the regauging is asymmetrical so that a net free force field results), then the free regauging EM energy can be dissipated by that net free force to perform net free work in external loads.

4. <u>*An inert vacuum*</u>. This has been falsified since at least 1930 by the advent of the Dirac Sea theory (Dirac, 1930) and the development of quantum mechanics and particle physics. In quantum field theory, all forces are generated by the interactions with mass of virtual particles in vacuum. Hence the vacuum cannot be inert, and spacetime cannot be flat, if any forces at all exist anywhere in the CEM/EE system. Evans points this out as follows:

   > *"This fundamental result of differential geometry implies that electromagnetic energy can be transmitted from a source to a receiver by scalar curvature R, and that electromagnetic energy is available in non-Euclidean spacetime. ...All fields in nature are fundamentally dependent upon, and originate in, scalar curvature R."* (Evans, M., 2004).

Similar considerations to those of number [3] above do apply.

5. <u>*That "static" EM fields are fixed*</u>. Instead, they are comprised of moving internal EM energy flows. In CEM/EE they are treated as analogous to a *frozen* waterfall. Instead, they are analogous to an *unfrozen* waterfall. Quoting Van Flandern:

   > *"To retain causality, we must distinguish two distinct meanings of the term 'static'. One meaning is unchanging in the sense of no moving parts. The other meaning is sameness from moment to moment by continual replacement of all moving parts. We can visualize this difference by thinking of a waterfall. A frozen waterfall is static in the first sense, and a flowing waterfall is static in the second sense. Both are essentially the same at every moment, yet the latter has moving parts capable of transferring momentum, and is made of entities that propagate. ...So are ... fields for a rigid, stationary source frozen, or are they continually regenerated? Causality seems to require the latter."* (Van Flandern, 1998, p. 8-9).

The fields and potentials represent continuous flows of EM energy (real observable photons) emitted at light speed from their associated source charges. The emitted photons continually establish and replenish these EM energy flows—and the resulting associated fields and potentials—at light speed. This continuous outflow of spreading observable real EM energy (observable photons) from any charge or dipolarity is easily measured experimentally, as is the fact that no *observable* energy input is provided to the source charge in this process.

This leads to the long-vexing *source charge problem*—solved by the present author and published in 2000 and subsequently (Bearden, 2000, 2002). The source charge problem has been pointed out but not solved by a number of physicists. E.g., Sen states:

> *"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics."* (Sen, 1968, p. viii).

Kosyakov states the source charge problem more directly:

> *"A generally acceptable, rigorous definition of radiation has not as yet been formulated. ...The recurring question has been: Why is it that an electric charge radiates but does not absorb light waves despite the fact that the Maxwell equations are invariant under time reversal?"* (Kosyakov, 1992, p. 135, 141).

The charge requires no *observable* energy input to produce a continual *observable* energy output. Prior to 2000, the source charge problem had not been solved, but it had been scrubbed from all the CEM/EE textbooks. With the proposed solution in hand,[4] the present author has nominated the source charge as the first known physical system producing continuous negative entropy as theoretically shown possible (Evans, D. and Rondoni, 2002). We have also nominated the source charge as a Feynman ratchet (Denur, 2004) and a true Maxwell's Demon (Maxwell, 1871).

Either the source charge problem destroys the entire conservation of energy law because the charge creates—from nothing at all—the observable output energy continuously flowing from it, or else the source charge must absorb *virtual state* disordered energy, reorder it (a negative entropy operation falsifying the present second law of thermodynamics), coherently integrate the ordered virtual energy to the next observable (quantum) threshold, and abruptly decay from the quantum threshold excitation by re-emitting the energy as an observable photon. *The second alternative mechanism is precisely what the charge does, and continually.*

Continual iterative performance of this mechanism means that the source charge is an example of the controversial Feynman ratchet (Feynman et al., 1996), continually consuming positive entropy of the virtual state fluctuations of the vacuum and producing negative entropy in the observable state. This is also in accord with the mathematical demonstration that *such systems are theoretically possible* (Evans, D. and Rondoni, 2002). Therefore the source charge and its associated EM fields and potentials (and their energy) either (i) falsify both the first and second laws of thermodynamics, or (ii) obey a slightly extended (to cover virtual energy input) first law while falsifying the present second law. The latter alternative is the case in nature, but CEM/EE assumes the former. In this paper we again present our formal correction and extension of the second law.[5]

6. <u>*That all EM field energy and potential energy has been freely created from nothing at all.*</u> First, the model assumes that every EM field, EM potential, and joule of EM energy in the universe is produced from its associated source charge(s), which is *true*. But the model further assumes that all the field energy and potential energy has been freely created by the source charges(s) from nothing at all, which is *false*. So the CEM/EE model assumes total violation of the conservation of energy law (the first law of thermodynamics) as well as of the second law (see discussion under items 5 and 6, above), by every EM field, EM potential, and joule of EM energy in the

universe as well as every charge and dipole in the universe. Hence either the CEM/EE model is terribly wrong, or most of physics and thermodynamics are terribly wrong. Quantum field theory already includes formation of observable EM energy by interaction of nonobservable energies. Thus it directly points toward the author's proposed solution of the source charge problem (Bearden, 2000, 2002).

7. *That the scalar potential is a basic entity and has no internal structures and dynamics*. This erroneous assumption has been falsified for more than a century[6] (Whittaker, 1903). In quantum field theory (e.g., Mandl and Shaw, 1984, 1993) the longitudinal photon and the scalar (time-polarized) photon are individually nonobservable, but their paired combination is observable as electrostatic scalar potential (common voltage). Hence the scalar potential (common voltage) decomposes into pairings of flowing time-polarized waves and longitudinal waves (Whittaker, 1903).

8. *That the EM field is also basic and has no internal structures and dynamics*. This erroneous assumption has also been falsified by Whittaker for more than a century[7] (Whittaker, 1903, 1904).

9. *That the isolated source charge is finite and does not polarize its surrounding "inactive" vacuum*. To the contrary, modern particle physics shows that the charge does indeed polarize the surrounding *active* vacuum, and that the vacuum has structure and dynamics, and is active. The erroneous "inert vacuum" assumption of the CEM/EE model ignores the associated *asymmetry of opposite charges* that accompanies any charge and the opposite charges of its *polarization ensemble*. Further, the bare charge inside the polarization screen is infinite, as is the screening virtual charge surrounding it. The difference between these two infinite charges, however, is finite and is what our instruments observe of the internal infinite bare charge.

Via its broken symmetry, the source charge ensemble continually consumes positive entropy of the virtual state vacuum, transducing it to negative entropy of the observable state—totally falsifying the present incomplete second law of thermodynamics. Indeed, broken symmetry implicitly requires that something virtual has become observable. Quoting Lee:

> *"Since non-observables imply symmetry, these discoveries of asymmetry must imply observables."* (Lee, 1981, p. 184).

Broken symmetry of opposite charges (and thus of any charge's polarization ensemble) was experimentally proven in 1957 (Wu et al., 1957) after earlier prediction by Lee and Yang (Lee, 1956; Lee et al., 1957). So revolutionary was the advent of broken symmetry in physics that the Nobel Prize was quickly awarded to Lee and Yang—in Dec. 1957—for their revolutionary prediction.

The "isolated charge" *does* polarize the vacuum, involving two infinite charges, as shown by quantum field theory. E.g., Nobelist Weinberg states:

> *"[The total energy of the atom] depends on the bare mass and bare charge of the electron, the mass and charge that appear in the equations of the theory before we start worrying about photon emissions and reabsorptions. But free electrons as well as electrons in atoms are always emitting and reabsorbing photons that*

> *affect the electron's mass and electric charge, and so the bare mass and charge are not the same as the measured electron mass and charge that are listed in tables of elementary particles. In fact, in order to account for the observed values (which of course are finite) of the mass and charge of the electron, the bare mass and charge must themselves be infinite. The total energy of the atom is thus the sum of two terms, both infinite: the bare energy that is infinite because it depends on the infinite bare mass and charge, and the energy shift ... that is infinite because it receives contributions from virtual photons of unlimited energy." (Weinberg, 1993, p. 109-110).*

So any "isolated charge" is actually an ensemble consisting of an intense (infinite) bare charge surrounded by clustering virtual charges of opposite sign (also an infinite charge). The observed difference between these two infinite charges is *finite*, and it has the sign of the inner bare charge. That observed finite difference is the *classical textbook's measured value* of the so-called isolated "classical charge".

Infinite energies are involved in the bare charge and in its polarized vacuum charge. The two infinite energy charges of the dipolar ensemble will not be dissipated in the slightest for any finite amount of energy collected from their freely flowing energy output. For the potential V, the simple equation describing that situation is W = Vq. As can be seen from this equation, from a given "static" V any amount W of EM energy can be collected on charges q, *given sufficient intercepting charges q and sufficient time!*

Or one can collect a given finite W on available fixed charges q with no current allowed to flow, disconnect the source of V without it having undergone any dissipation, re-complete the freely potentialized circuit (as with a resistor and diode in series) and *then* allow current to flow again in the already freely potentialized but asymmetrical new circuit sans the original source. This circuit will then freely dissipate the excess free potential energy in this asymmetrical regauged system as real, free work in the load. And it will not dissipate its original source—which can just be reused over and over for free potentialization (free asymmetric regauging of the external circuit).

Constituting a Feynman ratchet (Denur, 2004), this iterative potentialization process can be repeated over and over. In this way only a small switching and timing energy need be furnished by the operator, to collect, control, and direct very large amounts of energy. The startling conclusion and result is that *EM energy itself is totally free, from any charge or dipolarity! And any static source of potential V can continue to furnish unlimited energy to the circuit, undiminished, for any length of time—if the source dipolarity is not deliberately destroyed by inappropriate forced symmetrical operation of the potentialized collecting circuit itself.*

Even the small switching energy can then be subtracted from the total system output, slightly lowering the output to the load but producing a nonequilibrium steady state (NESS) system that freely powers its own switching and control in addition to powering its own losses and its load. *No laws of physics or thermodynamics are violated* —again, the system operation is analogous to that of a solar cell array electrical power system.

This shows that the availability of limitless observable and real EM energy from the vacuum is a reality, already shown by every source charge and dipolarity. That it has not long been done in our electrical power systems is due to the grave errors and inane self-limitations imposed in and upon our classical electrical power engineering CEM/EE

model—and consequently upon our electrical power systems and circuits by our scientists and engineers themselves.

10. *That Heaviside's giant usually nondivergent "curled" component of the energy flow vector (Heaviside, 1893) is of no physical significance and can be discarded, leaving only the tiny Poynting divergent flow component*.

The discarded and unaccounted Heaviside component output from every source is far greater in magnitude (Heaviside, 1893) than the small Poynting vector component (Poynting, 1884, 1885). Circa 1892 Lorentz—unable to state the source of this enormous but usually nonreacting Heaviside flow from every generator and battery—simply disposed of the problem itself. He stated that it had no physical significance since it did nothing (because it did not interact) (Lorentz, 1892).

Before his death, Heaviside had realized that his huge curled component of energy flow had gravitational significance. He had worked out a draft electro-gravitational theory based on this, and these hand-written papers were found some years after his death, beneath the floor boards of the little garret apartment where he lived in seclusion for the final years of his life. The papers have been published (Josephs, 1959) and commented upon very favorably (Laithwaite, 1982).

So to get rid of Heaviside's troublesome and huge curled component of the energy flow, Lorentz originated the trick of integrating the energy flow vector around an assumed closed surface surrounding any volume element of interest (Lorentz, 1931, p. 185). This procedure *arbitrarily* discards (from all accounting) the giant and inexplicable Heaviside component that does not usually interact to power the circuit or anything else. But the procedure retains the tiny *diverged* Poynting component that interacts to power the circuit. The CEM/EE model thus ignores the fact that, *when the huge Heaviside curled component of the energy flow vector is also considered, every dipolar source generator outputs far more EM energy than the mechanical energy that is input to crank the shaft of the generator*. The ignored Heaviside energy flow component is sometimes a trillion times as great in magnitude as the feeble Poynting component.

As an example, Jackson uses the same Lorentz argument (no physical significance) to ignore the extra Heaviside component. He states a true premise and then a false premise, assuming they are in agreement. Quoting:

> *"[T]he Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences."* (Jackson, 1975, p. 237).

To the contrary, with special measures a little of the huge Heaviside curled energy flow component can be diverged after all, and this diverged component can be collected and used. As an example, in the physics of negative resonance absorption of the medium (NRAM), sufficient additional spacetime curvature is elicited by self-resonating *spinning* charged particles of the medium. This results in additional energy diverged and collected by the resonant charges from the long-neglected curled Heaviside energy flow component. Hence *some 18 times as much energy emission occurs from the self-resonant medium, operating in the UV or IR, as was input to the medium in the Poynting energy flow component* (Bohren, 1983; Paul and Fischer, 1983; Letokhov, 1967, 1968, 1995). The experimentally proven COP of this NRAM process is therefore COP = 18.

Note that in the infrared (IR), *NRAM is a proven heat amplification process where excess energy for the amplification (for the COP > 1.0 is freely taken from the Heaviside energy flow component*. It could conceivably be added to the boiler in every steam-turbine-driving generating system. With an achieved amplification of only, say, 4.0, the process could dramatically reduce (to 25% of its present fuel requirement) the system's consumption of hydrocarbon fuel, nuclear fuel rods, etc. while maintaining the same heated steam output, and therefore maintaining the same electrical power output of the generating system. The excess energy input diverged from the neglected Heaviside energy flow environment would come from the additional curvature of spacetime invalidating the vector algebra assumption (in flat spacetime) that the divergence of the curl is zero. In sufficiently curved spacetime that assumption need not be true.

Hence in NRAM systems some of the *usually nondivergent* huge Heaviside component (when speaking of divergence by a static intercepting charge) *can and does get diverged* to become an "extra" free Poynting input component. That asymmetrical extra free energy input from the active NRAM environment violates Lorentz symmetry of the system, thereby allowing system performance of COP > 1.0. In short, it enables up to a theoretical COP = 18, even though the system efficiency is always less than 100% as required by system losses and the conservation of energy law. An actual COP = 4.0 or so would appear to be reasonably achievable in engineering development and practice.

11. *That the symmetrical, standard closed current loop circuit with source of potential connected as a load while current flows is the only proper one to use*. To the contrary, this inane circuit enforces symmetrical self-regauging, *forcibly preventing* COP > 1.0 Maxwellian system performance taking excess asymmetric regauging energy from the vacuum and using it to freely power a load. Lorentz symmetry in an electrical circuit forcibly equalizes its back emf and forward emf, and in a magnetic circuit it forcibly equalizes the back mmf and the forward mmf. The power company's power system transmission lines and circuits all enforce Lorentz symmetry, thus assuring that we continue to pay the power company to engage in a giant wrestling match inside its own generators and *always lose*. To borrow a phrase from Nikola Tesla, the ubiquitous use of this self-crippling circuit is

> *"...one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history."* (Tesla, 1919).

By deliberately violating the normal operation of this self-symmetrizing circuit, the system can be forced to violate Lorentz symmetry, hence permitting COP > 1.0. But because of the ubiquitous use of this terrible circuit, the false mystique has erroneously solidified in the scientific community that COP > 1.0 energy-from-the-vacuum (EFTV) electromagnetic circuits cannot be built and that the second law of thermodynamics cannot be violated. To the contrary, several areas in physics are already known to violate the second law. These areas are listed in some of the leading thermodynamics texts (Kondepudi and Prigogine, 1998 and 1999, p. 459) and are known and accepted by leading nonequilibrium thermodynamicists. One such area is the use of strong gradients (in EM circuits and elsewhere).

In addition, every statistical fluctuation in a system initially in equilibrium (in a state of maximum entropy) produces negative entropy and thereby lowers the system entropy from its initial maximum value. Quoting Maxwell:

"The truth of the second law is … a statistical, not a mathematical, truth, for it depends on the fact that the bodies we deal with consist of millions of molecules… Hence the second law of thermodynamics is continually being violated, and that to a considerable extent, in any sufficiently small group of molecules belonging to a real body." (Maxwell, 1878).

Precise fluctuation theorems exist for calculation of these effects (Evans and Searles, 1994; Crooks, 1999). Often the effect can be of significance; in certain chemical solutions the negative entropy effects from fluctuations can exist in up to a cubic micron of fluid, and can last for up to two seconds (Wang et al., 2002). In aqueous solutions a cubic micron may contain about 30 billion ions and molecules, and in that region some of the chemical reactions are *running backwards*.

12. *That EM energy is always positive energy, and that the mass of electrical charges is always positive*. To the contrary, with its electron lifted out and departed, a persisting Dirac sea hole has *negative* mass-energy. As a source charge each hole will also produce *negative energy* EM fields and potentials. Currents of such negative mass-energy holes (the so-called "dark matter") and their resulting negative energy EM fields (the so-called "dark energy") can be evoked and explored in actual circuits, as has been shown (Bedini and Bearden, 2004).

But even Dirac, who despised negative energy and devoted much of his effort to trying to get rid of it, did take the mistaken view that the hole would be observed as a positron—basing it on the assumption that when the hole was moved away, the *space* originally occupied by the hole will have lost its excess negative mass-energy and negative charge, and thus has become *more positive* in charge and with a *positive-going* increase in positive mass-energy. Of course this positive increase in the local space charge is not a direct observation of the departed hole itself, or of any physical interaction with the hole itself. Neither is the positive-going increase in mass-energy of the vacated space. It is just a reaction of a sudden sharp (and momentary) change in the *negative charge of a region of space* that started from a more negative charge condition and went to zero, and of the change in positive direction in the negative mass-energy of a region of space. It is the replacement of a negative mass-energy electron by a combined positive mass-energy electron and negative mass-energy electron (the replacement of the hole by a piece of ordinary vacuum). A certain charge change in space is thus observed as a *positive-going* charge change, after the hole has departed that position. But *that is most certainly not an observation of the departing hole, and it is not identically the hole*.

This mistaken notion of "observation of the hole itself as a positron" has been applied in materials since in interacting with a material lattice (as in the observing instrument) the hole almost always first eats an available electron and—together with the electron—the two as a couplet disappear back into the vacuum as a "piece of the Dirac Sea" (a piece of normal vacuum) without any radiation whatsoever.[8] This leaves behind an excess net positive charge in the lattice, and that net charge has positive mass-energy and positive energy EM fields. The hole, on the other hand, has negative mass-energy and negative energy EM fields.

So an excess positive charge is not the hole at all, because the hole is already departed elsewhere. Normal electron hopping in a material lattice with an extra positive charge results in the excess positive charge (the lattice positron) migrating around as a "lattice positron current". But it has been largely—and erroneously—accepted in solid

state physics as "identical" to the hole. To settle the issue, simply evaluate the hole and its fields prior to the hole moving or interacting with anything, so that observation has not occurred.

In this case, remarks by Farmelo are of direct interest. He stated:

"Dirac's idea was that 'empty space' actually contains electrons that obey the negative-energy solutions of the equation. He suggested that the negative-energy states are normally 'full', just like the electrons that fill up the low-energy states of heavy atoms, according to the Pauli principle. This means that positive-energy electrons can't make transitions to these negative-energy states, explaining why ordinary electrons don't continually disappear into space. … by 1931 he had changed his mind and come to a much more radical conclusion: 'A hole, if there was one, would be a new kind of elementary particle, unknown to experimental physics, having the same mass and opposite charge to the electron.' …By the time Dirac came to collect his Nobel prize in physics, towards the end of 1933, he was in the enviable position of the theorist who has been proven right after his colleagues had almost unanimously dismissed his most imaginative work as misguided and even perverse. His hole theory was soon superseded by quantum field theory (which he did much to invent and came to abominate), so one can only wonder at his ability to use a wrong theory to produce one of the most triumphant predictions of modern science." (Farmelo, 2002, p. 48).

13. *That EM waves in space are transverse; e.g., given propagation along the z-axis, the E-field might be taken as oscillating along the x-axis and the H-field along the y-axis*. This assumption of the transverse EM force-field wave in space is false. To explain its falsity, we must explain how the field is measured, and the implications.

Consider the Drude electron gas (Drude, 1900) in a conductor (as in a simple antenna or in a detecting instrument). The electrons continually hop off an atom, into the electron gas, onto another atom whose electron had gone wandering, etc. All the electrons have spin as well, and so we can roughly compare an electron to a spinning gyro if the analogy is not pushed too far.

When an EM signal moves through space longitudinally along a wire at nearly the speed of light, the electrons *do not* move (migrate) that way or at that speed at all. Longitudinal force is indeed developed in the Drude gas electrons by the diverged Poynting component. When a longitudinally-forced Drude gas electron tries to move longitudinally down the wire, it is repelled back nearly equally by all those electrons beyond it. So viewed as a gyro, the electron's spin axis is essentially *constrained longitudinally*. The restrained spinning electron acts as a gyro, and so it precesses (in the wire) at right angles to the longitudinal disturbing force generated by the potentialization energy flow. The longitudinally restrained electron precesses *laterally* across the cross section of the wire, when "pushed" parallel to the wire with a longitudinal force. As the potentialization signal oscillates to and fro *longitudinally*, the precessing electrons oscillate to and fro *transversely*, mostly within the wire's cross section.

In a conductor whose Drude electrons experience longitudinal to and fro forces from the longitudinally oscillating "signal from space" interaction, these electrons spend most of their time moving axially back and forth (transversely) in the wire, due to their *lateral gyro-precession* reaction to the longitudinal forces. The electrons do slip

longitudinally just a wee bit (particularly at the surface of the wire), and so they do move down the wire with only a small "drift velocity"—usually of a few inches per hour!

In space, the EM wave is a compression and rarefaction of the energy density of vacuum—i.e., of the stress energy of the vacuum. In short, it is analogous to a "sound wave", and hence longitudinal.

We *detect* the electron transverse precession movement and direction, so *we detect transverse electron gyroprecession waves in the wire*. Even for electrons in space away from wires, due to their masses the electrons are relatively very sluggish and inertially-restrained longitudinally, and so they still mostly precess transversely to and fro. The "effect" force field waves in charged matter are transverse electron gyroprecession waves. The "causative" EM waves in space are force-free longitudinal precursor waves of oscillating curvature changes in spacetime—and thus oscillating changes in the intensity of the virtual particle flux of the vacuum.

The detection of electron precession waves and theorizing of EM transverse waves in the conductor and in space were accomplished and fixed before the electron was even known or discovered. Hence no such thing as the electron, its gyroelectron precession effect, or the Drude electron gas itself was even suspected. Since *transverse* waves were detected in the receiving conductor and instrument, everyone thought that the EM waves coming in from space had just been "intercepted" in the wire. Thus it was assumed that the incoming EM waves in space must obviously be transverse force field waves also.

That is precisely how the pioneers of electrodynamics got the totally mistaken notion of the *transverse EM wave in space*. They believed in the material ether also, so to them there was not a single point in the universe where mass was absent. If there had been a material ether with spinning material particles to precess, then those transverse force fields (in the ether) would indeed have existed. No such ether exists, and no such transverse EM waves exist in the matter-free vacuum.

The luminiferous material ether was experimentally falsified in 1887, more than a century ago (Michelson and Morley, 1887). Not a CEM/EE equation was ever changed to rid the CEM/EE model of its false assumption of (1) the material ether, (2) force fields in space, (3) transverse EM force field waves in space, etc., and (4) the other falsities we listed and discussed above.

Tesla was very much aware that the EM waves in massless space were longitudinal, not transverse. He was perplexed that electrodynamicists did not understand this. Of the transverse wave theory, he stated:

"The Hertz wave theory of wireless transmission may be kept up for a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history." (Tesla, 1919).

As long as our scientific community refuses to correct the terribly flawed CEM/EE model, and all our self-crippling electrical power systems continue to be designed and built with that model by our electrical engineers, then the electric power meter will stay on our homes and factories and the gas pump meter will stay on our autos and trucks. In our incessant need for ever additional energy, we will continue to pollute the planet and biosphere, destroy species, highly constrain national economies, and increase global warming. The continuing struggle for meeting ever-increasing energy

demands will spawn wars of increasing ferocity, polarization of nations, collapses of national economies, great warfare destruction of cities and populations, and a return to a new "Dark Age" for humanity itself.

SOME IMPLICATIONS

In real Bedini circuits, to temporarily provide Dirac holes a sharp gradient of energy density is suddenly imposed on a small region of spacetime, lifting Dirac electrons from their holes for a sudden surge of normal positive energy current (often called the Lenz law effect),[8] and—unknown to electrical engineering—with the temporarily remaining holes surging as a negative energy current pulse in the opposite direction.[9] Both currents can be applied simultaneously to charge a battery very quickly, applying the electron current to one terminal in normal charging manner and the negative energy hole current backwards across the battery from the other terminal.[10] The result is an extraordinarily rapid and asymmetric charging of the battery using a COP > 1.0 process compared to "normal" COP < 1.0 battery charging standards. Bedini has patents granted and pending for circuits using this dual charging effect (Bedini, 2002, 2003, 2004; Bedini and Bearden, 2004).

One again calls attention to the fact that a sharp gradient is one of the areas in nonequilibrium thermodynamics that is already recognized to enable violation of the second law of thermodynamics. Unknown to the thermodynamicists, the sudden lifting of normal electrons from the vacuum by the strong gradient gives a sudden surge of excess positive energy (real electrons with real kinetic energy and positive energy EM fields) and also a sudden surge of excess negative energy (negative energy holes with negative energy EM fields) in the opposite direction. *This dual process is the actual mechanism that violates the second law for sharp gradients, because it produces negative entropy*. Bedini has it working in controlled and very useful COP > 1.0 circuits (Bedini and Bearden, 2004) and in other systems (Bedini, 2002, 2003, 2004).

This rapid charging with excess free energy (simultaneously with both the surge of free electrons and the surge of free holes) enables a COP > 1.0 battery charging operation. In return, with adroit switching and multiple battery sources, it also allows COP > 1.0 operation of a battery-powered *circuit or system*. Systems can be built whereby the circuit self-charges (with free asymmetric regauging energy) its own batteries while powering its loads, providing a self-powering system. Without violating physics or nonequilibrium thermodynamics, an *asymmetrical* Bedini system is permitted to—and can—keep its own batteries charged while they power the system losses and the system loads. In that case, the Bedini system exhibits COP = ∞, as does a windmill-powered electrical power system and a solar cell array electrical power system.

Thus Bedini has developed and utilized some of those permissible asymmetrical self-regauging Maxwellian systems that Lorentz arbitrarily discarded. It is strongly stressed that the solar cell array power system specifically proves that CEM/EE systems producing COP >1.0 and COP = ∞ are possible and practical, *given usable excess free EM energy input from the environment*.

All useful EM field energy and potential energy in an EM circuit is already extracted in usable form from the active vacuum by the charges q. Hence the trick is to undo the total misuse of the energy by conventional symmetrized circuits--by freely and *asymmetrically* utilizing the free "EM energy from the vacuum" more appropriately.

Conventional NESS systems such as windmill-driven power systems, hydroelectric power systems, and solar cell array power systems are *asymmetric* systems freely receiving excess energy from their environment by well-known environmental energy sources. Thermodynamically they are NESS systems with free *conventional* environmental energy inputs. Each produces COP = ∞. They have permissible direct analogs in electrical power systems taking excess energy from the vacuum via asymmetrical regauging, *if and only if we modify the closed current loop circuit to violate Lorentz symmetry (symmetrical regauging) and force a broken symmetry (asymmetrical regauging) system operation*.

Several versions of the Bedini asymmetric systems are presently in production engineering for production and marketing by already-licensed producers. Other asymmetrical regauging electrical power systems are also in engineering development toward future production (e.g., Patrick et al., 2002). Novel new motors are also in development.

NOVEL MOTOR DEVELOPMENT

As an example of other developments, IMP Ltd—a Welsh engineering company based in Neath—announced in April 2005 the development of a revolutionary electric motor and battery charging process (Radowitz, 2005). Patents are pending in the U.K., mainland Europe, U.S.A. and Hong Kong. The motor uses up to seven rotors in differing phases, with *input pulses* (strong gradients) across them. The motor produces some 400% more torque than any other comparable motor presently available. The motor is expected to lead to high performance electric cars, powered by batteries and having up to several hundred miles range. Funding has been provided by IP Wales, which is a business support initiative under the Technium® strategy, partly funded by the European Union and the official Welsh Development Agency.

We point out a viable possibility for the IMP motor: With multiple rotors at differing phases, and using *sharp gradients* across them, production of negative entropy and violations of the second law of thermodynamics can be invoked in multiple rotors at multiple phasings. To assemble a legitimate COP > 1.0 system, the proper switching and timing can select, coherently add, and apply the negative entropy outputs of the combinations of the individual rotors at specific times, so that the controlled output has a combination of excess positive energy (and also excess negative energy, usually just shorted out to ground). While this statement does not prove the motor, *it explains why the specific approach can in theory be viable for producing COP > 1.0 performance*.

DARK MATTER AND DARK ENERGY

It also appears that the Dirac hole and negative energy work of Bedini and the present author may have solved the mystery of dark matter and dark energy. Many *strong gradient processes* continually occur in planets, our sun, the stars, etc. and so Dirac holes and hole currents are continually being produced, as "dark matter" charges and currents of them, along with their associated negative energy EM fields and potentials (dark energy). Since negative mass of the holes and negative energy of their fields gravitationally repel normal matter and are repelled by it, the hole currents with their negative energy fields migrate toward the outside of the galaxy, exiting into intergalactic space.

Congregation of long-surviving and streaming Dirac hole currents outside the arms of a spiral galaxy and also more deeply intergalactically appears to provide the "dark matter" presently sought by astrophysicists. However, the major dark matter interaction on the immediate galaxy itself is from the congregations *outside* and near the galactic arms. Their net antigravity repulsion—back upon the galactic matter that would otherwise centrifugally escape the spiral galactic arms—holds the matter in the arms. The net antigravity force and its direction is the same as would be provided by excess positive gravity from excess hidden positive energy matter within the galactic arm, which is what the scientific community has been erroneously seeking as the "dark matter".

The negative energy EM fields of these holes, bunching and continually accumulating intergalactically with their Poynting and Heaviside $\mathbf{E} \times \mathbf{H}$ *negative energy* flow components, apparently is the long sought "dark energy" responsible for the antigravity repulsion on all distant galaxies, thus accelerating the expansion of the universe—as well as the extra antigravity from outside the galaxy repelling escape-prone galactic matter back into the galaxy and holding the spiral arms of the spiral galaxies together.

After the explosive beginning of the universe, an accumulation time was required for the congregating "bunching" of the extra-galactic dark matter and dark energy and their *antigravity repulsion* sufficient to equal the positive *gravitational attraction* of the positive matter of the galaxies. This long increasing accumulation period explains the long gradual decrease in the original gravitational slowing of the universe's original expansion rate until the *deceleration* of the universe's expansion rate was zeroed. Then the continued dark matter and dark energy production, increasing the accumulations further, accounted for the increasing *acceleration* of the universe's expansion. The acceleration is continuing today as the accumulations of dark matter and dark energy continue to increase with time.

Within our galaxy, a Pioneer spacecraft headed away from the sun and toward the outside of the galaxy experiences the lesser antigravity repulsion of these weaker and more distant streaming intra-galactic hole currents and their negative energy fields and potentials that are migrating to reach the edge of the galaxy and exit it. This antigravity repulsion back upon the spacecraft appears to account for the backwards antigravity repulsion (excess drag) experienced by the spacecraft.

By using Bedini methods, both dark energy and dark matter and their phenomenology can be produced, investigated, and utilized in the laboratory in specialized negative energy EM circuits and asymmetrical systems using pulsed sharp gradients to generate the sources and the phenomenology.

We strongly urge the physics and astronomy communities to investigate and explore negative energy and negative mass in appropriate circuits with appropriate sharp gradients. Such research can resolve the dark matter and dark energy questions, resulting in an appreciable advance in our understanding of nature and the physical universe.

A SIMPLE FREE EM ENERGY FLOW DEVICE

Even in the hoary old CEM/EE model, continuous free flow of EM energy from a static source does creep in and cannot be eliminated. E.g., consider an electret or charged capacitor laid on a permanent magnet, so that the **E**-field of the electrical component is at a 90 degree angle to the **H**-field of the magnet. By standard Poynting energy flow theory,

an energy flow vector **S** from that static arrangement is present, is continuous, is maximized, and is ongoing. The energy comprising the "static" EM field is in motion, as given by the simple formula $\mathbf{S} = \mathbf{E} \times \mathbf{H}$.

This problem is sometimes noted by scientists, but "what is in motion, and how" has not been resolved because classical electrodynamicists and electrical engineers erroneously assume that both the **E** of the electret and the **H** of the permanent magnet are "static" fields, not involving any sort of "energy flow". That of course is false. It ignores the fact that *any EM field is already a set of ongoing EM energy flow*s (Whittaker, 1903, 1904). Hence both the "static" **E** and the "static" **H** are already ongoing EM energy flows continuously extracted from the active vacuum by the associated source charges (magnetic poles or electrical charges as the case may be) (Bearden, 2000, 2002).

So one can easily build or assemble an EM energy device continuously producing a real, free flow of EM energy from the vacuum, where the device itself has COP >>1.0. The COP = ∞ since the operator need input no energy at all to maintain the continuous free EM energy flow once the device is assembled.

Further, the free flow of Poynting energy (and—unrecognized by present scientists—a giant free flow of Heaviside curled energy) will continue indefinitely. This example of the continuous production of giant negative entropy completely falsifies the present old second law of thermodynamics, which must be changed and corrected as previously shown. The device is an example of a negative entropy-producing system performing as has been shown theoretically possible (Evans and Rondoni, 2002). The best that electrical engineering has to offer in explanation is similar to Buchwald's comment recognizing the problem. Quoting:

> *"[Poynting's result] implies that a charged capacitor in a constant magnetic field which is not parallel to the electric field is the seat of energy flows even though all macroscopic phenomena are static."* (Buchwald, 1985, p. 44).

In the atoms and molecules of matter present since the creation of the present universe, every such crossed $\mathbf{E} \times \mathbf{H}$ field combination has been steadily pouring out EM energy freely for some 1.3×10^{10} years, and the energy flow has not yet run down or even diminished. We are universally surrounded by charges freely producing negative entropy, and our scientists have not even recognized it! *Basic EM energy flow is free, universally throughout the universe*. Evoking a continuous free EM energy flow is child's play: simply assemble some charge or a dipole, or crossed **E** and **H** fields, and then *leave the assembly alone and do not permit it to be destroyed or scattered*. Capture all the energy you wish, but in asymmetric circuits and systems which never destroy their source of free energy transduced and flowing from the seething vacuum.

With freely flowing EM energy universally available, the unanswered questions thus are:

1. Why is not our scientific community funding and unleashing its graduate students and post doctoral scientists to discover how to properly extract free EM energy from such a free and continuous EM energy flow, collect the energy in special *asymmetrical* circuits, and dissipate it to freely power our loads?
2. Why do our scientists and engineers keep building and propagating *symmetrical* circuits which—to blindly self-enforce Lorentz symmetry—use *half* their

collected free EM energy to kill their own source of EM energy flow, and *less than half* to power the load?

3. Why should we keep paying to crank the shaft of the generator with more dissipated energy than the work we get in the load, just to keep restoring the generator's source dipolarity that the circuits unnecessarily keep destroying?
4. Why does the scientific community continue to conceal and avoid the source charge problem, the static Poynting generator, and other systems continuously producing negative entropy?
5. Why is the scientific community so blinded that it will not recognize the serious self-contradiction of the present second "half-law" of thermodynamics, and correct and extend the old second law accordingly?
6. Why are the National Academy of Sciences, National Academy of Engineering, National Science Foundation, Department of Energy, great national laboratories, and all our universities and large power companies still insisting that we must use hydrocarbons, nuclear fuel rods, giant dams, giant windmills, etc. as "energy sources" that do nothing but provide raw environmental energy (in different form from the EM energy needed) to laboriously make source dipolarities in our electrical power systems? This giant set of *consuming front-end processes* requires that enormous "dirty" work be continuously done by this totally unnecessary apparatus of *energy-form-converting* processes, simply because we must uphold what has always been done and insist on using half the captured energy in every EM system to destroy the system dipolarity with its free flow of EM energy from the vacuum!!!. Our scientific, environmental, teaching, and research communities seem adamantly determined to perpetuate how it has always been done, and to gloriously enrich the giant cartels so handsomely profiting from doing it in that insane manner.

We shall not clean up our fragile and beautiful environment, provide decent economies to those terribly struggling poor nations and their horribly beset populaces, stop the killing of species, and stop the global warming until we completely revise our entire way of obtaining and providing energy for our modern needs.

The answer to the escalating energy crisis *is not obtained* by disposing of three-quarters of the human population in the name of "sustainment" as some of our environmentalists would have us do (shades of Adolph Hitler and his gas chambers!) It is not by expanding the provision and acquisition of oil, coal, natural gas, etc. so that "business can continue as usual, just lots more of it and lots more expensively.

It is not by building hundreds of new pebble-bed nuclear reactor power plants, so that the American public can be gloriously ripped off to the tune of a trillion dollars—as the salivating giant cartel (both industry and scientific components) in nuclear power has planned and convinced the Executive Branch of government to advocate.

Before long, the centralized electric power system is going to be laid down, never to work again, by the terrorist apparatus and capabilities already inserted in our nation. Unless decentralized power is readied in abundance, the U.S. will unavoidably suffer a catastrophic economic collapse, with subsequent full-bore weapons-of-mass destruction attacks in the asymmetric war's operations phase that we have entered as of the beginning of 2005.

The answer is not by rewarding and elevating the Professional Skeptic community bottom-feeders who (i) do not even realize that Newton's first law is the law of perpetual

motion once a state of motion is forcibly established, (ii) still believe the oxymoronic second law came down on the stone tablets with Moses, and (iii) have never learned the difference between COP and efficiency of a system.

The answer is not by further unleashing that small but evil 2% of implementation managers at the third level down from the top, present in all large and powerful human organizations—including governmental, industrial, scientific, social, environmental, etc. —to strike down any effective dissenting voice, as was almost certainly done in the assassinations of Dr. Eugene Mallove and several others.

Instead, the answer is for both the Executive and Legislative Branches of government to require the scientific community to do its appointed energy mission, correct its own glaring falsities so long perpetuated in the hoary old CEM/EE model, and unleash those presently-bound sharp young graduate students, doctoral candidates, and post-doctoral scientists to rapidly develop fuel-free asymmetric electrical power systems which can and will power our needs in far less vulnerable decentralized fashion.

THE MAGNETIC WANKEL ENGINE

Any competent electrical engineering department at any good technical university can easily build the magnetic Wankel system to directly demonstrate COP > 1.0 and even COP = ∞. Figure 1 below shows the schema of the magnetic Wankel engine.

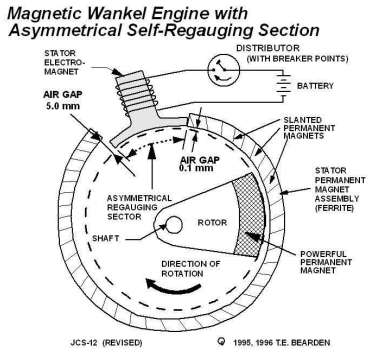

Figure 1. Magnetic Wankel engine with asymmetrical self-regauging section.

The magnetic Wankel is basically a rail gun (linear magnetic motor) stator consisting of permanent magnets, curved around and almost ending on itself but not quite. The linear motor drives a rotor magnet rather than a projectile. The forward mmf region is almost a closed circle, but with a small gap between the unclosed ends which is the back mmf region. Over and across the back mmf region there is placed a pole piece in the form of an inverted T, with a coil on the handle of the T wound in such way that a significant current in that coil will produce a magnetic field that overrides the back mmf magnetic field. In the coil one uses a tiny trickle current, making only a very tiny "back-mmf-overriding" field.

The motor freely drives the rotor forward (in the forward mmf region), accelerating for almost all its complete rotation, until the rotor magnet starts to enter the small back-mmf region that—together with the separate forward mmf region—completes the Lorentz symmetry of the system. In this separate back mmf region everything gained in the forward mmf region will be paid back, unless something is done to cancel that back mmf at least momentarily. That is done, using the arrangement and functions shown.

The little trickle current is abruptly broken, sharply evoking the Lenz law effect. Momentarily there is a *large free surge* of excess electron current in that T-coil, continuing the same way the little trickle current was going.[10] This surge of electron current produces a sufficient, sudden magnetic field to momentarily override the back mmf field in its region—just long enough for the rotor magnet to pass on through *with no net back mmf encountered*. This *externally input* extra opposite field gives the normally asymmetric back mmf region a matching "equal and opposite asymmetric partner" momentarily—converting the region to a null region having neither forward mmf nor back mmf. So that the *now-symmetrical regauging stress energy with net zero force field resultant in the "normally" back mmf region* cannot do work on the rotor. This prevents the rotor from *asymmetrically* experiencing the "back mmf" region—which would be required for a back mmf that could do any work to reduce the rotor's momentum.

As this momentary "back mmf canceling" field then decays away and the asymmetry of the back mmf region rises again, the rotor magnet is already through the back mmf region and again in the forward mmf region. It thus continues its asymmetric acceleration unchecked by countering back mmf action.

So a properly matched load connected to the shaft will be powered continuously and smoothly. For a tiny investment in trickle current and sharp switching, one has produced and applied (i) a known negative entropy operation via the sharp gradient and (ii) a slightly augmented permanent magnet rail gun motor with no *effective* back mmf, even though the back mmf actually exists most of the time (for most of the rotation) but does not affect the rotor.

This will produce a magnetic Wankel motor having COP > 1.0. The power delivered to the shaft is appreciably greater than the power required to power the trickle current and the switching.

To make the unit self-powering, one adds a little generator to the output shaft, taking off a little of the shaft horsepower output. This little generator then furnishes the power necessary to power the little trickle current and the switching circuit, replacing the operator's previous energy input. So with this additional change the magnetic Wankel will power itself and its matched load, exhibiting COP = ∞.

The input energy all comes directly from the seething vacuum, via the broken symmetry of the magnetic charges (poles) considered with their vacuum polarizations. Again a sort of *Feynman ratcheting* has been realized, whereby the iterative ratchet action continually overcomes and eliminates the asymmetric back mmf at just the properly selected times in the motor's operation.

The normal EE department will not understand where the continuous, free EM energy input to the self-powering magnetic Wankel engine is coming from or how, since the professors are unaware that a static magnetic field decomposes in Whittaker fashion to a set of real EM energy flows, steady and ongoing, extracted from the active vacuum by the asymmetry of the source charges (in this case, the magnetic poles). They are unaware that the "static" magnetic field is a set of free, ongoing, steady state, usable EM energy flows from the vacuum. Energy from this free flow can be extracted and used freely and continuously, if one deliberately violates Lorentz symmetry in one's circuitry —as the magnetic Wankel does.

With a properly matched load, the magnetic steady state Wankel is rigorously a nonequilibrium steady state (NESS) system receiving excess input energy—or even all its input energy in its COP = ∞ configuration—freely from the vacuum virtual state and producing steady usable output energy in the observable state, thereby producing steady useful free work in the load.

The sharp, *strong gradient* caused by abrupt breaking of the trickle current in the inverted T is also one of those classes of actions already known to violate the second law of thermodynamics (Kondepudi and Prigogine, 1999, p. 459). And, as Kondepudi and Prigogine point out, not much is known about it, either experimentally or theoretically. However, in this paper we have shed additional light upon the process by explaining the exact mechanism of the vacuum's energetic response to the sharp strong gradient.

CONCLUSION

Strong implications emerge from correcting the errors and falsities in the CEM/EE model. Some of these implications are:

1. *EM energy is actually free, and it occurs in free EM energy flows continuously pouring from every charge and dipole in the universe*. The energy for these continuing flows is freely extracted from the seething vacuum by the broken symmetry of opposite charges (of the dipole and the charge and its polarized vacuum ensemble dipolarity). We do not have to learn how to extract useful EM energy from the vacuum; *all EM energy is already freely extracted from the vacuum by the source charges*. Instead, all we have to do is learn how to build proper circuits that (i) intercept and collect usable EM energy from these free "currents" of energy flow, and that (ii) subsequently dissipate the asymmetrically regauged potential energy to provide free work in the load, without destroying the source dipolarity that is furnishing the free energy flow extracted from the vacuum.
2. *Electrical engineering has not admitted and has not directly used the precursor EM field in space in electrical power system engineering*. Since the precursor EM energy flows are free, then by paying a little for switching and control and timing, very strong free energy flows can be *directed and assembled* to form large

precursor energy flow patterns we refer to as *precursor engines*. These large force-free precursor EM engines can then interact with charged matter to form very large *force engines* in the charged matter, thus producing substantial power and work and specific dynamics in a physical electrical system. The work output can greatly exceed the operator's energy input, since very large energy inputs are freely received from the active environment.

By using precursor engineering, *negative entropy engineering* is both possible and feasible in real systems, replacing the positive entropy engineering enshrined in all our universities and in the scientific and engineering community.

We strongly accent that only the control and switching energy need be initially furnished by the operator, providing COP >> 1.0. Once the system is in operation with a large power and work output ongoing, a tiny bit of the output energy can then be deviated by clamped positive feedback to furnish the much smaller dissipation of "switching and control" energy. At that point the operator's input may be switched away, and the system becomes a self-powering NESS system with COP = ∞.

The COP > 1.0 performance is made possible because thermodynamically the system becomes a nonequilibrium steady state (NESS) system, freely receiving *almost all* its required energy input from the active vacuum. With clamped and regulated positive feedback, it becomes a NESS system freely receiving *all* its required input from the active vacuum, thereby producing COP = ∞ even though overall efficiency remains less than 100%.

As is known in nonequilibrium thermodynamics, a NESS system is permitted to exhibit five unusual characteristics: It can (i) self-order, (ii) self-oscillate or self-rotate, (iii) output more useful work than could be done by the energy input by the operator only (the required excess input energy is freely received from the environment), (iv) freely power itself and its loads (all the required energy input is freely received from the environment), and (v) exhibit production of negative entropy.

3. *The only reasons for the world energy crisis are (i) the present inadequate state of the CEM/EE model, (ii) a lack of scientific understanding of what really powers an EM system and how, and (iii) the continued propagation by the scientific community of the gross CEM/EE falsities.*
4. *The old second law of thermodynamics as stated is an oxymoron, false, and contains only half of nature's own second law of positive and negative entropy*. In this paper we include the correction of the old second law (a "half-law" at best) of thermodynamics.[5] For a century that law has actually been an oxymoron implicitly assuming its own contradiction. Also, since many areas are known to violate the old second law (by producing negative entropy), it follows that the second law must be changed to allow production of negative entropy as well as positive entropy, or zero entropy if the entropy remains unchanged in a given interaction.
5. *The long-suppressed negative entropy engineering is the wave of the future, or it can be*. By paying only a little for switching and control, great precursor energy engines can be assembled and controlled. Once the engine interacts with charged matter, it produces enormous force engines, and thus correspondingly large dynamics in and of the interacted material system. *There is no conservation of*

work law; there is only a conservation of energy law. Again, energy itself is free for the taking, direction, control, and usage as desired. One does not have to "pay" for the energy itself, but only for switching and control. Once a material system is activated powerfully by the force engine created, even the small amount of switching and control energy can be extracted from the huge output and fed back to the control unit for self-powering and COP = ∞.

6. *Every conventional EM circuit and system is insanely and deliberately designed to destroy its free flow of EM energy from the vacuum, faster than it powers its loads*. Conventionally the ubiquitous use of the Lorentz-symmetrical circuit self-enforces Lorentz symmetry and COP < 1.0, by leaving the source of free potential energy flow connected to the circuit while appreciable current is flowing. The result is that the source dipolarity—freely furnishing the free flow of EM energy from the vacuum—is deliberately destroyed faster than the load is powered. Hence to continually restore the source dipole so as to continue the continual EM energy flow, the operator continually has to furnish more energy to the system than the useful work that was obtained in the loads.

7. *Presently there are no electrical engineering departments, professors, or textbooks that calculate the actual EM field in space, or that teach what actually powers an EM system and circuit*. If the scientific community will correct the CEM/EE model, the vast problems resulting from the model's uncorrected use and application will fade into oblivion. A great new science of energy and distributed electrical power systems will be launched, ending the energy crisis quickly and permanently.

RECOMMENDATION

It is urgently recommended that the scientific community take strong action to correct the seriously flawed CEM/EE model as a matter of the highest national priority, necessary to solve the escalating energy crisis permanently and also to prevent eventual severe national economy collapses in major energy-using nations including the U.S.

NOTES

1. The thermodynamic *efficiency* of a system may be defined as the system's total useful energy output or work output, divided by the sum of all energy inputs from all sources, and expressed as a percentage. As a convenient memory device, one thinks "overall efficiency".

2. The thermodynamic *coefficient of performance* of a system may be defined as the system's total useful energy output or work output, divided by the operator's energy input only, and expressed as a decimal fraction. As a convenient memory device, one thinks "operator's coefficient of performance."

3. For example, simply triple the voltage applied to a circuit while the electron current is momentarily restrained so that dq/dt = 0. This triples the excitation of the pinned charges q, so that three times as much potential energy is now collected in the circuit. The

collection is work-free, since no current flowed and hence no power or work was done (i.e., the receiving circuit did not dissipate any of the free asymmetric regauging energy).

4. The charge continually absorbs disordered virtual photons from the vacuum, converting each to a differential of mass-energy of the charge. Since the mass of a fundamental charged particle is *already unitary*, the serial absorptions of disordered virtual photons are thus *reordered* (a negative entropy operation) as coherent changes in unitary mass. They result in a serial string of coherent, additive differentials of mass-energy and increasing virtual excitation of the absorbing charge. When this coherent integration of ordered differentials of mass-energy reaches the next quantum level, due to *zitterbewegung* the excitation abruptly decays by emission of an observable photon. Iteration of the process results in the charge acting as a Feynman ratchet to ratchet up reordered virtual energy into continually emitted observable EM energy. Hence the charge does indeed obey the overall conservation of energy law, while producing continuous negative entropy and violating the second law by continually emitting observable EM energy with only a *nonobservable* energy input.

5. The present second law may be stated as $S \geq 0$, or as $(0 \leq dS < +\infty)$, so that entropy can only remain the same or increase in ongoing successive interactions. To examine this statement, we note that any equilibrium system is in a state of maximum entropy. To produce entropy after once being in equilibrium, the system must first be "potentialized" or "excited" to move it away from equilibrium, adding potential energy (asymmetrical regauging) and lowering the system's entropy—in violation of the present second law. That action is properly written as the interaction $(-\infty < dS \leq 0)$. It is a *negative entropy operation*, completely contradicting the present second law, but just ignored. The second law actually assumes that such a negative entropy operation has *previously happened* but is not accounted.

In short, the present "half-law" merely records the entropic decay of a disequilibrium *previously-excited* state, back to zero excitation (back to equilibrium). It grossly fails to account for the previous excitation (negative entropy operation) it assumes. The old second law is thus an *oxymoron* implicitly assuming that its own contradiction has previously occurred but been ignored.

The present author formulated a correction to the second law that holds in all cases, including all the presently known exceptions to the present law. The new law is the law of positive and negative entropy, and it is simply $(-\infty < dS < +\infty)$. In other words, the expanded second law now includes positive, negative, and zero entropy processes and in any order. In a great many systems, the excitation and decay operations do occur separately and in serial order, so in that case the new second law becomes

$$(-\infty < dS < +\infty) = (-\infty < dS \leq 0) + (0 \leq dS < +\infty) \qquad [1]$$

In that form, the *old* half-law on the right side of equation [1] can clearly be seen as the rightmost term, and it is a special case for a system previously excited by a negative entropy operation as provided in the *new* leftmost term. For a system in statistical equilibrium, a transient fluctuation initially takes the system away from equilibrium via the leftmost term, and subsequently returns the system to equilibrium via the rightmost term. So transient fluctuation and fluctuation theorems (Evans and Searles, 1994) are also included, as are systems producing continuous negative energy (Evans and Rondoni, 2002). In the latter case, the rightmost term of equation [1] is simply zero.

And yet another startling change emerges. A change of geometry from Klein geometry to Leyton geometry is also required. The old Klein geometry (Klein, 1872) has driven much of physics for more than 100 years. Klein's Erlanger program describes geometric structures in terms of their automorphism groups. In Klein's geometry and more limited group methods, a broken symmetry at a given level loses the symmetry information at that level and *reduces* the overall group symmetry. Every charge in the universe already violates Klein's geometry.

In Leyton's object-oriented geometry (Leyton, 2001) with its more advanced group theoretic methods, a broken symmetry at a given level retains the information at that level, and also generates a new symmetry at the next higher level. Hence in Leyton's approach, a broken symmetry *increases* the overall group symmetry. *Every charge obeys Leyton geometry*.

Klein's geometry thus has a built-in entropy aspect and *excludes* negative entropy per se, while Leyton's approach permits and includes negative entropy. Klein geometry is counter to nature and *does not* permit the new second law or the source charge, while Leyton's geometry is in accord with nature and *does* permit the new second law and the source charge.

6. Whittaker 1903 shows that any scalar EM potential decomposes mathematically into a harmonic set of bidirectional pairs of EM longitudinal wave flows. Hence any potential has an internal set of more refined components and dynamics. If one deliberately alters the specific constitution of these internal energy flows and their dynamics, the new but specific set of components and dynamics is called an *internal engine*. Two seemingly "identical" potentials of the same magnitude (same envelope) may have dramatically differing internal engines. The deliberate interaction of such an altered potential—containing specific internal engines—with charged matter and particularly in living systems, can have extraordinary consequences presently completely absent from the CEM/EE model and from Western knowledge.

7. Whittaker also shows that any EM field pattern, wave pattern, etc. can be decomposed into two scalar potentials with differential functions applied (Whittaker, 1904). If one decomposes each of the two base scalar potentials into sum sets of bidirectional longitudinal EM wavepairs (Whittaker, 1903), and then applies the necessary differential functions as shown in Whittaker 1904, then the combination of both Whittaker's papers shows that all EM potentials, fields, and waves are but "envelopes" of an ongoing, more fundamental longitudinal electrodynamics and EM energy flows. As Cornille remarks:

> *"The ... scalar wave equation* [derived] *means that scalar standing waves are the source of the electromagnetic field: sound generates light! It is a remarkable result that from a scalar wave equation one can deduce Maxwell's equations by using successively more complicated potential definitions."* (Cornille, 1993, p. 179).

In addition to Whittaker's internal sum set, Donnelly and Ziolkowski added the product set, further perfecting the theoretical model to accord more fully with nature (Donnelly and Ziolkowski, 1992).

As *engine-transporting envelopes*, two given "identical" EM voltages (or "identical" EM fields, or "identical" EM waves by EE standards) may have dramatically differing internal Whittaker structures, and thus may interact very differently with either

inert or living systems or both. We may refer to a given internal structure and its dynamics as an *internal engine*, transported by the field or potential or wave being examined. In the West, no investigation has been performed of the impact of internal engines when interacting with complex systems (or with living systems)—which already have EM carriers with internal engines.

8. Combination of a hole and an electron combines (i) a negative mass-energy electron having negative energy EM fields and potentials with a positive mass-energy electron having positive energy EM fields and potentials. The combination of equal positive mass-energy and negative mass-energy gives zero net mass energy. The "disappearing" mass energies are simply converted to stress energy of the vacuum. The combination of equal negative energy EM fields and positive energy EM fields gives zero energy net EM fields, because the field energies have been turned into stress potential energy of the vacuum. Hence no *net field vector resultant* and thus no radiation occurs when a hole and an electron "annihilate" each other. The process just produces a piece of ordinary vacuum (a filled Dirac Sea hole).

9. This surge of electron current comes from the electrons lifted from the Dirac Sea by the sharp gradient, and is itself a *negative entropy operation*. At the same time, there is a surge of Dirac Sea hole current (a *negative energy* current) in the other direction, but the holes in this current are usually just shorted out by grounding and only the positive energy is accounted.

10. With additional adroit circuitry measures used to momentarily float the grounding and direct the negative energy hole currents to the battery, and by applying this novel current backwards from the "normal" charging direction, the battery can also be rapidly charged by the negative energy hole current. This is a Bedini method for COP > 1.0 battery-charging performance.

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