

EXTRACTING AND USING ELECTROMAGNETIC ENERGY FROM THE ACTIVE VACUUM

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"The first principles of things will never be adequately known. Science is an open-ended endeavor, it can never be closed. We do science without knowing the first principles. It does in fact not start from first principles, nor from the end principles, but from the middle. We not only change theories, but also the concepts and entities themselves, and what questions to ask. The foundations of science must be continuously examined and modified; it will always be full of mysteries and surprises." {1}

1. Introduction

We present new concepts which provide usable extraction of electromagnetic energy from the vacuum, and appear to be present but previously unrecognized in all electrical power systems.

We argue that generators and batteries do not use their available internal energy to power their external circuits, but dissipate it to separate their internal charges to produce source dipoles as negative resistors. Once formed, the source dipole receives and transduces EM energy flow from the vacuum {2}, and pours it out along the attached circuit, filling all surrounding space {3}. EM circuits and loads have always been powered by vacuum-provided EM energy. They are not powered by the energy the operator inputs to the generator shaft, nor by the chemical energy available in the battery.

A tiny fraction—the Poynting {4} component—of the huge energy flow transduced from the vacuum is intercepted and diverged into the circuit to power it. The huge remainder of the transduced vacuum energy flow—which we call the *Heaviside* {5} {6} *component*—misses the circuit entirely. It is not intercepted and is not diverged into the circuit. It is just wasted.

No one in the 1880s could explain the source of the startlingly large Heaviside energy flow component {7}. Faced with such a giant quandary, Lorentz arbitrarily discarded the Heaviside component as being "physically insignificant" {8} because it does not contribute to powering the circuit of interest. To the contrary, it is highly significant. In this paper we give its source and mechanism, its significance, and its practical use.

The common dipole breaks 3-symmetry in EM energy flow {2}, resulting in a novel and more fundamental negentropic Whittaker {9} *4-symmetry* EM energy flow completely freed from 3-symmetry and 3-space EM energy conservation {10}. We explain that special 4-symmetry and its giant negentropy in this paper.

Without the additional 3-symmetry condition, the resulting Whittaker 4-symmetry EM energy flow mechanism resolves the nagging problem of the "source charge" concept in classical electrodynamics theory. Quoting Sen {11}:

"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum mechanics."

We give the solution to the problem of the source charge in classical electrodynamics.

The giant negentropy mechanism also explains the heretofore unknown source of the enormous "dark^a (unaccounted) EM energy flow" component that was (i) discovered by Heaviside {5} {6}, (ii) never considered by Poynting {4}, and (iii) arbitrarily discarded by Lorentz {12}. Lorentz's discard of the Heaviside dark energy flow component has continued to be applied by electrodynamicists {13}.

This huge nondiverged EM energy flow is a dynamic ordering of the vacuum surrounding every EM circuit and EM field reaction. We present several mechanisms where the dark energy flow can be intercepted to provide excess energy from the locally reordered vacuum. The Bohren {14} {15} experiment—along lines pioneered by Letokhov {16}—is cited as proof that excess energy has been experimentally intercepted from the Heaviside energy flow component. We present more than a dozen candidate processes and mechanisms for extracting this available Heaviside EM energy from the vacuum, where asymmetrical self-regauging (ASR) {17}{18} is the *gauge freedom* key to breaking the Lorentz symmetrical regauging condition {19}.

ASR provides an open EM system far from thermodynamic equilibrium in its violent energy exchange with the active vacuum. As is well known, an open dissipative system in disequilibrium with an active environment is permitted to:

- (a) self-order,
- (b) self rotate or self-oscillate,
- (c) output more energy than is input by the operator (the excess is taken from the active environment, in this case the active vacuum),
- (d) power itself and its load simultaneously (all the energy is taken from the active environment, in this case the active vacuum), and
- (e) exhibit negentropy.

The common dipole exhibits all five functions, as we discuss.

Finally, we explain why ordinary electrodynamic systems do not exhibit such negentropic functions, and we state the principles necessary to correct the shortcomings in those systems which prevent it.

It appears that a permanent solution to the world energy problem, dramatic reduction of biospheric hydrocarbon combustion pollution, and eliminating the need for nuclear power plants (whose nuclear component is used only as a heater) could be readily accomplished by the scientific community {20}. However, to solve the energy problem we must (i) update the century-old false notions in electrodynamic theory of how an electrical circuit is powered, and (ii) correct the classical electrodynamics model for numerous foundations flaws.

^a By "dark" we mean nonobserved and nonintercepted, but physically present in space as a real EM energy flow. Obviously we have used the phraseology of the dark matter problem. We have in fact nominated the Heaviside dark energy as the solution to the dark matter problem, and as responsible for producing the excess gravity in the spiral arms of spiral galaxies that must be present to hold them together. See T.E. Bearden, "Dark Matter or Dark Energy?", *J. New Energy*, 4(4), Spring 2000, p. 4-11.

We reconsider both items (i) and (ii), based on more modern developments in particle physics and gauge field theory well after the foundations of electrodynamics were set by Maxwell. Self-powering systems readily extracting electrical energy from the vacuum to power themselves and their loads can be quickly developed whenever the scientific community will permit their research and development to be funded.

2. Lorentz Symmetrical Regauging

Two Equal and Opposite Regaugings

For energy flow through space around the circuit, we must use Maxwell's equations as we would for radiating energy, rather than employ only the $\mathbf{j}\phi$ circuit analysis conventionally utilized.

In Gaussian units, Jackson {21} shows that Maxwell's four equations (vacuum form) can first be reduced to a set of two coupled equations in the (\mathbf{A}, Φ) representation as follows:

$$\nabla^2\Phi + \frac{1}{c} \frac{\partial}{\partial t}(\nabla \cdot \mathbf{A}) = -4\pi\rho \quad [3]$$

$$\nabla^2\mathbf{A} - \frac{1}{c^2} \frac{\partial^2\mathbf{A}}{\partial t^2} - \nabla(\nabla \cdot \mathbf{A} + \frac{1}{c} \frac{\partial\Phi}{\partial t}) = -\frac{4\pi}{c} \mathbf{J} \quad [4]$$

The result is two coupled Maxwell-Heaviside equations. Jackson shows that potentials \mathbf{A} and Φ in these two equations are "arbitrary" (i.e., yield the same force fields) {22} {23} in a specific sense, since the \mathbf{A} vector can be replaced with $\mathbf{A}' = \mathbf{A} + \nabla\Lambda$, where Λ is a scalar function and $\nabla\Lambda$ is its gradient. The \mathbf{B} field is given by $\mathbf{B} = \nabla \times \mathbf{A}$, so that the new \mathbf{B}' field becomes

$$\mathbf{B}' = \nabla \times (\mathbf{A} + \nabla\Lambda) = \nabla \times \mathbf{A} + \mathbf{0} = \nabla \times \mathbf{A} = \mathbf{B} \quad [5]$$

The \mathbf{B} field due to the vector potential has remained entirely unchanged, even though the magnetic vector potential has been asymmetrically changed. However, if no other change were made, then the electric field \mathbf{E} would have still been changed because of the gradient $\nabla\Lambda$. In that case the net change would be asymmetrical, because one obtained a "free" \mathbf{E} -field and excess regauging energy, which could then do work on the system—either beneficially or detrimentally, depending upon the specific conditions, geometry, and timing. In order to prevent this excess "free" \mathbf{E} -field from appearing, electrodynamicists simultaneously and asymmetrically regauge (transform) the scalar potential Φ so as to precisely offset the \mathbf{E} -field change due to the regauging of equations [3] and [4]. In short, they also change Φ to Φ' , where

$$\Phi' = \Phi - \frac{1}{c} \frac{\partial\Lambda}{\partial t} \quad [6]$$

With that additional change, now both the *net* \mathbf{E} and \mathbf{B} fields remain unchanged {24}, even though—in terms of a physical system rather than abstract mathematical models—the fundamental stored (potential) energy of the system has changed twice, and two free excess forces have appeared in the system. "Unchanged net force fields" just mean that all excess new forces vectorially sum to a zero resultant; it does not address the effects of the additive energies of the "zero-summing" field components. This is what has been assumed by electrodynamicists

when they state that the net summation of the two *asymmetrical* regaugings has been entirely *symmetrical*. It is symmetrical with respect to translation, not with respect to spacetime curvature and gravitation.

After Lorentz, electrodynamicists assumed that the system designer can arbitrarily create and change force fields and potentials. The designer can freely change the potential energy of the system at will, theoretically without any input energy *cost* whatsoever. However, electrodynamicists also assumed that the system designer will be a "gentleman," and cooperate with their resulting *intention*. In short, the received view assumes that the designer will freely change the excess free energy and the excess free forces in his system only in a highly restrictive manner where all excess forces fight themselves to a draw and the excess energy cannot be used to perform useful work. In other words, they assume the designer will play the "Lorentz condition" game—for a *game* is all that it is. The designer is of course free to violate that "gentleman's agreement" at will, and the results have significant implication {25}.

Here's how the electrodynamicists do it, as Jackson points out. Conventionally, a set of potentials (\mathbf{A} , Φ) is habitually and *arbitrarily* chosen such that

$$\nabla \cdot \mathbf{A} + \frac{1}{c} \frac{\partial \Phi}{\partial t} = 0 \quad [7]$$

This *net symmetrical* regauging operation successfully separates the variables, so that two inhomogeneous wave equations result to yield the new Maxwell's equations

$$\nabla^2 \Phi - \frac{1}{c^2} \frac{\partial^2 \Phi}{\partial t^2} = -4\pi\rho \quad [8]$$

$$\nabla^2 \mathbf{A} - \frac{1}{c^2} \frac{\partial^2 \mathbf{A}}{\partial t^2} = -\frac{4\pi}{c} \mathbf{J} \quad [9]$$

Thus the two previously coupled Maxwell equations [3] and [4] (potential form) have been changed to the form given by equations [8] and [9], to leave two *much simpler* inhomogeneous wave equations, one for Φ and one for \mathbf{A} .

Of course the equations are simpler, since they arbitrarily discard that very large class of Maxwellian systems in local thermodynamic *disequilibrium* with the active vacuum! They arbitrarily discard all those Maxwellian systems which are capable of producing electrical circuits and power systems with COP>1.0.

Breaking the Lorentz Symmetrical Regauging Condition

For COP>1.0, three functions are required in the system: (i) we must first asymmetrically regauge the system, or have it asymmetrically self-regauge itself, in order to freely change its collected energy and obtain a net force to utilize. By gauge freedom, in theory this is cost-free to the system operator. Then (ii) we must adroitly utilize the excess force created by the asymmetrical regauging, along with its associated excess potential energy, to perform useful work. And (iii), we must dissipate this collected potential energy to do work, but *without* using half of it to more rapidly kill the source dipole of the system itself.

In short, we must violate the Lorentz symmetrical regauging condition during the excitation discharge represented by operation (ii) of an open system far from thermodynamic equilibrium.

The condition for violating Lorentz symmetrical regauging is

$$\nabla \cdot \mathbf{A} + \frac{1}{c} \frac{\partial \Phi}{\partial t} \neq 0 \quad [10]$$

Any regauging of the potentials that complies with equation [10] will *a priori* produce one or more excess forces in the system and freely change the energy of the system as well. By controlling the regauging to keep it asymmetrical, the engine designer may then control where, how, and when these excess forces appear, and how much excess energy appears in the system with them. Every system already performs this asymmetrical regauging function in its *excitation phase*.

During the *excitation discharge* phase, however, use of the closed current loop circuit results in a "back emf" across the source dipole interior, precisely equal to the "forward emf" around the external circuit across the external loads and losses. Since "emf" is just a force field, this gives symmetrical discharge of the free excitation energy of the circuit—half in powering the external loads and losses, and half in destroying the dipole itself. Hence it destroys the source dipole faster than it powers the load alone.

Since the closed current loop circuit is used ubiquitously, then present circuits and electrical power systems *a priori* cannot exhibit COP>1.0, since they violate equation [10] during their excitation discharge. Hence they violate condition (iii) required for COP>1.0.

3. Re-Examining The Common Dipole

Whittaker Decomposition of the Potential Between the End Charges

Any dipole has a scalar potential between its ends, as is well-known. Extending earlier work by Stoney {26}, in 1903 Whittaker {9} showed that the scalar potential decomposes into—and *identically is*—a harmonic set of bidirectional longitudinal EM wavepairs. Each wavepair is comprised of a longitudinal EM wave (LEMW) and its phase conjugate LEMW replica. Hence the formation of the dipole actually initiates the ongoing production of a harmonic set of such biwaves in 4-space {27}.

We separate the Whittaker waves into two sets: (i) the convergent phase conjugate set, in the imaginary plane, and (ii) the divergent real wave set, in 3-space. In 4-space, the 4th dimension may be taken as *-ict*. The only variable in *-ict* is *t*. Hence the phase conjugate waveset in the scalar potential's decomposition is a set of harmonic EM waves converging upon the dipole in the time dimension, *as a time-reversed EM energy flow structure inside the structure of time* {28}. Or, one can just think of the waveset as converging upon the dipole in the imaginary plane {29}—a concept similar to the notion of "reactive power" in electrical engineering.

The divergent *real* EM waveset in the scalar potential's decomposition is thus a harmonic set of EM longitudinal waves radiating out from the dipole in all directions in 3-space at the speed of light {30}. As can be seen, there is perfect 4-symmetry in the resulting EM energy flow, but there is broken 3-symmetry since there is no observable 3-flow EM energy input to the dipole but there is observable 3-flow of EM energy output.

Further, there is perfect 1:1 correlation between the convergent waveset in the imaginary plane and the divergent waveset in 3-space. This perfect correlation between the two sets of waves and their dynamics represents a *deterministic re-ordering* of a fraction of the 4-vacuum energy. This re-ordering is initiated by the formation of the dipole, and spreads radially outward at the speed of light so long as the dipole remains intact.

Interpreting the 4-Symmetry in Electrical Engineering Terms

The EM energy flow in the imaginary plane is incoming "reactive power" in the language of electrical engineering. The outgoing EM energy flow in the real plane (3-space) is "real power". So the dipole is continuously receiving a steady stream of reactive power, transducing it into real power, and outputting it as a continuous outflow of real EM power.

To initiate the hypothesized giant negentropy process, all one has to do is first expend a little energy to form the dipole. Once the dipole is formed, the process is automatically initiated and sustained by the broken 3-symmetry of the dipole {2}. The process continues indefinitely and freely, so long as the dipole remains intact {10}{31}.

Actually, this giant negentropy is to be expected from the further broken symmetry findings in particle physics. The various major symmetries can be individually broken, or multiples can be broken, so long as CPT itself is not broken. Quoting T.D. Lee {32}:

"At present, it appears that physical laws are not symmetrical with respect to C, P, T, CP, PT and C. Nevertheless, all indications are that the joint action of CPT (i.e., particle \leftrightarrow antiparticle, right \leftrightarrow left and past \leftrightarrow future) remains a good symmetry."

Indeed, that quotation reveals that one is free to violate PT (parity and time) symmetries simultaneously, so long as C symmetry is not violated. A little reflection reveals that time can be converted to spatial energy, under such condition. I.e., with PT broken but CPT conserved, a fraction of "time" flow is being converted to "spatial EM energy" flow or vice versa. It follows that, since the source charge (or source dipole) does not violate C symmetry, it is free to violate parity symmetry and time symmetry—which yields the giant negentropy of the common dipole (and as will be seen, of the common charge as well).

How the Reactive Power is Transduced into Real Power

We suggest a mechanism which accomplishes the transduction or at least models it. The charges comprising the ends of the dipole have a very special characteristic: Simply modeled, a charge may be said to spin 720° in making one complete rotation, not just 360°. We may say that it spins 360° in the imaginary plane, and spins 360° in the real plane (3-space). Let us examine a dipole charge spinning 720° per rotation in that manner. During its 360° spin in the imaginary plane, it *absorbs* the converging reactive power. During its 360° spin in the real plane (in 3-space), it *re-radiates* the EM energy it has absorbed from the imaginary plane, as real power in a steady, divergent, radial 3-flow of EM energy at the speed of light in all directions.

If one does not press it too far, this simple analogy is useful for visualization of the transduction process.

Interpreting What This Means

If the hypothesis holds, we have arrived at some interesting findings:

- a. As is well-known in particle physics, a dipole is a broken 3-space symmetry in the violent flux exchange between the active vacuum and the dipole.
- b. This dipole's broken 3-space symmetry in EM energy flow, provides a *relaxation* to a more fundamental EM energy flow symmetry in 4-space where P and T symmetries are broken but CPT symmetry is maintained.

- c. This means that time (or "time-like EM energy flow") is transduced to 3-spatial EM energy flow. Hence we must understand time-as-energy and timelike energy flow as well as 3-spatial EM energy flow.
- d. There is no law of nature or physics that requires 3-symmetry of EM energy flow as an additional condition applied to 4-symmetry of EM energy flow.
- e. The dipole is a practical and very simple means of "breaking" the additional 3-flow symmetry condition in EM energy flow, and of relaxing to the fundamental 4-flow symmetry *without* 3-flow symmetry.
- f. So long as the dipole statically exists (e.g., imagine an electret suddenly formed, or a charged capacitor with no leakage), real usable EM energy will continuously pour from the dipole at light speed in all directions. At the same time, reactive EM power (actually, energy) will continuously flow into the dipole from the time-domain (the complex plane), and be transduced into real EM power output in 3-space by the dipole.
- g. A dipole and its scalar potential thus comprise a *true negative resistor* system of the most fundamental kind. The dipole continually receives EM energy in unusable form (reactive power, which cannot perform real work), converts it to usable form (real power, which can perform real work), and outputs it as usable, real EM energy flow (real power) in 3-space.
- h. Simultaneously, at its formation the dipole initiates a continuing *giant negentropy*—a progressive reordering of a substantial and usable portion of the vacuum energy {10}{33}. Further, this reordering of vacuum energy continuously spreads in all directions from the initiation point, at the speed of light. In original atoms formed shortly after the beginning of the universe, *dipoles*—and as we shall also see, *charges*—have been pouring out real EM energy in 3-space for some 15 billion years or so. Each has reordered a fraction of the entire vacuum's energy, where the magnitude of the reordering varies inversely as the radial distance from the dipole.
- i. If the dipole is destroyed, the ordering of the vacuum energy ceases, leaving a "separated chunk" of reordered vacuum energy that continues to expand and propagate radially at the speed of light in all directions, steadily reducing in local intensity as it expands.
- j. At any very small volume in spacetime, from the dipole dynamics of the universe it follows that a great conglomerate of reordered vacuum flows and fluxes—some continuous, some chopped—is continually passing through that 4-volume. Further, the situation is totally nonlinear, so that direct wave-to-wave interactions occur continuously amongst these energy flows and waves. We hypothesize that this is the actual mechanism constituting Puthoff's cosmological feedback mechanism {34} {35}.
- k. Further, in 1904 Whittaker {36} showed that any EM field or wave pattern can be decomposed into two scalar potential functions. Each of these two potential functions, of course, decomposes into the same kind of harmonic longitudinal EM wavepairs as shown in Whittaker 1903, plus superposed dynamics. In other words, the interference of scalar {37} potentials—each of which is actually a set of longitudinal EM waves, and not a scalar entity {38} at all, but a *multivectorial* entity—produces EM fields and waves and their dynamics. Hence we

hypothesize that the Whittaker interference of the propagating reordered EM energy entities, continuously occurring at any point in space, generates the zero-point EM field energy fluctuations of the vacuum itself. Indeed, an AIAS group paper by Evans *et al.* {39} has already shown that just such "scalar interferometry" produces transverse EM fields and waves in the vacuum.

4. Mechanism Generating the Flow of Time

Background: Observation As an Operator

Since the nature of time is itself an unresolved question, we take a simple approach in order to arrive at a mechanism generating the "flow of an object through time".

First, it is well-known in physics that the choice of fundamental units one chooses for one's model is arbitrary. While most often *mass*, *length*, *time*, and *charge* are used, a perfectly valid model can be generated using only a single fundamental unit.

Suppose we use the joule as the single fundamental unit. Then each of the entities we conventionally call "mass", "length", "time," and "charge" will become totally a function of energy. So we can legitimately state that "mass is energy", and we are already comfortable with that statement since the dawn of relativity and the nuclear age. But we can also legitimately state that "time is energy", and be rigorously accurate. We have previously postulated that one second is equal to spatial EM energy compressed by the factor c^2 . So time is just extremely compressed EM spatial energy {40}. In that case, time has the same energy density, so to speak, as does mass.

We also point out that any observable is an instantaneous 3-spatial snapshot of a 4-dimensional event. "Observation" itself may be taken as a process where a $\partial/\partial t$ operator is invoked upon 4-space (spacetime), leaving a purely 3-spatial output. However, no observable "exists in time", since rigorously it is only a single, frozen "3-slice" at one single instant, forever fixed. So *mass does not exist in time, but masstime does.*

Observation's Relationship to Cause and Effect

We define the 4-entity prior to the invocation of the $\partial/\partial t$ operator (observation) as the *causal side* of the observation process. The most significant concept embedded in the concept of causality would appear to be that an entity exists and acts during time. The most significant content of the concept of the effect is that it was "caused" by an entity existing in and acting in time, but it (the effect) itself does not exist in time. We define the 3-entity that is the output of observation (after the application of the $\partial/\partial t$ operator) as the *effect side* of the observation process. As is well known, all observation is 3-spatial, so an observed entity does not exist or act in time. We also speak of the *intermediary* as the entity—usually a *mass* which itself an effect, or *masstime* which is a causal entity—with which the causal entity interacts and to which the $\partial/\partial t$ operator is applied.

We completely accept the Sachs {35} unification approach to a combined general relativity and electrodynamics, generalized from a topological standpoint.

Polarizations of Photons and EM Waves

As is known in quantum field theory, there are four polarizations of a photon {41}. These are the *x-*, *y-*, *z-*, and *t-*polarizations, where *x-*, *y-*, *z-*, and *t-* refer to the four dimensions in a

4-space. Thus—at least in theory—there must also be four polarizations of electromagnetic waves, even though not all these waves are yet experimentally known.

The x - and y - polarizations (or any combination) are the familiar transverse photon and the transverse wave. The z - polarization along the line of propagation gives the longitudinal photon and the longitudinal EM wave.

Without further elaboration, we speak of a mass in which a small portion exists as *masstime* rather than mass, as having been "time-charged" or "time-excited".

Imperfect Longitudinal EM Waves

In attempting to produce longitudinal EM waves (LWs) from transverse EM waves (TWs) that are input to a polarization transduction process, it is reasonable that only imperfect LWs are produced, and that a residue of TW content remains. The resulting imperfect LW might be referred to as an Undistorted Progressive Wave (UPW). Some work has been done on UPWs {42}. Such waves are theorized to have remarkable characteristics including wave velocities either slower or faster than standard light velocity {43}.

The t - polarization wave in the time dimension is quite unique: The *spatial* energy of the wave is in equilibrium and not vibrating at all; instead, the photons comprising the wave are vibrating in their *time* components. That is called a "time-polarized" photon or a *scalar photon*". Its wave version does not yet seem to be known in the literature.

EM Waves and Photons Carry Both Spatial Energy and Time Energy

On the other hand, the entire question of "EM waves in spacetime" may be in need of a thorough overhaul. A photon is a "piece of angular momentum" in the form of $(\Delta E)(\Delta t)$. Hence the photon carries an increment of spatial energy ΔE and also an increment of time-energy Δt . The time-energy component (Δt) may be regarded as ordinary spatial energy that has been compressed by the factor c^2 .

So the photon transports two types of energy: (i) a "weak spring" spatial energy ΔE , so to speak, and (ii) a "very stout spring" time-energy Δt , so to speak {44}.

When a mass m absorbs a photon $(\Delta E)(\Delta t)$, the (ΔE) component is compressed spatially by the factor c^2 , turning it into an extra amount of mass Δm , so that the mass becomes $(m + \Delta m)$. At the same time, the (Δt) component is joined, so that what results is $(m + \Delta m)\Delta t$. In short, mass m is changed to masstime mt by photon absorption. So in the absorption of a photon γ by a mass m , we have

$$\gamma + m \rightarrow (\Delta E)(\Delta t) + m \rightarrow (m + \Delta m)\Delta t \quad [11]$$

In short, the mass turns into masstime, and masstime mt is as different from mass m as impulse Ft is from force F . We point out that "mass" m alone does not even exist in time; masstime mt does exist in time. This is proposed as a simple but fundamental correction to much of present physics.

In the simplest case, in the next instant a photon is re-emitted, and so we have

$$(m + \Delta m)\Delta t \rightarrow (\Delta E)(\Delta t) + m \rightarrow \gamma + m \quad [12]$$

So emission of a photon changes masstime back to mass, in the simplest case.

In passing, what we call "observable" change must involve

$$(VE)(Vt)^3 \frac{h}{4p} \quad [13]$$

Photon Interaction as the Mechanism Generating Time Flow and Duality

From the foregoing, mass cannot continuously exist as mass; mass rigorously exists only at a single point in time, and never again. It only appears to exist in time because of the reactions in equations [11] and [12] above. Rigorously, a mass does not really "travel through time" continuously *per se*, but proceeds with an overall serial change mechanism, driven by its total virtual and observable photon interactions, as

$$m \rightarrow mt \rightarrow m \rightarrow mt \rightarrow m \rightarrow \dots \quad [14]$$

We propose that this may account for the duality of particle and wave. When a mass is observed, time has been stripped away, leaving a frozen 3-spatial snapshot, which we will see as (having been) a particle (simplest case). That occurs just after major (observable) photon emission from the masstime state. Immediately another observable photon is absorbed, and so state *mt* occurs. The particle of mass actually oscillates at a very high rate between the *m* and *mt* states—so high a rate that by arranging the interaction conditions one may interact with it either as a wave (react predominantly in the *mt* state) or as a corpuscle (react predominately in the *m* state). "Mass" as it exists is actually an oscillation or wave between *m* and *mt* states.

The Overall Flow of Time Is Internally and Dynamically Structured

During the transition in any mass to masstime state by reaction of the mass with an "observable" photon, a myriad of tiny virtual photon interactions involving very tiny $(\Delta E)(\Delta t)$ components of size

$$(DE)(Dt) \ll \frac{h}{4p} \quad [15]$$

occurs with the mass *m*. These tinier increments of time and their increments of energy, constitute internal structures in the overall time flow process. Therefore they are "energy currents" or "time-like energy currents" and *dynamic* structures inside the flow of time.

So the Δt component of masstime has a myriad of energy-time dynamics infolded within it. Hence the *mt* state is very dynamic in time, particularly for fundamental particles. The *mt* state is in fact a "collection of time-energy dynamics" and therefore "wavelike".

The major point is that mass does not emit photons; masstime does. Mass "travels through time" by an extremely high oscillation between corpuscle-like state *m* and wavelike state *mt*.

The concept can be extended, but this suffices for our concept of energy currents in time, and the interaction of such energy currents with mass in a mass system.

5. Connection Between Field and Source

The Problem of the Charge as a Source

We use the foregoing hypothesis to propose a solution to a previously unsolved major foundations problem in electrodynamics. Quoting Sen {45}:

"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics."

The problem really lies in how we approach the notion of the "source charge", since the usual classical electrodynamics does not model the interaction of the vacuum and the charge {46}. With no active vacuum input to the charge, the received crippled and fragmentary model of electrodynamics implies that the charge not only creates the fields and potentials which surround it, but also creates *out of nothing* all that EM energy comprising those associated fields and potentials. Since energy can neither be created nor destroyed, but only changed in form, the conventional notion that the source charge produces its associated fields and potentials and EM energy, in the absence of any interaction with the vacuum, is a non sequitur. This is the vexing and hitherto unresolved problem referred to by Sen.

The real difficulty is that the conventional model eliminates the vacuum interaction. Conservation of energy flow is an expression of symmetry, and there can be no symmetry without the vacuum interaction. Hence by not modeling the vacuum interaction, the conventional EM model must grossly violate the conservation of energy law. Its view of the charge as the source of fields and potentials and their energy, with no input of energy, essentially reduces the notion of source charge to a *perpetuum mobile*. In short, it simply posits an output of EM energy without any energy input at all.

What Experiment Shows

Experimentally, of course, it is easily shown that 3-spatial EM energy does continuously diverge *out of* that charge, creating all its associated fields and potentials which do appear around it. Just create a charge (e.g., as in pair production), and measure the resulting outflow of the fields and potentials and EM energy from it, at the speed of light in all directions.

Experiment also shows that there is no detectable (observable) 3-space EM energy flow that converges *into* the charge. Hence we are left with a quandary: Experiment shows that there is a broken symmetry in the conservation of EM energy 3-flow, directly associated with the source charge.

So the dilemma is: Where *does* the energy come from that is pouring out of the charge continuously?

The charge alone cannot be a true source, since rigorously there can be no such thing. As Semiz {47} puts it:

"The very expression 'energy source' is actually a misnomer. As is known since the early days of thermodynamics, and formulated as the first law, energy is conserved in any physical process. Since energy cannot be created or destroyed, nothing can be an energy source, or sink. Devices we call energy sources do not create energy, they convert it from a form not suitable for our needs to a form that is suitable, a form we can do work with."

We really do not have *energy sources* as such in nature, even though we sloppily use that term. Instead, we actually have *energy transducers*. Else we must discard the conservation of energy law itself: *Energy can neither be created nor destroyed, but only changed in form.*

A priori, since we can measure no real 3-space input of EM energy to the unchanging charge but we can measure real 3-space EM energy pouring from it, energy must be input to it from the active vacuum in a *nonobservable* (other than 3-space) form, and converted by it into an *observable* (3-space) form that is re-emitted, usable, and produces what we call the "fields and potentials" and their energy, associated with that "source charge".

Since it is common usage, we will continue to use the sloppy term "source charge" or "source dipole", but with the understanding that we refer to a special kind of energy transducer. Our problem is in showing where the energy comes from. So far, we know that (i) it does not come from 3-space, hence must come from the imaginary plane or the time dimension, and (ii) it must converge upon the source charge (transducer) in a flow whose magnitude is precisely equal to that of the emitted divergent 3-space EM energy flow.

The Charge As a Composite Dipole

To solve the source charge problem, we first point out that there exists no such thing as an *isolated charge*. As is well-known in quantum electrodynamics, clustered around any "isolated charge" in the vacuum are virtual charges of opposite sign. We take one of the separated virtual charges, and a correspondingly small piece of the observable charge of opposite sign, and call the pair a *composite dipole*. So the so-called "isolated charge" is actually a set of composite dipoles. Any of the clustering virtual charges and any of the pieces of the observable charge thus comprise such a composite dipole. The "isolated" observable charge is thus seen as a great entanglement of composite dipoles.

Further, each composite dipole has its own scalar potential between its end charges. With the previously stated reservation {27}, this scalar potential decomposes per Whittaker 1903 {9} and thus initiates a giant negentropic reordering of the vacuum energy as previously discussed. So any charge is really an entire set of composite dipoles, composite negative resistors, and broken 3-symmetries in the vacuum flux exchange. Energy flow 4-symmetry must rigorously apply.

The charge is a dipolar system (actually it is a *great set* of dipoles). It pours out a continuous flowset of real EM power in 3-space, radially at the speed of light in all directions. The composite dipoles comprising the charge system are being fed by a continuous converging flowset of reactive power from the imaginary plane, as we mentioned previously.

The real EM wave energy flow pouring out radially in all directions in 3-space from the charge system, forms the well-known fields and potentials associated with that "source charge". The actual source of the EM energy flow from the charge is the hypothesized negentropic reordering of the 4-vacuum energy into a giant 4-circulation of EM energy flow.

The 4-symmetry in EM energy flow is conserved at all times. *Energy is not created by the charge*—which creation has been implied in classical EM theory without the vacuum interaction, without the charge as a composite dipole, and without the Whittaker {9} decomposition of the scalar potential between the poles of every dipole. Instead of the present "creation of energy" non sequitur in the conventional model, the charge's received EM energy flow in unusable form is *transduced* by the charge's spin into usable form and output continuously. We note but do not further pursue that "charge" transduces the normal 3-symmetry energy flow into a 4-symmetry energy flow without concomitant 3-symmetry energy flow. This may eventually form the basis for a more vigorous definition of *charge*.

In short, as a dipolar entity the charge is an *open system far from thermodynamic equilibrium in 3-space EM energy flow*. Indeed, it has no input energy flow in 3-space, but instead has an input energy flow from the imaginary plane (from the time dimension). Hence classical 3-equilibrium thermodynamics does not apply.

The charge is simultaneously in perfect energy flow equilibrium in 4-flow. It continuously receives EM energy from the time dimension (imaginary plane), transduces the energy into real 3-space, and radiates it radially outward in 3-space as a real EM energy flow, producing the fields and potentials associated with that "source charge".

As a dipolar system, the charge's broken 3-symmetry in EM energy flow has allowed the system to relax to a more fundamental 4-symmetry energy flow without the arbitrary additional condition of 3-symmetry energy flow. The charge (composite dipole set) and the dipole are thus the ultimate and universal *negative 4-resistors* {48}.

As we shall see, the source dipole furnishes the energy to power every electrical system and circuit, since all EM systems and circuits must involve charge which is nothing but a set of composite dipoles receiving reactive power and pouring out real power (real EM 3-energy flow).

Entropic Engineering

When we "make entropy", we must do work. We wrestle nature fiercely to the mat, so to speak, by brute force. All the while, nature protests our entropic brutality by providing the Newtonian third law reaction force {49} back upon our causative wrestler performing the "forcing". To do entropic engineering, we have to continually input energy to the wrestling mechanism or engine, losing a bit of the input energy in the inefficiencies, and fighting the "back emf", "back mmf", or Newtonian third law reaction that is nature's protest all the while. Those are nature's penalties for imposing 3-space EM energy flow symmetry upon her as—to nature—an *additional and highly undesired condition*.

In short, with 3-symmetry we have to provide the continual input energy to our entropic processes by burning fuel, damming rivers, erecting windmills, building waterwheels, erecting solar cell arrays, building nuclear power plants, building and charging chemical batteries, etc. In the process, we destroy and pollute the biosphere on a giant scale as we rip down forests, strip-mine and drill the earth, and spill pollutants into the atmosphere, the rivers, the oceans, etc. We do all that biospheric destruction because we inexplicably insist upon 3-space energy flow symmetry, and thus adamantly require nature's adherence to classical equilibrium thermodynamics {50}.

We have to pay and pay continuously, for insisting on doing such atrocious entropic work. In so doing, we "tie nature's feet down" with that added arbitrary requirement for 3-symmetry in energy flow. We ourselves prohibit nature from performing the giant negentropy she so dearly loves and very much prefers. We also arbitrarily and *meanly* discard the bountiful electromagnetic energy 3-flow that nature loves to furnish us so freely when we indulge her vast preference for negentropy.

Negentropic Engineering

A far better way is to cooperate with nature and "let nature make copious negentropy". To do that, we now can see the startlingly simple mechanism. We simply make a little dipole, entropically. So we have to pay for *making* the dipole, *once*, and we have to do a little gentle violence to nature, *once*. Then we need do no more violence, if we just leave the dipole intact and do not destroy it.

When we make the dipole, we make a little bit of "broken 3-symmetry" in the universe's energy flow. Voila! Nature sings for joy at finally having her feet freed a little from the shackles of 3-symmetry energy flow. In great glee, she instantly sets to re-ordering a substantial and usable portion of the vacuum energy, in all directions at the speed of light. As long as we do not destroy the dipole (the broken 3-symmetry) which breaks the shackles, nature's feet remain freed from the 3-space symmetry, and she delightedly continues to reorganize a portion of the vacuum energy, with the reordering spreading radially outward at the speed of light.

Simultaneously, in great gratitude, nature pours out an immense real EM energy 3-flow from that little dipole. She will continue to pour it out forever, if we do not destroy the dipole.

Entropic Versus Negentropic Engineering

To summarize: If we make *entropy*, we tie nature's feet and she forces us to pay for it, and pay continually.

If we make *negentropy*, we only pay a very tiny "one-time initiation fee." From then on a delighted nature pays us for our thoughtfulness, and pays us copiously, continuously, and freely.

The smart thing to do is make just a little bit of entropy wisely, using it to break 3-space energy flow symmetry (basically, to make a dipole). Then we should—adapting a phrase—*leave that mother of all negative resistors and free energy generators alone!* We should concentrate on intercepting, extracting, and using the free energy copiously flowing forth from the ongoing giant negentropy, without destroying the dipole that is freely providing it.

6. How the External Circuit of a Battery or Generator is Powered

EM Energy from the Vacuum Powers Every Circuit

Neither the shaft energy introduced into a generator nor the chemical energy present in a battery is used to power the external circuit. The internal energy in a generator or battery is only dissipated to perform work upon the internal charges, to separate them and form a source dipole between the terminals, with some of the energy dissipated in other internal losses. A battery also uses its internal chemical energy to separate its charges, forming (or reforming) the source dipole.

Once formed, the source dipole is a broken symmetry {2} {51} in the vacuum's energy flux along the lines discovered by C.S. Wu {52} *et al.* in 1957. As Nobelist Lee {53} states,

“Since non-observables imply symmetry, these discoveries of asymmetry must imply observables.”

The broken symmetry of a dipole in its vacuum flux exchange has been known in particle physics for more than 40 years. In classical electrodynamics (CEM) the active vacuum and its exchange are omitted altogether, even though experimentally established for many years. As Lee also pointed out, there can be no symmetry of any *observable* system anyway, unless the vacuum interaction is included.

Further, by the definition of broken symmetry, the proven asymmetry of the source dipole in the vacuum flux *must* receive virtual energy and output observable energy. Since we see only the 3-spatial output, to us *it appears* that the source dipole somehow "extracts" from the vacuum some unobservable energy, transduces it, and then pours it out as the observable EM energy that we do observe.

Since the term "source charge" and "source dipole" are widely used, we will continue to use them, but with the clear understanding that in each case we are really speaking of 4-space energy transduction of received virtual energy into output observable energy.

Negative Resistor Function of the Source Dipole

To summarize: The total energy flow in space surrounding the conductors has two components as follows:

1) A tiny *Poynting component* {4} of the energy flow directly along the surface of the conductors strikes the surface charges (54) and is diverged (deviated) into the conductors to power the circuit.

2) The huge nondiverted *Heaviside component* {5} {6} filling all space around the circuit, misses the circuit entirely and is wasted in all those circuits using only a single pass of the energy flow. After having passed the circuit, the Heaviside energy flow can still furnish additional energy to the circuit if retroreflected to again pass back over the surface charges. However, conventional power systems use only a single pass of the energy flow, and completely ignore this enormous "dark" (unaccounted) energy accompanying every circuit. Other methods of extracting energy from the neglected Heaviside component are discussed later.

The sharp-minded reader will note that we have also completely replaced "statics" in electrostatics with "steady state dynamics".

7. Why Lorentz Eliminated the Heaviside Flow Component

The Nondiverged Heaviside Component

The Heaviside component is enormous, and often some 10^{13} times as great in magnitude as the Poynting component {17}. The Heaviside nondiverged energy flow component was arbitrarily discarded by H.A. Lorentz {12}, who integrated the energy flow vector itself around a closed surface enclosing any volumetric element of interest. This discards any *nondiverted* (nondiverged) energy flow components, regardless of how large, and retains only the *diverted* (diverged) component, regardless of how small.

Effectively Lorentz arbitrarily changed the *energy flow* vector into its *diverted flow component* vector—a fundamental non sequitur. In one stroke he discarded the bothersome Heaviside component, reasoning that it was "physically insignificant" because—in single pass circuits—it does not enter the circuit and power it.

This is rather like arguing that all the wind on the ocean that does not strike the sails of a single sailboat, is "physically insignificant." A moment's reflection shows that the "insignificant" remaining wind can power a large number of additional sailing vessels. A very large amount of energy can be extracted and used to do work, if that "physically insignificant" wind is intercepted by additional sails {55}.

No Apparent Source of the Enormous Heaviside Energy Flow Component

Suppose Lorentz had not arbitrarily discarded the huge Heaviside energy flow component surrounding the circuit and not contributing to its power. In that case, electrodynamicists in the 1880s would have been confronted with the dilemma of explaining where such an enormous flow of energy—pouring forth out of the terminals of every generator and battery—could possibly have come from. There was then no conceivable source for such a startling profusion of energy flow. Obviously the operator does not input such enormous energy, since the Heaviside flow is often some 10^{13} times as large in magnitude {55} {56} {57} {58} as is the retained

Poynting flow. Neither does a battery contain such enormous chemical energy to provide such a flow for even one second by chemical-to-electrical energy conversion.

To avoid strong attack and suppression from the scientific community on grounds of advocating perpetual motion and violation of energy conservation, in the 1880s there was no other choice but to discard the Heaviside component on some pretext. So Lorentz simply discarded the vexing component. He could not *solve* the problem so he *got rid* of it.

8. Some Characteristics of Power Systems

The Deadly Closed Current Loop Circuit

In conventional systems, a closed current {59} loop contains the generator or battery source dipole as well as the external circuit's loads and losses. This arrangement requires that half the collected energy in the circuit must forcibly pump spent electrons in the ground return line back through the back emf of the source dipole. Specifically, for every electron passing through the voltage drop across the loads and losses in the external circuit, an electron—so to speak—must be forcibly rammed back up through the source dipole against the same voltage.

Forcing the spent electrons through the source dipole's back emf performs work upon the end charges of the dipole to forcibly scatter them. This destroys the dipole and cuts off its free extraction of energy from the vacuum. In a charged battery, this "back emf work" scatters the dipole charges, whose restoration as a source dipole again is performed by dissipation of some of the chemical energy. This dissipation of part of the chemical energy causes a partial reversal of the normal chemistry {60} of the electrolyte-plate system, which reduces the chemical energy available by the battery to re-establish the source dipole. The battery's remaining chemical energy is expended to continually restore the source dipole as it is continually destroyed, until the chemical energy is exhausted. Then one must introduce additional energy into the battery to "recharge" it by forcing the chemistry back to its initial fully charged condition.

Electrical loads are—and always have been—powered by energy extracted and converted from the vacuum by the source dipole, not by shaft energy furnished to the generator or by the chemical energy in the battery. For *unitary current* {61} closed loop circuits, half the Poynting energy collected in the external circuit is expended in the circuit loads and losses (forward emf direction), and half is expended against the back emf of the source dipole (in the back emf direction), destroying the dipole.

Another way of seeing this is to simply examine the scalar potential existing between the two charges of a dipole, as we mentioned previously. A "scalar" potential is not really a scalar *entity*, although it has a scalar reaction cross section for reaction with a static charge {37}. Instead, it is a harmonic set of bidirectional phase conjugate longitudinal EM wavepairs, as shown by E.T. Whittaker {9} in 1903. Thus any dipole (negative 4-resistor) or charge (composite dipole set) has an enormous set of longitudinal EM wave energy flows into it from the time domain as we previously discussed, and a corresponding enormous set of longitudinal EM wave energy flows out from it in 3-space, in all directions. Once the source dipole is formed in the generator or battery, this energy flow exchange between source dipole and the universal active vacuum is established and ongoing, as is the broken symmetry of the dipole in that energy flux exchange with the active vacuum. At any point in the universe where the negentropic reordering has reached at its light speed, a charge will interact with the flow and extract energy from it. We emphasize that *any scalar potential itself is such a negative 4-resistor, and the negative 4-resistor process is induced upon any charge or dipole placed in that potential.*

Present Power System Design Forcibly Applies Lorentz Regauging

A conventional (unitary closed current loop) circuit's energy dissipation potential is separated into two equal halves, each in opposite direction. One which provides the force for discharge through the external circuit of the source dipole uses what is called the "forward emf". The other which represents a resistance force back through the internal dipole provides what is called the "back emf". The purely forward emf discharge represents energy dissipation in the load and losses. The forward emf discharge proceeds, however, only by simultaneously—so to speak—ramming the spent charge carriers in the ground return line back through the dipole, scattering the charges and destroying the dipole. Precisely as much energy is used in *destroying the source dipole* as is dissipated in the external loads and losses combined. Hence the circuit destroys its source dipole—and the negentropic reordering of the vacuum energy from which the circuit's excitation energy is extracted. And it does this faster than it powers the load itself.

The closed current loop circuit thus enforces a special sort of dynamic *Lorentz symmetrical self-regauging* during discharge of the circuit's excitation energy. The energy rate being destructively returned to the vacuum in destroying the source dipole, is equal to the energy rate being constructively returned to the vacuum from the external loads and losses. The excited system forcibly kills its free input of energy from the vacuum as fast as it powers the combined loads and losses—and thus faster than it powers its loads.

To restore the destroyed dipole, the operator must input as much energy as was required to destroy it. But with the closed current loop circuit, this operator input *a priori* is greater than the useful output of work in the load. Hence the coefficient of performance (COP) of this closed current loop system (with unitary m/q of the charge carriers) is self-limited to $COP < 1.0$.

Classical thermodynamics with its infamous second law rigorously applies during the excitation discharge phase of the closed current loop system, since the system itself is diabolically designed to continuously and forcibly restore itself into equilibrium with its active environment by killing its own source dipole gusher of vacuum energy flow as fast as it powers its loads and losses.

In a generator-powered system, continual input of energy to the generator shaft is required to continually add energy to perform work on the scattered charges, in order to restore the source dipole which the closed current loop continually destroys. Thus our present *self-crippling* vacuum-powered generator circuits/systems exhibit $COP < 1.0$ *a priori*, as do our self-crippling battery-powered circuits and systems.

We must pay for the initial energy input to the generator to establish the source dipole. *Once formed*, the dipole continuously extracts and pours out enormous observable EM energy flow from the vacuum—if we do not foolishly destroy the dipole. However, all our conventional circuits are deliberately designed to do just that—destroy their source dipoles faster than they power their loads. They are deliberately—though unwittingly—designed specifically as systems that self-enforce $COP < 1.0$.

The typical closed current loop circuit receives only a single-pass of the energy flow, and therefore only intercepts, collects, and utilizes the very small Poynting component, simply wasting the enormous Heaviside component that misses the circuit altogether. Our present *single-pass* power systems nominally waste some 10^{13} times as much energy as they catch and utilize. Scientists can easily do better than this if they (i) remove Lorentz's arbitrary and erroneous discarding of the Heaviside energy flow, (ii) develop circuits and circuit functions to catch and use much of that available but *presently neglected* huge energy flow, and (iii) develop and utilize circuits which destroy their source dipole slower than they power their loads.

Those are in fact the requirements for electrical power systems exhibiting $COP > 1.0$. Such open systems in disequilibrium with their active vacuum are permitted. Such a system can also be "close-looped" to power itself and its load. E.g., an open dissipative system with $COP = 2.0$, can use 1.0 of its COP to power itself, and the other 1.0 to power the loads and losses. This is no different than the operation of a windmill, except that the electrical system operates in an EM energy wind initiated from the vacuum by the source dipole. We point out that "powering a system" actually need only be "powering its internal losses" if the source dipole is maintained.

What We Pay the Power Company To Do

Essentially we pay the power company to engage in a giant Sumo wrestling match inside its generators and to *lose* by killing the free extraction of energy from the vacuum faster than the wrestling process powers the loads.

We pay the power company to use only a "single pass" of the energy flow along its transmission lines and the consumer power circuits, and thereby to just "waste" some 10^{13} times as much available EM energy as the company allows us to "use".

Present electrical power systems simply repeat this travesty over and over, so that we are continually inputting external energy to the generator to restore the source dipole, and having to input more than we get back out as work in the load. That is why all conventional EM power systems exhibit $COP < 1.0$ *a priori*. The system is specifically designed to force itself to do precisely that, by killing itself faster than it powers its load.

Such an inane power system continually forms a marvelous extractor of vacuum energy, then turns upon itself suicidally. In an oil derrick analogy, the system continually destroys its own energy flow "well head" (source dipole) and does not capitalize upon it. That is rather like drilling an oil well, bringing in a great gusher, catching a little oil in barrels, burning half of the barreled oil to deliberately cap the well, then drilling another well beside the first one, forcibly recapping the second one, and so on.

This is what keeps those coal trains running, the fleets of oil tankers steaming, the natural gas lines flowing with gas and the oil pipe lines flowing with oil, and gasoline and diesel engines powering our transport. It keeps enormously expensive nuclear power plants being built so that their nuclear reactors can produce heat to boil water to make steam to run turbines to input shaft power to the electrical generators for the generators to restore their continually-killed source dipoles {20}.

This insanity keeps our energy costs high, economically burdens every citizen and every nation, impoverishes many undeveloped and developing nations along with their peoples, and pollutes the planet to the limit of its tolerance and beyond. On our present course, we are embarked upon destroying our biosphere and ourselves along with it.

Eerily, our scientific community ignores the terrible 135-year-old foundations errors in classical electromagnetics and assures us that this is the best that electrodynamics can do. In fact, the scientific community has not yet even recognized the problem, much less the solution. As Bunge {62} so poignantly stated over three decades ago,

"...it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state."

Since that statement, not very much has been done to alleviate the problem—particularly in the electrodynamics model utilized to design and build electrical power systems. Heartbreakingly, the community itself seems predominately bent on defending non sequiturs and

the status quo, rather than correcting a remarkable but aged electrodynamics discipline that is seriously flawed and in great need of revision from the foundations up.

9. Requirements for Maxwellian EM Power Systems Exhibiting COP > 1.0

Along with some suggestions, the characteristics for *permissible* electrical power systems that exhibit COP > 1.0 are:

- 1) Particularly during its excitation discharge, the system must be an open thermodynamic system far from equilibrium in its energetic exchange with the active vacuum. In that case classical equilibrium thermodynamics does not apply, and such a system is permitted to:
 - (a) self-order,
 - (b) self-oscillate or self-rotate,
 - (c) output more energy than the operator inputs (the excess energy is received from the vacuum,
 - (d) power itself and its loads simultaneously (all the input energy is received from the vacuum), and
 - (e) exhibit negentropy.
- 2) The external circuit's loads and losses must not be *completely* coupled into the same closed unitary current loop with the source dipole in the generator. One suggestion is to develop and use proven *energy shuttling* in circuits. This discovery by Tesla {63} can only be seen (and designed) by electrodynamics theory embedded in an algebra of higher topology than tensors {64}.
- 3) The system must iteratively collect additional energy from the available but normally wasted enormous Heaviside energy flow component.
 - (a) A primary way to do this is to iteratively retroreflect the nondiverted Heaviside energy flow component after each pass, reflecting it back and forth across the surface charges in the circuit's conductors, collecting additional EM energy in the circuit on each repass.
 - (b) A second avenue is to intensively re-investigate and develop Kron's {127} discovery of the "open path" for EM networks as a dual of the conventional closed path.
 - (c) A third suggestion is to further investigate and develop (in higher topology algebra) Tesla's energy-shuttling in EM circuits as shown and improved by Barrett {63} {64}.
 - (d) A fourth suggestion is to utilize intensely scattering optically active media (ISOAM) and develop self-excitation processes in the medium. With output in the infrared region, such a process could use the excess heat to provide the heater portion of conventional power plants, allowing relatively straightforward phase-in of clean vacuum energy powering of most present major power systems. Previous experiments with such ISOAM have utilized *external* excitation of the medium and thus have COP < 1.0. However, *self*-excitation looms in the mechanisms being uncovered in the most recent experiments {65}, which have shown positive feedback loops, trapping of light flow energy in large random walks of over 1,000 individual interactions, weak Anderson-type localization, and constructive interference of forward time and reversed time light paths. These recent experiments point toward a potential "*vacuum-energy-powered heater.*"

With additional research, such a heater can become self-powering by the presence of sufficient positive feedback (which will allow excess collection from the Heaviside energy flow component). We have pointed out {18} that this ISOAM process—with the self-excitation occurring spontaneously as a "kick-in" process in an exploding gas—probably accounts for the phenomena observed in the gamma ray burster. Re-ignition, afterglow, and similar effects are observed in both the gamma ray burster and also in the latest ISOAM experiments. Similar phenomena occur in x-ray bursters as well, and perhaps even in the recently confirmed gamma ray emissions from intense storm clouds.

- (e) A fifth suggestion is to reopen the intensive investigation of true negative resistors such as those by Kron {127} and Chung {66}—and the potential and the dipole as negative 4-resistors as given in this paper—adding the consideration of vacuum energy interaction into the electrodynamics utilized for the investigation. Indeed, the original point-contact transistor often behaved in true negative resistor fashion, but was never understood. As Burford and Verner {67} state: "*...the theory underlying their function is imperfectly understood even after almost a century... although the very nature of these units limits them to small power capabilities, the concept of small-signal behavior, in the sense of the term when applied to junction devices, is meaningless, since there is no region of operation wherein equilibrium or theoretical performance is observed. Point-contact devices may therefore be described as sharply nonlinear under all operating conditions.*" The point-contact transistor was simply bypassed by advancing to other transistor types more easily manufactured and with less manufacturing variances.
- (f) As a sixth suggestion, we point out that all semiconductor materials are also optically active materials, and that a point discharge into such materials represents a very sharp regauging discharge due to the increase in potential at the tip. This means that the junction involves asymmetrical self-regauging, iterative time-reversal retroreflection, increased Poynting and Heaviside energy flow components, optical scattering processes inside the junction materials, etc. The Fogal semiconductor {68} is expected to be in production shortly. This semiconductor exhibits the desired characteristics for proper negative resistor work. Fogal has rigorously demonstrated to several large communications companies—now funding him—and is filing patents upon the use of his unique semiconductor to "in角度" and "outfold" EM signals of extremely wide bandwidths into and out of a DC potential via a proprietary process. This is believed to be a direct application of the Sachs {35} unified general relativity and electrodynamics approach, along lines indicated by Evans {69}, whereby the internal structure of a DC potential may be very much richer than is given by Whittaker {9} decomposition. Ziolkowski {70} has previously added the product wave set in addition to Whittaker's sum set. Since wave products are modulations, this has direct signal infolding implications. Mathematically, specialized semiconductors and their circuits should be able to perform Whittaker-Ziolkowski infolding of EM signals inside a DC potential, as the Fogal chip and circuits have now experimentally demonstrated.

- (g) As a seventh suggestion, intense sudden discharges in ionized gases are especially of interest due to the presence of optical frequency components and the involvement of iterative optical retroreflection etc. These processes seem to be involved in several investigations and inventions {71}.
- (h) As an eighth possibility, the present author {72} {73} has advanced an engineerable mechanism—still largely proprietary—for altering the rate of flow of a mass particle (or a set of them, comprising a mass) through time, including time-reversing the particle back to a previous state. The mechanism provides for exciting and discharging a charge with a *time-charge* excitation (pumping in the time domain—imaginary plane—where the absolute value of the time-charge (time-energy) is ordinary spatial energy compressed by the factor c^2 . Hence absolute value of time-charge (time-energy excitation) has equal energy density to mass. Being in the time domain, however, this highly compressed EM energy exists in the complex plane. In a small time-reversal zone (TRZ) created by the time-pumping process, like electrical charges attract and unlike electrical charges repel. This phenomenon thus allows like charges to attract in even numbers, without violation of the Pauli exclusion principle. We believe this process or a similar one {74} may be involved in the intense clusters of like charges demonstrated by Shoulders {75} and in cold fusion reactions. The law of attraction and repulsion of charges is reversed in a TRZ, so that even numbers of fermions there may act as quasi-bosons and thus be time-reversed. The TRZ then decays away, providing new and different *excitation decay* reactions of the quasi-bosons by quark flipping; these decay reactions do not exist in normal forward-time particle physics. An entirely new class of "inside-to-outside" nuclear interactions is available at low spatial energy (but high time-energy) which are not achievable by present "outside to inside" collision physics. As the TRZ decays, energetic decay changes are initiated which *start* from every point in spacetime inside the TRZ—including inside nucleons located in the zone—and move outward, interacting first with the nearly-time-reversed quarks and gluons so that quark-flipping—and change of proton to neutron and vice versa—become favored reactions and not formidable {76}. In the highly localized TRZ the quarks are nearly unglued by the time reversal anyway, so that alteration of quarks is not formidable. We have proposed novel new *time-energy* reactions {72}{73} which are consistent with most of the observed low *spatial energy* transmutations of the electrolyte experiments. The mechanisms involved in these reactions are also consistent with the anomalous phenomena experienced in the instruments occurring for several years in electrolyte experiments at China lake {77}. In addition to a vast new set of highly localized nuclear reactions of extremely high *time-energy* but extremely low *spatial* energy, the TRZ mechanism would seem to allow the production of true negative resistors—e.g., to be used as an external circuit bypass shunt around the source dipole in the generator, transformer, or battery. If so, once the process is developed and shown to be valid, EM circuits exhibiting $COP > 1.0$ will hopefully become a standard development, as will direct engineering of the atomic nucleus and nucleons in that nucleus.
- (i) As a ninth mechanism, application by Kawai {78} of adroit self-switching of the magnetic path in magnetic motors results in approximately doubling the COP.

Modification of an ordinary magnetic engine of $COP < 0.5$ will not produce $COP > 1.0$. However, modification of available high efficiency $COP = 0.6$ to 0.8 magnetic engines to use the Kawai process does result in engines exhibiting $COP = 1.2$ to 1.6 . Two Kawai-modified Hitachi engines were rigorously tested by Hitachi engineers and produced $COP = 1.4$ and $COP = 1.6$ respectively. The Kawai process and several other Japanese overunity systems have been blocked by the Yakuza from further development and marketing.

- (j) As a tenth suggestion, the magnetic Wankel engine {79} should also be capable of $COP > 1.0$ and closed-loop self-powering, but apparently it has also been suppressed, as have all present Japanese $COP > 1.0$ EM systems. The Wankel engine simply wraps a linear magnetic motor around most of a circular path, with only a few degrees open between the ends. The back mmf upon a rotating rotor magnet is thus confined to that few degrees of the rotation. A small external coil with a continuous small trickle current has its current sharply interrupted just as the rotor enters the back mmf region. The resulting sharp Lenz law effect temporarily overrides the back mmf magnetic field, reversing the net magnetic field in the region and converting it to a forward mmf region. This boosts the rotor through the critical region, so that it continues to drive forward, and requires only the minute expenditures in the coil and the switching costs. This produces a magnetic rotary motor with no net back mmf, with less energy input by the operator in comparison to the work produced by the engine. The dipolarity's extraction of energy from the vacuum is what actually powers the engine anyway, as we have discussed.
- (k) As an eleventh suggestion, multivalued magnetic potentials arise naturally in magnetics theory {80} {81} as well as in other potential theory. This is particularly true during phase transitions, where multivalued potentials seem to be the rule rather than the exception {82}. Theoreticians do all in their power to minimize or eliminate their consideration {81}. However, if deliberately used and optimized, the multivalued magnetic potential can provide a nonconservative field, where $\mathbf{F} \cdot d\mathbf{s} \neq 0$ around a rotary permanent magnet loop. In theory, this can enable a "self-powering" permanent magnet rotary engine {83}. Nonlinear effects (such as the magnetic Wankel's external use of Lenz law and Johnson's internal use of deliberately initiated and controlled exchange forces) may be evoked to provide the multivalued potentials and net nonconservative fields.
- (l) As a twelfth suggestion, certain passive nonlinear circuit components such as ferroelectric capacitors {84} have multiple nonlinear current processes ongoing inside. In principle it is possible to utilize such components only during the time they pass the current against the applied voltage. By adroit switching, in theory one can intermittently connect and utilize such passive components as true negative resistors.
- (m) As a thirteenth suggestion, feedback systems with a multipower open loop chain can produce $COP > 1.0$ performance {85}. Indeed, a frequency converter using 64 transistor stages and similar sophisticated feedforward and feedback mechanisms was placed in the original Minuteman missile {86}, then deliberately modified to stop its demonstrated $COP > 1.0$ performance. Very quietly, Westinghouse engineers then obtained several patents {87} surrounding the

technology, but no further mention of it appears in the literature. The particular germanium transistor involved, was later removed from production.

- (n) As a fourteenth approach, Johnson {88} has built many novel linear and rotary motors and at least one self-powering magnetic rotary device—later stolen in a mysterious break-in at his laboratory—personally tested by the present author. Johnson uses a bidirectional "two particle" theory of magnetic flux lines which can be justified by Whittaker's earlier work showing the internal bidirectional energy flows in all potentials and fields. He also utilizes controlled spin-waves and self-initiated precise exchange forces, which are known to momentarily produce bursts of very strong forcefields {89}. His approach is to use highly nonlinear assemblies of magnets which initiate the foregoing phenomena at very precise points in the rotation cycle. In short, he seeks to produce precisely located and directed sudden additional magnetic forces, using self-initiated nonlinear magnetic phenomena. This is analogous to what the Wankel engine did using the Lenz law effect by sharply interrupting a weak current in an external coil. We point out that the Lenz law effect and other very abrupt field changes momentarily produce not only an amplified *Poynting* energy flow component, but also an amplified *Heaviside* energy flow component as well.
- (o) As a fifteenth approach, we previously proposed a patent-pending mechanism whereby a degenerate semiconductor alloy (say, of a bit of iron in aluminum wire) is utilized for the conductors of the external circuit. By obtaining an electron relaxation time of, say, a millisecond, one can excite the circuit with potential alone, then switch away the excitation source prior to decay of the excitation potential—i.e., prior to the flow of any appreciable current. In this way, almost pure asymmetrical regauging is used to excite the circuit, without requiring work (except for switching, which can be made very efficient). The excited circuit then discharges in Lorentz symmetrical fashion, but all the work in the load is "free". If LE is load energy and SE is switch energy utilized, this approach yields $COP = LE \div SE$ and $COP > 1.0$ is possible.
- (p) As a sixteenth approach, at CTEC we are presently working on a patent-pending process whereby a permanent magnet is given a "memory" at will. By adroitly manipulating the memory, most of the magnetic flux from the magnet can be made to prefer and take a desired magnetic path among several available. Then the memory (and preference) is adroitly switched. Once one controls what path the flux "prefers" and when it prefers it, obviously $COP > 1.0$ is possible. This in fact is a special kind of "Maxwell's Demon", but so what? A Maxwell's Demon is indeed possible, if switching (actually, directed asymmetrical regauging) can be accomplished at a level deeper than the energy process utilized. The reader will recall that gauge freedom guarantees the ability to change the potential energy of the system at will. If one does that deterministically, then also regauges so as to asymmetrically discharge the excess potential energy deterministically in the load, *a priori* one has built a permissible Maxwell's Demon {90}.
- (q) As a seventeenth approach, Bedini {91} has perfected a remarkable process for dephasing—and freely overpotentializing—the ion currents inside a storage battery between its plates, from the electron currents circulating between the outside of the plates and the external circuit including the load. He takes

advantage of the fact that the loop current is non-unitary, and that the internally confined ion currents have an m/q ratio several hundred thousand times greater than the m/q ratio of the external electron currents. Consequently a significant hysteresis (relatively speaking) between ion current response and electron current response can be obtained by adroit sharp switching. He also creates an *overpotential* (a true negative resistor) on the interface of the plates between the two currents. This excess dipolarity thus extracts reactive power from the active vacuum (as we explained previously for a dipolarity), and blasts it out in both directions, onto the ion currents in charge mode internal to the battery and also onto the electrons in the external circuit in load powering mode. Hence the battery is simultaneously blast-charged with excess energy (the ions collect greater than normal energy) while the load is powered with excess energy (the Drude electrons are also overpotentialized and thus excited with excess energy). Bedini has produced working models (several personally tested, e.g., by this author) and is moving toward the market with his patent-pending process.

- 4) The system must dissipate its excess collected energy (its asymmetrically regauged excitation energy) in the load (and in the external circuit losses) *without* dissipating the source dipole—or at least so that the discharge is asymmetrical and dissipates the source dipole much slower than it powers the load. For a two-wire circuit, one method might be to utilize a *true* negative resistor shunt {92} in parallel with the primary source dipole but in its external circuit. This splits the return current in the secondary into two parts: (i) one part passes back through the secondary, causing back-field coupling into the primary for that component, and (ii) one part which does not pass back through the secondary, so that this component does not cause back-field coupling into the primary. In that way, the net back-field coupling into the primary is reduce, and the primary does not have to dissipate as much energy as does the secondary. It of course has to pass the energy flow to the secondary, but that need not be dissipated in the primary. With that arrangement, the primary will furnish all energy dissipated in the secondary circuit, but will not dissipate in itself as much energy as is dissipated in the secondary circuit. Hence a transformer-coupled system using such a nonlinear transformer permissibly exhibits $COP > 1.0$. We point out that the negative resistor represents excess energy input into the secondary circuit from the surrounding organized Heaviside dark energy flow component.
- 5) For self-powering of Maxwellian $COP > 1.0$ systems once developed, clamped positive energy flow feedback from output side to input side and excess collection from the Heaviside component can be used to power a motor turning the generator shaft, with the remainder of the output dissipated in a load. We stress that no laws of physics, electrodynamics, or thermodynamics are violated. Nor are the Maxwell-Heaviside equations violated, *before their arbitrary Lorentz regauging*. The conservation of energy law is obeyed at all times. Such an open dissipative Maxwellian system—which is what is being described—rigorously is permitted to self-power itself in that fashion, as shown by Prigogine {93} and others {94} in the study of nonlinear systems far from thermodynamic equilibrium. But following Lorentz, electrodynamicists have arbitrarily discarded all such permissible Maxwellian systems *merely because it greatly simplifies the mathematics!*

10. Proof of the Available, Neglected Heaviside Energy Flow Component

Bohren's Experiment

To prove the ubiquitous existence of the Heaviside energy flow component, and to demonstrate that it can easily be tapped, one can refer to Bohren's {14} demonstration that a resonant particle collects and emits up to 18 times as much energy as is input to it by conventional accounting (that is, in the Poynting component of the true energy input). Resonant particle absorption and emission is a $COP > 1.0$ process already proven and standard in the literature for decades; e.g., see the pioneering work by Letokhov {16}. The effect reported by Bohren was confirmed and verified, e.g., by Paul and Fischer {15}. Bohren, Paul, Fischer, and other electrodynamicists are unaware that their energy input actually included the huge *unaccounted* Heaviside energy flow component as well as the *accounted* Poynting flow defined by reaction with a *static* unit point charge.

Explanation for Bohren's $COP = 18$

The reason for the $COP > 1.0$ in this process is that the *resonant* particle sweeps out a greater *geometrical reaction cross section* in the total energy flow than is included in Poynting's theory for a standard *static* particle's interception. In short, it proves that the neglected Heaviside component is present and can be readily intercepted to obtain real expendable energy. We did a back-of-the-envelope calculation for the relative magnitude in a simple DC circuit of the Heaviside component compared to the Poynting component. The neglected Heaviside component for a nominal simple circuit was on the order of 10^{13} times as great in magnitude as the feeble Poynting component. A more exact calculation and a functional theoretical model would be welcomed, but we could not locate such in the literature {27}.

The Heaviside Energy Flow Component Was Arbitrarily Discarded

Practical EM power systems exhibiting $COP > 1.0$ are included in the Maxwell-Heaviside equations prior to Lorentz's symmetrical regauging {19}, which changed the equations to a small subset of the Maxwell-Heaviside theory. Specifically, the Lorentz procedure arbitrarily discards that entire class of Maxwellian systems that are not in equilibrium with their active vacuum environment. It is precisely that discarded class of Maxwellian systems that contains all Maxwellian EM power systems exhibiting $COP > 1.0$, by functioning as open dissipative systems freely receiving and using excess energy from the active vacuum.

11. Proposed Solution for the "Dark Matter" Gravitational Energy

Background of the Problem

As is well-known, the observable or accountable matter in distant spiral galaxies is insufficient to generate sufficient gravity in the spiral arms to keep the matter in the arms from flying away {95}{96}. It has been conjectured for some time that various types of exotic new "matter" never observed (and therefore "dark"), must be responsible for the excess gravity.

In general relativity, it is not mass per se, but mass-energy that is assumed to be responsible for gravitation, by the energy acting upon spacetime to curve it. In short, if appreciable "dark energy" can be discovered that has been previously unaccounted, that could well explain the extra gravity.

So rigorously one is seeking excess, unaccounted "dark energy" in some form—which may or may not be in the form of "exotic new matter".

A Proposed "Dark Energy" Candidate

We have found what may be the perfect candidate.

Lorentz arbitrarily discarded the vast Heaviside energy flow component accompanying every EM *field or potential* reacting with charge {97}. The previous calculations of the fields, potentials, and energy radiations for all such reactions in the universe—including in those distant spiral galaxies—have grossly underestimated the actual EM energy involved, using only the reaction cross section of the field or potential to a unit point static charge rather than the field or potential itself.

It follows that throughout the observed universe a myriad of negative 4-resistor interactions are pouring forth very large amounts of unaccounted Heaviside EM field energy flow, across the universe in all directions. Consequently, at any location in space, there exists a vast flux of these Heaviside "dark radiation" energy flow components. Indeed, in our view the nonlinear wave and field interactions of these unaccounted dark energy flows may be taken as what is "driving" the EM vacuum fluctuation of "zero-point" energy, essentially what is included in Puthoff's cosmological feedback principle {98}.

Some Observations of Interest

Three facts {95} are of interest: (i) The local gravitational potential from the distribution of stars perpendicular to the Galactic plane seems greater than can be provided by the masses of known types of stars, (ii) due to the decrease in luminosity to mass (or energy) in the outward direction from the center of galaxies, there must be some form of missing "dark" (non-Poynting radiant) matter (or alternatively, unaccounted and therefore "dark" energy flow) in the outer galactic regions which contributes to the gravity, and (iii) in clusters of galaxies it is known that there must be more mass (or dark energy) present than is contained in the visible (by Poynting detection) parts of galaxies.

The Dark Energy is Present at Every EM Field Interaction With Matter

We point out that the Heaviside component of radiation does in fact represent a "dark" and massive form of radiated EM energy that is physically always present, is missed by standard detectors, is arbitrarily excluded from the EM theory, and has been completely unaccounted in astrophysics as well as elsewhere. Certainly the EM dark energy radiation is gravitational, so one may hypothesize it as a candidate or major contributor to resolving the dark matter problem. In short, the dark matter problem may arise not because of missing *matter*, but because of *unaccounted, undetected, and theoretically discarded dark EM radiation of Heaviside form*.

As with any other hypothesis, of course, this one requires falsification or validation by future experimental and theoretical investigations. We hope to see such definitive experiments in the future.

12. The "Scalar" Potential Is a Multi-Vectorial, Multi-Wave Entity

There is of course a scalar potential established between the two end charges of a source dipole. Let us examine what kind of energy flows actually comprise a "scalar" potential, and whether it is a scalar entity or actually a set of multi-wave multi-vector EM energy flows.

When a "scalar" potential is set upon a transmission line, it speeds down the line at nearly light speed, revealing its vector nature. When it is set onto the middle of the transmission line, it speeds off in both directions simultaneously, revealing its *bidirectional* vector nature. In addition to this observation, there is rigorous mathematical proof as well.

In 1903 E.T. Whittaker {9} {99} showed that the scalar potential *identically is* a harmonic set of longitudinal EM bidirectional wavepairs, where each wavepair is comprised of a coupled longitudinal EM wave and its phase conjugate replica. Hence the potential is a bidirectional, multiwave, multi-vectorial entity and an equilibrium condition in a myriad bidirectional flows of longitudinal EM wave energy. There is thus a vast, bidirectional, longitudinal electromagnetic wave "infolded electrodynamics" inside every potential and comprising it.

In 1904 Whittaker {36} showed that any EM field or wave consists of two scalar potential functions, initiating what is known as *superpotential* theory {100}. By Whittaker's {9} 1903 paper, each of the scalar potential functions is derived from internally structured scalar potentials. Hence all EM fields, potentials, and waves may be expressed in terms of sets of more primary "interior" or "infolded" longitudinal EM waves and their impressed dynamics {101}. This is indeed a far more fundamental electrodynamics than is presently utilized, and one which provides for a vast set of new phenomenology presently unknown to conventional theorists.

13. Deeper Negentropy of the "Isolated Charge" in Space

A Charge Is a Set of Composite Dipoles

From quantum electrodynamics and particle physics, it is known that "empty space" is filled with intense virtual particle activity. An "isolated charge in space" must interact with the fleeting virtual charges that appear and disappear in accordance with the uncertainty principle of quantum mechanics. Consequently, virtual charges of opposite sign will be drawn toward the observable charge, before they disappear. The result is a formation of denser virtual charges of opposite sign, surrounding the observable charge, and a polarization of the local vacuum.

We may take a tiny "piece" of the observable charge, coupled with a nearby virtual charge of opposite sign during its existence, and consider the pair to be a *dipole* in a special "composite" (coherent virtual and observable) sense. So the "unit point charge" often used in electrodynamics to interact with the fields and potentials—and erroneously "define" them as their own reaction cross sections—is not really a point charge at all but is a set of *composite dipoles*. Further, it occupies the "neighborhood of a point" rather than a point.

Decomposing the Dipole's Potential

Each little composite dipole also has a "scalar potential" between its ends. We may decompose that potential into a harmonic set of bidirectional EM longitudinal wave (LW) pairs {9}, where each pair consists of an outgoing LW and an incoming LW. Now, however, the incoming (convergent) LWs are virtual; i.e., comprised of organization and dynamics in the virtual flux of the vacuum.

We may repeat this analysis for each of the composite dipoles comprising the so-called "isolated observable charge".

So any "isolated charge" in fact organizes and dynamicizes a fraction of the entire vacuum potential of the universe. The simple charge imposes a fraction of negentropy and organization upon the vacuum, spreading at light speed across the universe. A vast set of "energy circulations" in the form of LWs and virtual LWs is established by charge-vacuum interaction, where a set of convergent virtual LWs feeds virtual energy continuously into the "charge", and

the charge organizes some of its received energy into observable LW energy radiated out to the ends of the universe.

The charge, scalar potential, and dipole are all true negative 4-resistors of extraordinary magnitude. They order the virtual state energy flux of the vacuum, and bridge the gap between virtual and observable state, extending into the entire macroscopic universe level.

Deepening the Structure and Dynamics

Each of the virtual particles (virtual charges) comprising the composite end of the dipole, e.g., will also be accompanied by an organization of much finer, localized virtual particles of opposite sign. Hence another set of even finer composite dipoles is formed, each of which can again be decomposed into finer harmonic composite bidirectional LW wave sets. Thus there is "structuring within structuring" to as deep a level as we care to examine.

The *organization of the vacuum potential* continues at ever finer levels without limit.

So even a single electron organizes a fraction of the vacuum energy of the universe, to a very surprising depth and degree. The vast, ever-changing interactions of the vacuum organization and dynamics, with particle dynamics, simply stretches one's imagination. But it is real, and the total energy content affected by each "reorganization" is enormous. This is an indication of the vast extent and dynamics of the "self-ordering" that the entire energetic vacuum performs, in response to the slightest stimulation by a charge. It also illustrates that the vacuum is a special kind of scalar potential, with internal Whittaker {9} structuring and dynamics {36} {102}. In essence this favors an already chaotic statistics, resolving the quantum mechanics problem of the missing chaos. It also means that spacetime itself—and each of its curvatures—possesses remarkable internal structuring.

Vacuum Engines as Deterministic Spacetime Curvature Sets

We argue that now we have uncovered in what manner the concepts of vacuum, spacetime, and potential are just different names for the same entity.

Once the internal structuring of a potential is formed, that internal structuring consists of patterned sets of spacetime curvatures with impressed deterministic dynamics. This is the spacetime curvature engine concept—or "engine" or "vacuum engine" for short. The engine and its dynamics will then work freely, both externally and internally at any and all levels, upon any matter placed in it and exposed to it. It will work indefinitely, without any additional input of energy by the operator once the engine is made.

Virtual energy which appears and disappears in the dynamics of the engine's actions, need exhibit no inertia in this reordering, since the reordering occurs "between" the extinction of one virtual particle and the appearance of another. There is no "change of an ordering" in the classical sense, but only the "emergence of a new ordering." In short, in the *causal domain* (such as the active vacuum) prior to the invocation of the $\partial/\partial t$ observation operator, negentropy is readily and freely obtained on a massive scale.

We point out that such engines also may be considered to consist of sets of bidirectional longitudinal EM waves with impressed dynamics.

Causal System Robots (CSRs)

We provide an example of some of the startling implications of the Sachs-Evans approach.

In theory it is possible to form complete functioning *causal systems* of such spacetime curvature engines, to include almost any set of functions that will deterministically act upon

matter, energy, fields, etc. In other work we have referred to such a system as a *causal system robot* (CSR). In theory, such a functioning robot system in the 4-space causal domain can be designed and produced to perform most conceivable functions upon matter, regardless of level or complexity. The reason is simple: any physical system already identically is a dynamic mass assembly in mutual interaction with a resident set of spacetime curvature engines and their dynamics. Any system proves that a causal system robot performing the engines functions already exists and is therefore possible.

Further, ordinary EM fields, potentials, and waves appear to be "superhighways" for such systems to travel. The conventional EM fields, potentials, and waves consist of nothing but bundles of such longitudinal EM waves and their dynamics anyway. So the "propagation" of a CSR "inside" ordinary electrodynamics, is simply the propagation of a set of LW wave dynamics of special kind, in the "inner LW medium" of the electrodynamic fields, waves, and potentials.

According to general relativity, for any observed function of an observable system, there must correspond such a precise functioning "engine set" of spacetime curvatures {103} {104}. It follows that a CSR can be structured to perform the spacetime curvature analog of any physical function. This includes, e.g., communications, signal processing, etc. Eerily, if one has developed longitudinal EM wave technology, one could even communicate with such systems via LW communication, if the necessary communication and signal processing functions are built into the CSR system.

It would be very difficult to make and "debug" such a functioning CSR system the first time. However, once one is made and debugged until it is sufficiently accurate, any number of copies could be replicated with ease and very cheaply. Merely insert the CSR inside an ordinary EM signal and record the resulting "internally structured" signal on a diskette or CD-ROM. Then replicate the diskette or CD-ROM, and the replicated signal will also have an internal replica of the CSR. So clones could be made for pennies per copy, without limit{105}.

Remarks on Vacuum Engineering

It is therefore not surprising that the "self-organization action" of a small source dipole in a generator or battery should produce such an enormous reorganization of vacuum energy and such great negentropy as is demonstrated in the Heaviside component. It should also not be surprising that, with no available theory dealing with or even touching such matters, Lorentz simply chose to resolve the "Heaviside energy flow component" problem by eliminating it altogether.

One result of the Lorentz integration of the energy flow vector around a closed surface {12} was to eliminate all that intense negentropic self-reorganization of the local vacuum that *did not* interact immediately with the circuit. In today's terms, he effectively eliminated *vacuum energy engineering* from electrodynamics.

Decades later, the vision of vacuum engineering was glimpsed by modern physicists such as Lee {2} {106}. But vacuum engineering by electrodynamic means, though theoretically straightforward in extended electrodynamics based on the Sachs approach, is still missing from conventional electrodynamics by arbitrary exclusion.

14. AIAS Contributions To a New Electrodynamics

The Institute and Its Noted Director

The Alpha Foundation's Institute for Advanced Study (AIAS) is a novel scientific organization directed by Dr. Myron W. Evans, a noted scientist who has nearly 600 papers in the refereed literature. Other noted scientists such as Dr. Lehnert of the Alfvén Laboratory in Sweden and Dr. Vigier in the Laboratoire de Gravitation et Cosmologie Relativistes, Université Pierre et Marie Curie, Paris, France, and Dr. Mendel Sachs constitute the Fellows of the AIAS.

A major effort has been underway by AIAS theorists (and a few other scientists as well) to extend electrodynamics into a non-Abelian electrodynamics in $O(3)$ symmetry using gauge field theory {107}. Numerous failings of the present $U(1)$ electrodynamics have been pointed out by the AIAS in a series of papers published in the literature and others presently in the referee process. Some 80 AIAS extended electrodynamics papers are presently carried on a controlled Department of Energy (DOE) website for reference by DOE scientists. The papers are being published in leading journals as rapidly as possible.

In a recent AIAS group paper {108} on the stress energy momentum tensor, it is shown that the Poynting vector in the received view is identically zero: *reductio ad absurdum* {109}. In the new method, based on equating ϕ with A , the Poynting flow in vacuo is unlimited, simply because the A_μ drawn from the vacuum defines the Lehnert charge current density in the vacuum. A new paper in this area of vacuum energy, treating the subject in greater depth, has been completed {110} at this writing. The results appear directly from local gauge invariance. In the new method, it is only assumed that there is an A present in the internal gauge space, and that A can be subjected in vacuo to a local gauge transform. Several other papers dealing with extraction of electrical energy from the vacuum are in preparation.

$O(3)$ EM Is a Subset of Sachs' Generalized Unified Field Theory

The $O(3)$ electrodynamics is now being further extended as a very important subset of Sachs' {35} generalization of unified general relativity and electrodynamics.

Thus the vacuum is indeed a very active and engineerable medium, filled with many kinds of real EM energy currents, and these energy currents may and do interact with EM circuits in such a manner that the circuits extract usable EM energy from the vacuum. As we have argued, conventional circuits receive *all* their EM energy from the vacuum interaction with the source dipole and not from the generator or battery. As is slowly being developed and published, there is a rigorous theoretical basis for extracting and using electrical energy directly from the vacuum. It is a concept whose time has come.

Other Scientists and Inventors Are Recognized Also

We also recognize the enormous contributions made by other advanced theorists outside the AIAS such as Barrett {64} {111}, Cornille {112}, Ziolkowski {113}, Letokhov {16}, Cole {114} and Puthoff {114} {115} as well as many others. Happily Sachs {35} is now a Fellow Emeritus of AIAS. We also specifically recognize inventors including Mills {116}, Shoulders {75}, Johnson {88}, Kawai {78}, Patterson {117}, Lawandy {118}, Mead and Nachamkin {119}, Sweet {120} (now deceased), Mandel'shtam *et al.* {126}, Bedini {91}, Fogal {68} {121}, Chung {66}, Paula and Alexandra Correa {71}, and many others {122} {123}.

15. Conclusion

Non Sequiturs in Conventional Electrodynamics

There are many foundations non sequiturs in classical electrodynamics that are sorely in need of correction; we have pointed out only a few {124}. The present energy crisis has occurred largely as a result of continuing to perpetuate these major flaws in electrodynamics theory, and continuing to build our electrical power systems in accord with the flawed theory.

Extracting Copious EM Energy From the Vacuum Is Easy

Most electrodynamicists hold the opinion that extracting usable electrical energy from the vacuum is extraordinarily difficult. To the contrary, it is a very simple thing to do and has always been done by our conventional power systems anyway. Just collect some charge (a composite dipole) or form a dipole, and the "scalar" potential between its end charges represents an organized, enormous, bidirectional 4-flow of EM energy, being established over the entire vacuum at the speed of light. Real EM 3-space energy flows outward in all directions from the dipole, and reactive power (i.e., EM energy in the imaginary plane) flows into the dipole continuously from the imaginary plane, as shown by Whittaker {9} nearly a century ago. Since the beginning, every electrical load has been powered by energy extracted directly from the vacuum, and not by the heat energy produced from all the hydrocarbons burned and nuclear fuel rods consumed, or by the energy from the hydroturbines and waterwheels turned by dams across streams, or by windmill-powered generators, or by solar cells, or by the chemical energy in batteries, etc.

Collecting and Utilizing the Dark Energy Is the Long-Ignored Problem

The problem is in *collecting and using* the enormous energy easily extracted from the vacuum, not in simply producing the direct Heaviside EM dark energy flows. In short, the problem is how to obtain much more Poynting (*intercepted*) energy from the easily available and enormous Heaviside (*nonintercepted*) energy. And then the problem is not to use half of the collected energy to destroy the dipole negative 4-resistor furnishing the energy from the vacuum.

One can build a "vacuum energy extractor" for less than a dollar. Simply place a charged capacitor (or electret) upon a permanent magnet, so that the E-field of the capacitor is at right angles to the \mathbf{H} -field of the magnet, and the energy flow from the magnet (a function of $\mathbf{E} \times \mathbf{H}$) is maximized {125}. The system will extract energy from the vacuum and steadily output it indefinitely as a Heaviside energy flow. It does, however, sharply focus attention on the real problem of *how to collect and use some of the energy from the balanced vacuum energy 4-circulations set up by the system between the local vacuum and the distant, nonlocal vacuum*. Again, the problem is how to convert Heaviside dark energy flow to Poynting (intercepted) energy flow.

Once the vacuum energy transducer (generator's source dipole) is in place, it is another matter to intercept, collect, and use the "modified local vacuum circulation energy" pouring from the transducer to power loads, and to do so without destroying the source dipole created in the collecting generator. Unfortunately our power scientists and engineers have been focusing upon the wrong end of the problem for more than a century. They have focused enormous efforts on getting additional energy into the shaft of the generator, and reducing its internal losses. They have not focused upon what happens once the source dipole is formed inside the generator, and the giant negentropy 4-resistor and vacuum energy extraction emerge.

Burning Fuel Does Not Add a Single Watt to the Power Line

This has led to one of the greatest ironies in the history of science: All the hydrocarbons ever burned, all the steam turbines that ever turned the shaft of a generator, all the rivers ever dammed, all the nuclear fuel rods ever consumed, all the windmills and waterwheels, all the solar cells, and all the chemistry in all the batteries ever produced, have not directly delivered a single watt into the external circuit's load. All that incredible fuel consumption and energy extracted from the environment has only been used to continually restore the source dipole that our own closed current loop circuits are deliberately designed to destroy faster than we restore them.

We strongly urge the rapid, high priority development of permissible $COP > 1.0$ EM power systems which violate the Lorentz symmetrical regauging condition in their discharge of free excitation energy received from the vacuum via the source dipole. We will gladly contribute our own findings to the effort, including citing $COP > 1.0$ power systems {126} and negative resistors {66} {92} {127} produced by known scientists and documented in the literature, but usually suppressed by scientific resistance to any dramatic change in U(1) electrodynamics and the Lorentz condition.

Classical Electrodynamics for Energy Systems Is in Woeful Shape

It is known in particle physics that there can be no symmetry of a mass system without the incorporation of the active vacuum interaction. Yet the vacuum interaction is still missing from the classical electrodynamics model. Symmetry implies non-observables, and asymmetry implies observables. So every observable mass system, being asymmetrical *a priori*, must be accompanied by non-observables interacting with it, else it can have no symmetry (or equilibrium). Yet classical electrodynamics continues to assume equilibrium and symmetry in observable systems without incorporating the active vacuum.

Everywhere we examine classical U(1) electrodynamics, we find non sequiturs of first magnitude. This alone should be a compelling reason for the scientific community to assign the highest priority, ample funding, and the best theoreticians to the sorely-needed revision of electrodynamics from the foundations level up.

Vigorous Corrective Action Is Warranted and Imperative

With vigorous and refocused attention by the scientific community to development of the electrodynamics of $COP > 1.0$ energy systems and circuits, self-powering electrical power systems fueled by vacuum energy can be developed and deployed in rather straightforward manner. The problem is nowhere near as complex as hot fusion or developing a large new accelerator. {128} The cost of one large hydrocarbon-burning powerplant will allow the development to be done. The energy crisis can be solved forever. The present enormous pollution of the Earth's environment by hydrocarbon combustion and nuclear wastes can be dramatically lowered. Global warming can be slowed and eventually even reversed.

Our children, the biosphere, and the slowly strangling species on Earth will benefit enormously from that sorely needed scientific effort. We desperately need to *do it*, and we need to *do it now*.

BIBLIOGRAPHY

1. A. O. Barut, "Debating the Final Theory," Found. Phys., 24(11), Nov. 1994, p. 1571.
2. See T. D. Lee, Particle Physics and Introduction to Field Theory, Harwood, New York, 1981, p. 184. In particle physics the dipole is a particle-antiparticle broken symmetry in its fierce energy exchange with the active vacuum.
3. E.g., see John D. Kraus, Electromagnetics, Fourth Edn., McGraw-Hill, New York, 1992. An illustration of this space-filling energy flow is shown in Figure 12-60, a and b, p. 578.
4. J. H. Poynting, "On the transfer of energy in the electromagnetic field," Phil. Trans. Roy. Soc. Lond., Vol. 175, Part II, 1885, p. 343-361. Poynting only considered that part of the energy flow that enters the circuit.
5. Oliver Heaviside, "Electromagnetic Induction and Its Propagation," The Electrician, 1885, 1886, 1887, and later; — Electrical Papers, Vol. 2, 1887, p. 94, 405, 514.
6. Oliver Heaviside, "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," Phil. Trans. Roy. Soc. Lond., 183A, 1893, p. 423-480.
7. There was no special or general relativity, no quantum mechanics, no electron, no atom, no atomic nucleus, etc. available at the time. There was no theory of the active vacuum, and there was no broken symmetry of the dipole with such an entity.
8. That erroneous notion in similar phraseology such as "can have no physical consequences" is often used by electrodynamicists to this day. E.g., see J. D. Jackson, Classical Electrodynamics, Second Edition, Wiley, New York, 1975, p. 237.
9. E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Math. Ann., Vol. 57, 1903, p. 333-355.
10. T. E. Bearden, "Giant Negentropy in the Common Dipole," Proc. IC-2000, St. Petersburg, Russia, 2000 (in press).
11. D. K. Sen, Fields and/or Particles, Academic Press, London and New York, 1968, p. viii.
12. H. A. Lorentz, Vorlesungen über Theoretische Physik an der Universität Leiden, Vol. V, Die Maxwellsche Theorie (1900-1902), Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. Figure 25 on p. 185 shows the Lorentz concept of integrating the energy flow vector around a closed cylindrical surface surrounding any volumetric element of interest. This discarded the Heaviside *nondiverged* component, leaving only the Poynting *diverged* component. I have not yet discovered the original earlier paper where Lorentz first did this procedure, and would welcome a citation to it.
13. E.g., W. K. H. Panofsky and M. Phillips, Classical Electricity and Magnetism, Addison-Wesley, Reading, MA, 1962, 2nd edition, p. 181 shows this Lorentz exercise, as do W. Gough and J. P. G. Richards, Europ. J. Phys., 7, 1986, p. 195.
14. Craig F. Bohren, "How can a particle absorb more than the light incident on it?" Am. J. Phys., 51(4), Apr. 1983, p. 323-327.

15. H. Paul and R. Fischer, {Comment on "How can a particle absorb more than the light incident on it?}," Am. J. Phys., 51(4), Apr. 1983, p. 327 verify the Bohren experiment and results.

16. V. S. Letokhov, "Generation of light by a scattering medium with negative resonance absorption," Zh. Eksp. Teor. Fiz., Vol. 53, 1967, p. 1442; Sov. Phys. JETP, Vol. 26, 1968, p. 835-839; "Laser Maxwell's Demon," Contemp. Phys., 36(4), 1995, p. 235-243.

17. T. E. Bearden, "Use of Asymmetrical Regauging and Multivalued Potentials to Achieve Overunity Electromagnetic Engines," J. New Energy, 1(2), Summer 1996, p. 60-78.

18. M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al.*, "Classical Electrodynamics Without the Lorentz Condition: Extracting Energy from the Vacuum," Physica Scripta 61(5), May 2000, p. 513-517.

19. Ludwig Valentin Lorenz first effectively regauged the Heaviside-Maxwell equations symmetrically in Lorenz, "On the identity of the vibrations of light with electrical currents," Phil. Mag., Vol. 34, 1867, p. 287-301, not long after Maxwell's seminal 1864 oral presentation of his paper, "A dynamical theory of the electromagnetic field," published in Phil. Trans. Roy. Soc. Lond., Vol. 155, 1865. When the prestigious H. A. Lorentz later adopted the symmetrical regauging because it provided simpler equations that were easier to solve, electrodynamicists adopted it quickly. No one seemed to notice that physically this constituted the arbitrary and total discard of all Heaviside-Maxwell systems not in thermodynamic equilibrium with their active vacuum. Even Jackson, 2nd Edition, *ibid.* erroneously states that the Lorentz-regauged equations are the same in every respect.

20. T. E. Bearden, "The Unnecessary Energy Crisis: How to Solve It Quickly," Association of Distinguished American Scientists, June 24, 2000 is an ADAS position paper on the subject.

21. J. D. Jackson, Classical Electrodynamics, *ibid.*, 1975, p. 220-223.

22. See Paul Nahin, Oliver Heaviside: Sage in Solitude, IEEE Press, New York, 1988., p. 134, n. 37. Quoting: "In an 1893 letter to Oliver Lodge, Heaviside said of his own work that it represented the 'real and true "Maxwell" as Maxwell would have done it if he had not been humbugged by his vector and scalar potentials." The false notion that changing the potentials has no physical significance if the force fields are not changed, is due largely to Heaviside. Heaviside considered potentials "mystical" and "not real", and stated they should be "murdered from the theory." Along with Hertz etc., he reduced Maxwell's 20 quaternion equations in 20 unknowns to four equations, getting rid of many potentials in so doing.

We point out that an EM potential is a change to the energy density of the vacuum, hence produces spacetime curvature, which is a gravitational effect. Heaviside's position predated relativity by decades, and is one of the reasons that electrodynamicism and general relativity have not been successfully combined in an engineering theory.

23. See H. J. Josephs, "The Heaviside papers found at Paignton in 1957," Monograph No. 319, IEE, Jan. 1959, p. 70-76. Ironically, well after Heaviside's death, his hand-written notes containing a theory of electrogravitation, based on his theory of energy flow, were found beneath the floor boards in his little garret apartment. His trapped EM energy flow loops were gravitational.

24. However, so-called "canceling" appositive EM fields are actually produced, which sum to a vector zero which the electrodynamicists then discard by assumption. We point out, but do not further pursue, that the locally-produced *field energies* of the appositive fields remain and add, even though the fields offset each other translationally, since the energy of the field is proportional to its square, and that is always positive regardless of field orientation. Thus "trapped" EM energy has been localized in spacetime in the symmetrical regauging of CEM, and this is a local curvature of spacetime *a priori*. Thus any substantial EM gauge symmetry transformations are accompanied by local gravitational changes in the regauged system. This in fact may prove to be the road to practical antigravity processes and devices, achieved by EM means. At least one system—Sweet's vacuum triode device—seems to have accomplished antigravity effects. See Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," Proc. 26th Intersoc. Energy Conversion Eng. Conf. (IECEC '91), Boston, MA, 1991, p. 370-375.

25. See reference 18. Also see M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al.*, "Derivation of the Lehnert Field Equations for Gauge Theory in Vacuum: Space Charge and Current," Found. Phys. Lett., 13(2), Apr. 2000, p. 179-184; — "Runaway Solutions of the Lehnert Equations: The Possibility of Extracting Energy from the Vacuum," Optik (in press); — "Vacuum Energy Flow and Poynting Theorem from Topology and Gauge Theory," (submitted); — "The Effect of Vacuum Energy on the Atomic Spectra," Found. Phys. Lett., 13(3), June 2000, p. 289-296; — "Electromagnetic Energy from Curved Space-Time," (submitted); M.W. Evans and T. E. Bearden, "The Most General Form of the Vector Potential in Electrodynamics," (submitted).

26. G. Johnstone Stoney, "Microscopic Vision," Phil. Mag. Vol. 42, Oct. 1896, p. 332; , "On the Generality of a New Theorem," Phil. Mag., Vol. 43, 1897, p. 139-142; "Discussion of a New Theorem in Wave Propagation," Phil. Mag., Vol. 43, 1897, p. 273-280; "On a Supposed Proof of a Theorem in Wave-motion," Phil. Mag., Vol. 43, 1897, p. 368-373.

27. We accent that the waves exist in 4-space. The incoming EM longitudinal waves are in the imaginary plane, hence are incoming from the time domain *-ict*. Evans has pointed out that Whittaker's method depends upon assuming the Lorentz gauge. If the latter is not used, the Whittaker method is inadequate, because the scalar potential becomes even more richly structured, as captured by Sachs' generalization which removes the necessity for the Lorentz gauge. For the negentropic vacuum-reordering mechanism involving only the dipole or the charge as a *composite dipole*, it appears that the Whittaker method can be applied without problem, at least to generate the minimum negentropic process itself. However, this still leaves the capability for *additional structuring*, so that the actual negentropic reordering of the vacuum energy (and the structure of the outpouring of the EM energy 3-flow from the charge or dipole) may be made much richer than given by the simple Whittaker structure alone. Specifically, 4-flow symmetry may be broken while n-flow symmetry is maintained, where the integer $n > 4$. The Whittaker structure used in this paper should be regarded as the *simplest* structuring of the negentropic process that can be produced, and hence a lower boundary condition on the process.

28. Time-like currents and flows do appear in the vacuum energy, if extended electrodynamic theory is utilized. E.g., in the received view the Gupta-Bleuler method removes time-like photons and longitudinal photons. For disproof of the Gupta-Bleuler method, proof of the

independent existence of such photons, and a short description of their characteristics, see Myron W. Evans *et al.*, AIAS group paper, "On Whittaker's F and G Fluxes, Part III: The Existence of Physical Longitudinal and Time-Like Photons," *J. New Energy*, 4(3), Winter 1999, p. 68-71; "On Whittaker's Analysis of the Electromagnetic Entity, Part IV: Longitudinal Magnetic Flux and Time-Like Potential without Vector Potential and without Electric and Magnetic Fields," *ibid.*, p. 72-75. To see how such entities produce ordinary EM fields and energy in vacuo, see Myron W. Evans *et al.*, AIAS group paper, "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," *ibid.*, p. 76-78. See also Myron W. Evans *et al.*, AIAS group paper, "Representation of the Vacuum Electromagnetic Field in Terms of Longitudinal and Time-like Potentials: Canonical Quantization," *ibid.*, p. 82-88.

29. D. S. Jones, *The Theory of Electromagnetism*, Pergamon Press, Oxford, 1964, p. 57-58 gives a short treatise on the complex Poynting vector. In a sense our present use is similar to the complex Poynting energy flow vector, but in our usage the absolute value of the imaginary energy flow is equal to the absolute value of the real energy flow, and there is a transformation process in between. So we are only working in four dimensions (Minkowski space). This usage is possible because the imaginary flow is into a *transducer*, which takes care of transforming the received *imaginary* EM energy into the output *real* EM energy. We stress that the word "imaginary" is not at all synonymous with *fictitious*, but merely refers to what "dimension" or state the EM energy flow exists in. We also point out that ultimately the concept of "dimension" just refers to a fundamental mathematical degree of freedom.

30. We mention in passing that this dramatically alters the conception of how the EM field is thought to exist in spacetime. Take the E-field as an example. In 3-space the E-field \mathbf{E} exists as an outgoing longitudinal EM wave. At any 3-space point, \mathbf{E} exists as an ongoing energy flow process in 4-space, where a convergent inflow of longitudinal EM wave energy from the time domain (imaginary plane) enters the point, and the outgoing EM longitudinal wave in 3-space comes from the point.

Maxwell in fact simply assumed the transverse EM wave in space, based on the notion of Faraday's "taut string" field lines (lines of force). When Maxwell wrote his theory, the electron, nucleus, atom, and molecular structure were unknown. He wrote a purely material fluid theory, since the material ether was ubiquitously assumed and nowhere in all the universe was there thought to be any "total absence of matter". Consequently, applied to currents in wires and to circuits, Maxwell ignored the simultaneous recoil of the positive nuclei which were not even known. He only used a "unitary electrical material fluid" flowing (from positive to negative) down the wire like water through a pipe. Further, electron drift velocity was unknown since the electron was unknown, and the fluid was thought to move at signal velocity.

Actually, the Drude electrons, during their 360° spin in 3-space, act as gyros and are constrained longitudinally by repulsion of other charges beyond. Hence the gyroelectrons precess laterally to their longitudinal disturbing force, yielding the well known *measured* transverse wave. Almost all our instruments still are electron-precession detectors.

In any field applied to the wire, the simultaneous apposite recoil of the nuclei—with equal energy to the electron gyroprecession but highly damped in amplitude because of the much greater m/q ratio of the positive nuclei—was ignored (and still is, even though known to occur).

In a transmitting wire antenna, the surrounding spacetime is perturbed by two perturbations: (i) the Drude electrons (which are confined to the wire), and (ii) by the recoiling nuclei. There is a very tiny phase deviation from 180° between the two perturbations. So the total "disturbance" of the surrounding spacetime medium by the two equal energy and nearly opposite direction charge perturbations, is very nearly a 3-spatial longitudinal EM wave—in agreement with the Whittaker decomposition of the source dipole potentials between any two separated perturbed charges in the wire.

The ready reaction of the resulting "quasi-longitudinal" EM wave with a distant wire antenna, results in the leading half (from the electrons) reacting with the distant Drude electrons, stripping off that leading half of the incoming quasi-longitudinal wave. The remaining half enters the nuclei, interacting with them and producing the well known Newtonian third law recoil. Electrodynamists accept the third law recoil but consider it as an effect without an EM cause—which is erroneous.

If that phase conjugate half of the wave does not interact with the nucleus—e.g., in multiwave interactions prior to the phase conjugate wave reaching the nucleus, as occurs in a pumped phase conjugate mirror—then the Newtonian third law recoil does not occur in that pumped mirror material because its electromagnetic causative interaction did not occur with the nuclei. The *results* of that phenomenon are experimentally verified and well-known.

Much of electrodynamic 136-year-old foundations fundamentals are either erroneous or flawed, and a serious reconstruction of the model from the ground up is warranted.

31. Thus the significance of the closed current loop circuit, ubiquitously utilized in all electrical power systems. Such a circuit utilizes half its collected Poynting energy to destroy the dipole, while using less than the other half to power the load. In short, it shuts off the giant negentropy and free 3-flow of energy, faster than it can freely collect and discharge energy to power the load. Such a circuit exhibits $COP < 1.0$ *a priori*. More than a dozen processes and mechanisms for approaching $COP > 1.0$ systems are given in M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al.*, "Classical Electrodynamics without the Lorentz Condition: Extracting Energy from the Vacuum," Physica Scripta, *ibid.*

32. T. D. Lee, *ibid.*, p. 187-188.

33. Unfortunately entropy is one of those concepts in physics for which there are several differing major views. For our work in energy from the vacuum, we take the very simple view that a negentropic process is like a negative resistor: It receives energy in a form unusable to us, transforms it, and outputs it into a form that is usable. We completely avoid the various notions of "information" and attempts to equate information and energy. We do point out, however, that a time-reversal process in one form or another is involved. In that sense, e.g., Newton's third law is a negentropic process and involves time-reversal. Its cause in electrodynamic interactions is the interaction with mass of that missing half of the EM wave in vacuum, unwittingly omitted by Maxwell.

34. H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-Point Energy," Phys. Rev. A, 40(9), Nov. 1, 1989, p. 4857-4862.

35. See M. Sachs, General Relativity and Matter, Reidel, 1982. In Sachs' great generalization of a combined general relativity and electrodynamics, we are also speaking of spacetime curvature

functions, and a unified field theory. See also M. Sachs, "Symmetry in Electrodynamics: From Special to General Relativity, Macro to Quantum Domains," in this series of volumes comprising Contemporary Optics and Electrodynamics.

36. E. T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372. The paper was published in 1904 and orally delivered in 1903.

37. As Whittaker showed in 1903, *ibid.*, the scalar potential is actually a harmonic set of bidirectional EM longitudinal EM wavepairs, where each pair is composed of a longitudinal EM wave and its phase conjugate replica. Only because classical electrodynamicists have erroneously defined the field and potential as their own reaction cross sections with a unit point static charge, has the "static" potential been misidentified as a *scalar* entity, which it is not. The energy diverged from a uniform potential, around a fixed static point unit charge, is actually the set of divergences around the intercepting charge of the energy flows of all those EM waves comprising the potential. The sum total of all these individual wave divergences indeed has a scalar magnitude, but the magnitude of the total energy divergence from the potential is not the potential itself nor its magnitude.

38. We point out the obvious: A "scalar" mass in 3-space actually has a time-vector since it moves through time continually, just to continue to exist. Further, it is a special form of energy (energy compressed by c^2) moving through time. Since we may choose any form of energy we wish by simple transduction, we may take it as compressed EM energy. So the mere continued existence of any mass proves conclusively that EM energy can and does ubiquitously flow through the time dimension. The combined continued existences of numerous masses proves conclusively that the flow of time can have a myriad internal electromagnetic energy flows. An equilibrium between (i) an inflow of EM energy to a transducer from the time dimension, and (ii) an outflow of EM energy in 3-space from the transducer, will be seen as a discrete excitation (potential energy) associated with the transducer. Hence the notion of the charge.

39. Myron W. Evans et. al., "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," J. New Energy, 4(3), Winter 1999, p. 76-78.

40. T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," Proc. INE Symposium, University of Utah, Aug. 14-15, 1998, published in J. New Energy, 3(2/3), 1998, p. 12-28.

41. E.g., see Lewis H. Ryder, Quantum Field Theory, Second Edition, Cambridge University Press, 1996, p. 147+.

42. W. A. Rodrigues, Jr. and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds $0 \leq v < \infty$ in nature," Found. Phys., 27(3), 1997, p. 435-508. A slightly corrected version is downloadable as hep-th/9606171 on the Los Alamos National Laboratory web site. It includes corrections to the published version.

43. W. A. Rodrigues, Jr. and J. Vaz Jr., "Subluminal and Superluminal Solutions in Vacuum of the Maxwell Equations and the Massless Dirac Equation," Adv. Appl. Clifford Algebras, Vol. 7(S), 1997, p. 457-466.

44. Since waves are made of photons comprised of both spatial energy and time-energy, then the wave propagation must transport not only spatial energy but time-energy. The "*spatial energy only*" EM transverse wave, comprised of oscillating E and H fields, cannot exist in spacetime prior to interaction with charged mass. Instead, what exists in spacetime prior to interaction must be Et and Ht dimensionally—in short, *impulse field* waves. After interaction (observation), the $\partial/\partial t$ operator has been applied, converting the impulse fields (the causes) into force fields (the effects). Present electrodynamics seems substantially confused between the *effect entity* side of the observation process and the *causal entity* side. The causative side (input) entities must occupy LLLT, while the effects side entities are restricted to LLL. No LLL entity can be a cause *a priori*.

45. D. K. Sen, Fields and/or Particles, Academic Press, London and New York, 1968, p. viii.

46. For example, the notion of charge is very much more complicated in gauge field theory than is usually assumed in more classical EM theory. In gauge-theoretic electrodynamics, the field is a curvature in spacetime and so is charge, so that the field intrinsically possesses charge. Further, being a curvature in *spacetime*, the charge is inextricably connected both to the time coordinate and the 3-space coordinates. *A priori*, field changes thus may involve changes in the very nature of charge as we observe it, and correspondingly charge changes may involve changes in the very nature of the field effects we observe. As a crude example, changes in the "time" portion of the charge-as-spacetime-curvature can readily affect changes in the "spatial energy" aspect. It is not too difficult then to visualize that an inflow of EM energy into the time portion of the charge-as-spacetime-curvature alters the time aspects—which in turn causes a corresponding canonical alteration of the 3-space aspects of the charge, producing an outflow of 3-space EM energy from the charge. Indeed, conservation of 4-energy would require such. A joint paper by Evans and Bearden is being prepared in this symmetry area, and a magnificent paper by Mendel Sachs, "Symmetry in Electrodynamics: From Special to General Relativity; Macro to Quantum Domains," is included in these volumes comprising Contemporary Optics and Electrodynamics.

47. Ibrahim Semiz, "Black hole as the ultimate energy source," Am. J. Phys., 63(2), Feb. 1995, p. 151.

48. The conventional notion of the negative 3-resistor is that 3-spatial energy is received in unusable form, converted to usable form, and output as usable 3-spatial energy flow. The negative 4-resistor receives energy from the time dimension (the imaginary plane), and not from 3-space. The output of the negative 4-resistor is real 3-spatial EM energy flow.

49. Newton's third law reaction in mechanics is usually "demonstrated" in elementary fashion by colliding balls. Note that time must be continuously interacting with the balls, in the mass/masstime/mass.... manner, if the balls are even to exist. Taking one ball to observe, the incoming ball's momentum is the "cause" and the resulting momentum acquired by the struck ball is the "effect", so to speak. Note that by "cause" and "effect" we are speaking of the input and output of the observation process itself. So there exists a back reaction from the change in the "struck" ball (the change in the effect side of observation) upon the "causal" side, altering the momentum of the incoming ball. The point is that, with respect to the observation process, cause interacts upon an intermediary to produce a change on the effect (output) side, and the effect acts

back through the intermediary to produce a change in the cause (input) side. Newton's third law is a description of what happens, but does not contain the mechanism producing what it describes. In mechanics and electrodynamics the Newtonian third law is assumed, while in general relativity its causal mechanism exists in the theory. Simply put, any change in the curvature of spacetime (the change in the causal input to the observation process) causes a change in the mass-energy (to the effects side or to the output of the observation process). Also, any change in the effects side of observation (any change in mass-energy) produces a simultaneous change in the causal (spacetime curvature) side.

50. Equilibrium thermodynamics is usually interpreted in terms of 3-spatial energy symmetry anyway, to begin with, and then one "loses some control" steadily and hence loses some ordering. Actually, the thermodynamics of systems far from equilibrium in 3-spatial energy flow, must always be in symmetry in energy 4-flow. "3-space disequilibrium" thermodynamics and 4-space equilibrium thermodynamics are postulated as different views of the same thing.

51. T. D. Lee, *ibid.*, p. 184. As Lee points out, the asymmetry between opposite signs of electric charge is called C violation, or charge conjugation violation, or sometimes particle-antiparticle asymmetry.

52. C. S. Wu, E. Ambler, R. W. Hayward, D. D. Hoppes and R. P. Hudson, Phys. Rev., Vol. 105, 1957, p. 1413.

53. T. D. Lee, *ibid.*

54. J. D. Jackson, "Surface charges on circuit wires and resistors play three roles," Am. J. Phys., 64(7), July 1996, p. 855-870. Here Jackson points out the decisive role played by the surface charges in the circuit. His earlier book, Classical Electrodynamics, *ibid.*, did not cover circuits except for some minor capacitive and inductive effects.

55. The Heaviside component represents a huge region of dynamic organization of the vacuum energy. There is no limit to such vacuum organization, as shown by the giant negentropy operation initiated by the broken 3-symmetry of the dipole.

56. But see D. Hilbert, Göttingen Nachrichten, Vol. 4, 1917, p. 21. It may surprise or even shock the reader that in general relativity there are really no *conservation of energy laws* as we know them, as was pointed out by Hilbert shortly after Einstein published his general theory. Hilbert wrote: "*I assert... that for the general theory of relativity, i.e., in the case of general invariance of the Hamiltonian function, energy equations... corresponding to the energy equations in orthogonally invariant theories do not exist at all. I could even take this circumstance as the characteristic feature of the general theory of relativity.*"

57. See A. A. Logunov and Yu. M. Loskutov in their "Nonuniqueness of the predictions of the general theory of relativity," Sov. J. Part. Nucl., 18(3), May-June 1987, p. 179. Commenting on Hilbert's remarkable assessment, Logunov and Loskutov made the following statement: "*Unfortunately, this remark of Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that in general relativity conservation laws for energy, momentum, and angular momentum are in principle impossible.*" It remains largely unrecognized to date. We hypothesize that we may recover the conservation

laws in 4-space if we extend them to include time-energy, time momentum, time potential, time force, and the giant negentropy induced by broken 3-symmetry.

58. In simple language, to see that reordering of vacuum energy (negentropy) does not require work: The organization of the vacuum represents a change to the "primal cause" or "primal energy." Organization of virtual state energy without the involvement of mass effects does not require observable work, because force is not involved and observable work ultimately involves the forcible translation of a resisting mass. So one can organize the "potential for doing work" without having to perform work in doing so. This is in fact what "regauging" or "gauge freedom" actually involves.

Any local region of the vacuum is after all an open system far from equilibrium with the surrounding rest of the vacuum. So that local region can exhibit (i) self-ordering, (ii) self-oscillation, self-spinning, etc.; and (iii) negentropy.

To use this principle in practice, the trick is to "tickle" the local vacuum into performing the exact type of reordering and self-structuring that one wishes. One does this by adroitly changing the *effect* side of the observation process, thereby altering the *causative* side as well—and changing the effect side precisely so that the desired set of changes occurs on the causal side. A discussion of this process is well-beyond the extent of this paper. In mechanics and electrodynamics the interaction of the effect back upon the cause has been erroneously omitted, and is included as Newton's third law reaction—an effect conventionally posited without a cause. But its cause is present in general relativity since curvature of spacetime (cause) acts on mass-energy (effect) to change it, and a change in mass-energy (effect) interacts back upon spacetime curvature (cause) to change it accordingly. That back-reaction—missing from classical electrodynamics—is the cause of the Newton third law reaction.

A logical mess exists in electrodynamics, where the effect has been rather universally confused with the cause. All illustrations continue to show the *E-H* planar (X-Y) wave in 3-space, which is an effect existing after the interaction with charge. What exists in spacetime before interaction must be *Et-Ht*, since observation itself is a $\partial/\partial t$ operator imposed upon the LLLT entity and producing an LLL entity—in this case, *E-H*. The integration of *E-H* along *z* does not add the missing time dimension, but merely represents a "3-spatial composite" of many frozen X-Y slices. It is thus the *spatial spread of the serial effects*. Consideration of the *Et-Ht* "impulse" or causal wave in spacetime prior to the interaction with matter, particularly in phase conjugation pairs, leads to many very interesting new EM phenomena not covered in this paper.

59. In the generator this current is unitary—consisting of charges having the same *m/q* ratio. In the battery this is not true, since the internal lead ion current between the plates has an *m/q* ratio hundreds of thousands of times that of the *m/q* ratio of the electrons in the current between the external surfaces of the plates and the external circuit. Accordingly, in the storage battery it is possible to adroitly dephase the massive ion currents in charge mode, from the much less massive external electron currents which can be in load-powering mode. The result is the Bedini overunity battery switching process, with a negative resistor created right on the surface of the plates between the two dephased currents. See reference 91 below.

60. David Linden, Editor in Chief, Handbook of Batteries, Second Edition, McGraw Hill, New York, 1995 gives the pertinent battery chemistry. Also see Colin A. Vincent and Bruno Scrosati,

Modern Batteries: An Introduction to Electrochemical Power Sources, Second Edition, Wiley, New York, 1997.

61. A unitary current is a current whose basic flowing charges all possess the same m/q ratio.

62. Mario Bunge, Foundations of Physics, Springer-Verlag, New York, 1967, p. 176.

63. T. W. Barrett, "Tesla's Nonlinear Oscillator Shuttle-Circuit (OSC) Theory," Annales de la Fondation Louis de Broglie, 16(1), 1991, p. 23-41. Several of Tesla's patented circuits exhibit this effect, as analyzed and rigorously shown by Barrett. However, this can only be seen when the circuits are examined in a higher topology electrodynamics. Barrett's analysis is in quaternionic electrodynamics.

64. Barrett later improved Tesla's mechanism for use in communication systems and obtained patents. See T. W. Barrett, "Active Signalling (sic) Systems," U.S. Patent No. 5,486,833, Jan. 23, 1996; "Oscillator-Shuttle-Circuit (OSC) Networks for Conditioning Energy in Higher-Order Symmetry Algebraic Topological Forms and RF Phase Conjugation," U.S. Patent No. 5,493,691, Feb. 20, 1996.

65. For the early discovery, see V. S. Letokhov, "Generation of light by a scattering medium with negative resonance absorption," Zh. Eksp. Teor. Fiz., Vol. 53, 1967, p. 1442; — Soviet Physics JETP, Vol. 26, 1968, p. 835-839; — "Laser Maxwell's Demon," Contemp. Phys., 36(4), 1995, p. 235-243. For initiating experiments with external excitation of the medium, see N. M. Lawandy *et al.*, "Laser action in strongly scattering media," Nature, 368(6470), Mar. 31, 1994, p. 436-438. See also D. S. Wiersma, M. P. van Albada, and A. Lagendijk, Nature, Vol. 373, 1995, p. 103. For new effects, see D. S. Wiersma and Ad Lagendijk, "Light diffusion with gain and random lasers," Phys. Rev. E, 54(4), 1996, p. 4256-4265; D. S. Wiersma, Meint. P. van Albada, Bart A. van Tiggelen, and Ad Lagendijk, "Experimental Evidence for Recurring Multiple Scattering Events of Light in Disordered Media," Phys. Rev. Lett., 74(21), 1995, p. 4193-4196; D. S. Wiersma, M. P. Van Albada, and A. Lagendijk, Phys. Rev. Lett., Vol. 75, 1995, p. 1739; D. S. Wiersma *et al.*, Nature, Vol. 390, 1997, p. 671-673; F. Sheffold *et al.*, Nature, Vol. 398, 1999, p. 206; J. Gomez Rivas *et al.*, Europhys. Lett., 48(1), 1999, p. 22-28; Gijs van Soest, Makoto Tomita, and Ad Lagendijk, "Amplifying volume in scattering media," Opt. Lett., 24(5), 1999, p. 306-308; A. Kirchner, K. Busch and C. M. Soukoulis, Phys. Rev. B, Vol. 57, 1998, p. 277. An excellent overview is in Diederik Wiersma and Ad Lagendijk, "Laser Action in Very White Paint," Phys. World, Jan. 1997, p. 33-37.

66. Shoukai Wang and D. D. L. Chung, "Apparent negative electrical resistance in carbon fiber composites," Composites, Part B, Vol. 30, 1999, p. 579-590. Chung *et al.* found that the carbon fiber composite can be produced as either a negative resistance or a positive resistance, by controlling the production process.

67. William B. Burford III and H. Grey Verner, Semiconductor Junctions and Devices, McGraw-Hill, New York, 1965, p. 281-291. The quote is from p. 281. We comment that point-contact transistors can easily be developed into true negative resistors enabling COP > 1.0 circuits.

68. William Jay Fogal, U.S. Patent No. 5,196,809, Mar. 23, 1993; — U.S. Patent No. 5,430,413, July 4, 1995; — "Charged barrier semiconductor technology and wave function bipolar designs," Proc. Internat. Symp. on New Energy, Denver, Colorado, May 12-15, 1994, p. 109-120.

69. M. W. Evans *et al.*, "O(3) Electrodynamics," 2000, submitted to Optik.
70. Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," J. Math. Phys., 26(4), April 1985, p. 861-863.
71. E.g., the anomalous quenching of the Hall effect generates a negative resistance effect. The Hall voltage across a narrow current-carrying channel in the presence of a perpendicular magnetic field B behaves anomalously around $B = 0$. The Hall resistance fluctuates about zero and is "quenched", then rises to a plateau at higher fields, then recovers and exhibits normal behavior beyond that region. Also see Paulo N. Correa and Alexandra N. Correa, "Electrochemical Transduction of Plasma Pulses," U.S. Patent No. 5,416,391, May 16, 1995; patent no 5,449,989, "Energy Conversion System," Sept. 12, 1995; and related patent no. 5,502,354, Mar. 26, 1996. See also patents by Mills and by Shoulders, cited elsewhere in this paper as references 116 and 75.
72. T. E. Bearden, "Formation and Use of Time-Reversal Zones, EM Wave Transduction, Time-Density (Scalar) EM Excitation and Decay, and Spacetime Curvature Engines to Alter Matter and Convert Time Into Energy," Invention Disclosure Document #446522, Oct. 26, 1998. While this paper is proprietary, some overall details have been given; see note 73 below.
73. T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," Explore, 8(6), 1998, p. 7-16; — "Toward a Practical Unified Field Theory and a Deep Experimental Example," presented at the INE Symposium, University of Utah, Aug. 14-15, 1998.
74. E.g., one might extend our notion of the isolated fermion (such as an electron) as a composite dipole. Each of the dipoles would thus be acted upon in a time-reversal zone, such that like virtual charges would now cluster around the observable fermion while the former unlike virtual charges would be repelled. Since the energy density of time is so great, sufficient energy is readily available for lifting whole fermions of like sign out of the Dirac Sea. If valid, this approach would indeed yield intense clusters of like observable charges, perhaps explainable in no other way. One thing is certain; Shoulders has experimentally shown that the clusters do indeed exist, in discharge situations strongly suggestive of intense phase conjugate actions and thus time reversal zone formations. The actual mechanism responsible for these demonstrated clusters is as yet purely speculative.
75. Kenneth R. Shoulders, "Energy Conversion Using High Charge Density," U.S. Patent # 5,018,180, May 21, 1991. See also Shoulders' patents 5,054,046 (1991); 5,054,047 (1991); 5,123,039 (1992), and 5,148,461 (1992). See also Ken Shoulders and Steve Shoulders, "Observations on the Role of Charge Clusters in Nuclear Cluster Reactions," J. New Energy, 1(3), Fall 1996, p. 111-121. A proposed theory is given by Shang-Xian Jin and Hal Fox, "Characteristics of High-Density Charge Clusters: A Theoretical Model," J. New Energy, 1(4), Winter 1996, p. 5-20.
76. We note that Sachs' epochal unification of general relativity and electrodynamics (reference 35 above) does cover the quarks and gluons causally, as well as fermions and bosons. We point out that curvature of spacetime involves both positive and negative curvatures—with time

involve as well as space. Certainly the theory is compatible with the consideration of time as a special form of EM energy.

77. Melvin H. Miles and Benjamin F. Bush, "Radiation measurements at China Lake: Real or Artifacts?", Proc. ICCF-7(Internat. Conf. on Cold Fusion—7, Vancouver, BC, Canada, Apr. 1998, p. 101.

78. Teruo Kawai, "Motive Power Generating Device," U.S. Patent No. 5,436,518, Jul. 25, 1995.

79. For details, see T. E. Bearden, "The Master Principle of EM Overunity and the Japanese Overunity Engines," Infinite Energy, 1(5&6), Nov. 1995-Feb. 1996, p. 38-55.

80. E.g., J. C. Verite, "Calculation of multivalued potentials in exterior regions," IEEE Trans. on Magn., Vol. MAG-23(3), May 1987, p. 1881-1887.

81. P.R. Kotiuga, "On making cuts for magnetic scalar potentials in multiply connected regions." J. Appl. Phys., 61(8), 1987, p. 3916-3918.

82. Yongzhong Huo, "A classification of thermodynamical potentials for two-variable transition systems," Meccanica [Netherlands], 30(5), Oct. 1995, p. 475-494.

83. T. E. Bearden, "Use of Regauging and Multivalued Potentials to Achieve Overunity EM Engines: Concepts and Specific Engine Examples," Proc. Internat. Sci. Conf. "New Ideas in Natural Sciences," St. Petersburg, Russia, June 17-22, 1996; Part I: Problems of Modern Physics, 1996, p. 277-297.

84. Martin Diestelhorst; Horst Beige, and Ralph-Peter Kapsch, "Parametric small signal amplification near pitchfork bifurcations," Ferroelectrics, Vol. 172, 1995, p. 419-423 detail many of the pertinent phenomena. In particular, multivalued conjugate reflectivities may become involved in some ferroelectric capacitors; see S. Itoh *et al.*, "Simulational and experimental studies on anomalous reflectivity of phase conjugate wave," Ferroelectrics, Vol. 170, 1995, p. 209-217.

85. Romano M. DeSantis *et al.*, "On the Analysis of Feedback Systems With a Multipower Open Loop Chain," Oct. 1973, AD 773188, available through the U.S. National Technical Information System.

86. This information was obtained in private conversations with engineers directly involved with the project and involved with the frequency converter both before and after its modification. The converter exhibited COP = 1.05 to 1.15, prior to modification to prevent it.

87. J. H. Andreatta, "High Power Switching Amplifier Wherein Energy is Transferred to a Tuned Circuit During Both Half Cycles," U.S. Patent No. 3,239,771, Mar. 8, 1966; Tom L. Dennis, Jr., "Highly Efficient Semiconductor Switching Amplifier," U.S. Patent No. 3,239,772, Mar. 8, 1966; Heber J. Morrison, "Square Wave Driven Power Amplifier," U.S. Patent No. 3,815,030, June 4, 1974.

88. Howard R. Johnson, "Permanent Magnet Motor." U.S. Patent No. 4,151,431, Apr. 24, 1979. See also Johnson's U.S. Patents 4,877,983, Oct. 31, 1989 and 5,402,021, Mar. 28, 1995.

89. For an exposition of exchange forces and exchange energy, see B. D. Cullity, Introduction to Magnetic Materials, Addison-Wesley, Reading, MA, 1972; A. G. Gurevich and G. A. Melkov,

Magnetization Oscillations and Waves, CRC Press, 1996; Victor S. L'vov, Wave Turbulence Under Parametric Excitation: Applications to Magnets, Springer-Verlag, Berlin, 1994. See also V. S. L'vov and L. A. Prozorova, "Spin Waves Above the Threshold of Parametric Excitation," in A. S. Borovik-Romanov and S. K. Sinha, Eds., Spin Waves and Magnetic Excitations, North-Holland, Amsterdam, 1988.

90. For typical objections, see Stanley W. Angrist, "Perpetual Motion Machines," Sci. Am., Vol. 218, Jan. 1968, p. 114-122; L. Brillouin, "Life, thermodynamics, and cybernetics," Am. Sci. Vol. 37, 1949, p. 554-568; Max Jammer, "Entropy," in Dictionary of the History of Ideas, vol. 2, edited by P. Wiener, Scribner's, New York, 1973 (section on Maxwell's Demon); Harvey S. Leff, "Available work from a finite source and sink: How effective is a Maxwell's demon?," Am. J. Phys., 55(8), Aug. 1987, p. 701-705. Harvey S. Leff, "Resource Letter MD-1: Maxwell's Demon," Am. J. Phys., 58(3), Mar. 1990, p. 201-209 gives many references for the 120 year debate.

Most extant arguments against Maxwell's Demon invoke ad hoc assumptions requiring either classical thermodynamics, or information "costs", or both. There is nothing in gauge freedom which requires expenditure of energy as work, and there is nothing which prohibits it from being invoked deterministically at will and without cost. Simply moving energy from one place to another is not work. If we can do this sufficiently accurately and cheaply in the real world, then we can permissibly build a *Maxwell's Demon* in the real world. The regauging process (change of potential) is actually a change in the local vacuum potential, so that in the regauged systems *a priori* one creates an open system not in equilibrium with its environment—the active environment. Perpetual motion critics already recognize that one, but call it "fictitious perpetual motion". This "fictitious perpetual motion" energy production from a simple dipole, has been going for some 15 billion years in those extant dipoles formed in the original creation of the universe. That is quite a persistent Maxwell's Demon indeed!

91. See T. E. Bearden, "Bedini's Method For Forming Negative Resistors In Batteries," Proc. IC-2000, St. Petersburg, Russia, July 2000 (in press).

92. Negative resistor candidates for such a shunt may arise from point-contact transistors, from the Fogal transistor, and from the work of Chung *et al.* previously referenced.

93. Ilya Prigogine, From Being to Becoming: Time and Complexity in the Physical Sciences, W.H. Freeman and Company, San Francisco, 1980. In 1977, Russian-born Belgian chemist Ilya Prigogine received the Nobel Prize for chemistry for contributions to nonequilibrium thermodynamics, especially the theory of dissipative structures.

94. E.g., see L. Brillouin, "Life, thermodynamics, and cybernetics," Am. Sci. Vol. 37, 1949, p. 554-568; G. Nicolis and I. Prigogine, Exploring Complexity, Piper, Munich, 1987.

95. Malcolm Longair, "The New Astrophysics," in Paul Davies, Ed., The New Physics, Cambridge University Press, New York, 1989—specifically "Dark matter in galaxies and clusters of galaxies," p. 163.

96. Lawrence M. Krauss, Quintessence: The Mystery of Missing Matter in the Universe, Revised Edition, Basic Books, Perseus, New York, 2000 gives a thoroughly updated account of the entire dark matter problem.

97. Here we are specifically considering the "charge" as a set of composite dipoles, since there really is no such thing as an "isolated charge" anyway.

98. H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-Point Energy," Phys. Rev. A, 40(9), Nov. 1, 1989, p. 4857-4862.

99. In addition to Whittaker's sum set of waves comprising the "scalar" potential, Ziolkowski added the product set. See Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," J. Math. Phys., 26(4), April 1985, p. 861-863. See also I. M. Besieris, A. M. Shaarawi, and R. W. Ziolkowski, "A bidirectional travelling plane wave representation of exact solutions of the scalar wave equation," Journal of Mathematical Physics, 30(6), 1989, p. 1254-1269; Rod Donnelly and Richard Ziolkowski, "A Method for constructing solutions of homogeneous partial differential equation: localized waves," Proceedings of the Royal Society of London A, Vol. 437, 1992, p. 673-692.

100. An overview of much of superpotential theory is given by Melba Phillips, "Classical Electrodynamics," in Principles of Electrodynamics and Relativity, Vol. IV of Encyclopedia of Physics, edited by S. Flugge, Springer-Verlag, 1962.

101. One might appropriate the Russian name "information content of the field" for this more fundamental interior EM, from which all other EM is made. The "infolded" electrodynamics is largely ignored in the Western scientific community, which heretofore has erroneously equated "information content of the field" as mere spectral analysis. In so doing, it has dismissed an engineerable unified field theory of great power. The Sachs combined GR and EM theory allows this information content of the field to be rigorously dealt with. Evans' melding of O(3) electrodynamics into a special subset of the Sachs unified field theory allows direct engineering to be developed.

102. An even more primary vacuum (spacetime curvature) electrodynamics, not limited by the Lorentz condition, is given by Mendel Sachs, "Symmetry in Electrodynamics", in the present 3-volume set.

103. The cellular regeneration system, for example, uses this fact plus an extension of phase conjugate mirror theory to heal damaged cells and restore them back to normal. Weak longitudinal EM waves are used to "pump" the damaged cell and all its internal components at every level. The cellular nonlinearities add a coupled phase conjugate and extend the pumping to include pumping in the time domain, since the coupled phase conjugate, per Whittaker 1903, is incoming from the time dimension (the complex plane). The resident "engine" for that damaged cell consists of the engine for a normal cell and a "delta" engine representing the exact damage. The resident engine serves as the input or "signal wave" analogue (in standard NLO pumping). Every part of the pumped cell is highly nonlinear and acts as a pumped phase conjugate mirror to any and all time-domain frequencies. An amplified antiengine precisely specific for that cellular disease or damage or genetic change (as in AIDS) is formed in the pumped cell and every part of it. The action of the antiengine produces a time-reversed propagation of the cell and all its parts in the time domain rather than the spatial domain. The cell and its parts "dedifferentiates" (biology term) or "time-reverses" (physics term) back to a previous physical state, healing the cell. The body does this within its capabilities, and that is the long-sought mechanism for healing. The Prioré effort in France demonstrated an amplification

of this exact action in cells, in thousands of successful lab animal tests in the 1960s and early 1970s, but no one could understand the mechanism. At the time, phase conjugate optics as we know it today had not been developed—much less its extension into NLO pumping in the time dimension. Nonetheless, revolutionary cures of terminal tumors, infectious trypanosomiasis, and atherosclerosis were rigorously demonstrated the scientists working with the Prioré method. Suppressed immune systems were also restored if the treated animal was sufficiently mature to have possessed a developed immune system at the time of its suppression. The immune system of a very young animal with an immature immune system at the time of suppression, could only be restored back to the immature state it had at the time prior to immune suppression. This strongly exhibited the direct time-reversal effect that was occurring.

The work was suppressed when the French government changed in the early 1970s. The revolutionary results of the Prioré experiments was presented to the assembled French Academy by Robert Courier, head of the biology section of the Academy and also its *Secrétaire Perpetuel*. See R. Courier, "Exposé par M. le Professeur R. Courier, Secrétaire Perpetuel de L'Académie des Sciences fait au cours d'une réunion à L'Institut sur les effets de la Machine de M. A. Prioré le 26 Avril 1977" [Presentation by Professor R. Courier, Perpetual Secretary of the Academy of Sciences, made at the meeting of the Academy on the effects of the machine of M. A. Prioré, 26 April 1977]. Many of the results of the lab animal tests are contained in Prioré's doctoral thesis, A. Prioré, Guérison de la Trypanosomiase Expérimentale Aiguë et Chronique par L'action Combinée de Champs Magnétiques et D'Ondes Electromagnétiques Modulés. [Healing of intense and chronic experimental trypanosomiasis by the combined action of magnetic fields and modulated electromagnetic waves], thesis submitted in candidacy for the doctoral degree, University of Bordeaux, 1973. The thesis was then rejected by the university during the intense suppression of the project after the government changed. The original thesis is in the files of the present author. Eleven years later, after Prioré was dead, the university did finally approve a doctoral thesis on the subject: see Eric Perisse, Effets des Ondes Electromagnétiques et des Champs Magnétiques sur le Cancer et la Trypanosomiase Experimentale [Effects of Electromagnetic Waves and Magnetic Fields on Cancer and Experimental Trypanosomiasis], Doctoral thesis, University of Bordeaux No. 83, March 16, 1984. Historical popular coverage of the entire affair is given by Jean-Michel Graille, Dossier Prioré: A New Pasteur Affair, De Noel, Paris, 1984 [in French].

104. U.S. scientists who examined the work and the scientific reports in the French literature, also could not comprehend the mechanism. E.g., J. B. Bateman, A Biologically Active Combination of Modulated Magnetic and Microwave Fields: The Prioré Machine, Office of Naval Research, London, Report R-5-78, Aug. 16, 1978 reports on the Prioré device, its use in treating and curing cancer and leukemia, including terminal cases in numerous laboratory animals. Bateman is not particularly sympathetic, but realizes that somehow, something extraordinary has been uncovered. He comes very close when he states that "*The possibility that some hitherto unrecognized feature of the radiation from a rotating plasma may be responsible for the Prioré effects should not be dismissed out of hand...*" That "unrecognized feature" is in fact the emission of longitudinal EM waves, which were impressed inside ordinary but very strong pulsed magnetic fields. The magnetic fields guaranteed the interaction of all the cells of the animal's body, and all the parts of the cells down to and including the atomic nuclei in the atoms. In this way the transported LWs pumped every part of every cell in the treated animal's

body. Normal cells just got a little younger. The damaged and diseased cells were time-reversed back to an earlier, healthy state. The immune system's ability to recognize the pathogen was also restored, so that the revitalized immune system destroyed the pathogen. A cancerous cell was just time-reversed back into a normal cell. We strongly point out the implications for such a methodology, to the treatment and prompt cure of AIDS even in its early stages, metastasized cancer and leukemia, etc. In principle, any detrimental condition of the body is marked by the presence in that body's resident engine of a specific engine delta for that condition. And an amplified antiengine, acting upon that body at all levels, is in theory capable of directly reversing the condition. We also suggest the possibility of rejuvenation of the aged.

105. At least two nations appear to have weapons programs in this area, but that is beyond the scope of this paper. Nevertheless, a good theoretical basis for such systems can be taken from the Sachs unified field theory approach presented by Sachs in this series and other places.

106. T. D. Lee, 1981, *ibid.*, p. 380-381. On p. 383 Lee points out that the microstructure of the scalar vacuum field (i.e., of vacuum charge and polarization structuring) is not utilized. Lee indicates the possibility of using vacuum engineering in "Chapter 25: Outlook: Possibility of Vacuum Engineering," *ibid.*, p. 824-828.

107. E.g., see M. W. Evans *et al.*, AIAS group paper, "A General Theory of Non-Abelian Electrodynamics," Found. Phys. Lett., 12(3), June 1999, p. 251-265. See particularly M. W. Evans, "O(3) Electrodynamics," a review of 250 pages in this present series of volumes.

108. M. W. Evans *et al.*, AIAS group paper, "Inconsistencies of the U(1) Theory of Electrodynamics: Stress Energy Momentum Tensor," Found. Phys. Lett., 12(2), Apr. 1999, p. 187-192.

109. M. W. Evans, AIAS correspondence.

110. M. W. Evans *et al.*, "Vacuum Energy Flow and Poynting Theorem from Topology and Gauge Theory," (submitted).

111. T. W. Barrett and D. M. Grimes, [Eds.], Advanced Electromagnetism: Foundations, Theory, & Applications, World Scientific, Singapore, 1995. See particularly T. W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in A. Lakhtakia, (ed.), Essays on the Formal Aspects of Electromagnetic Theory, World Scientific Publishing, River Edge, NJ, 1993, p. 6-86.

112. Patrick Cornille, "Inhomogeneous waves and Maxwell's equations," Chapter 4 in Essays on the Formal Aspects of Electromagnetic Theory, Ed. A. Lakhtakia, World Scientific, 1993, p. 138-182. Quoting, p. 168: "*The calculation concerning the electromagnetic conservation laws given in most textbooks, for example in Jackson [Classical Electromagnetics, 2nd Edition, John Wiley, New York, 1975, p. 239] is not correct, as noted by Selak [Astrophys. Space Sci., Vol. 158, 1989, p. 159] et al., because it is not permissible to substitute a convective time derivative for an Eulerian time derivative even when we have a constant volume of integration.*"

113. E.g., Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," J. Math. Phys., 26(4), April 1985, p. 861-863;—"Localized Transmission of Electromagnetic Energy," Phys. Rev. A, Vol. 39, 1989, p. 2005,—and Michael K. Tippet,

"Collective effect in an electron plasma system catalyzed by a localized electromagnetic wave," Phys. Rev. A, 43(6), Mar. 15, 1991, p. 3066-3072.

114. Daniel C. Cole and Harold E. Puthoff, "Extracting Energy and Heat from the Vacuum," Phys. Rev. E, 48(2), Aug. 1993, p. 1562-1565.

115. H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-Point Energy," Phys. Rev. A, 40(9), Nov. 1, 1989, p. 4857-4862.

116. Randell Lee Mills *et al.*, "Lower-Energy Hydrogen Methods and Structures," U.S. Patent 6,024,935, Feb. 15, 2000 with 499 claims recognized. Randell Lee Mills, "Energy/Matter Conversion Methods and Structures," Australian Patent No. 668678, Nov. 20, 1991. See also Art Rosenblum, "Randall L. Mills—New Energy and the Cosmic Hydrino Sea," Infinite Energy, 3(17), Dec. 1997-Jan. 1998, p. 21-34.; Eugene Mallove, "Dr. Randall Mills and the power of BlackLight," Infinite Energy, 2(12), Jan.-Feb. 1997, p. 21, 35, 41. Due to outside pressure, the U.S. Patent and Trademark Office abruptly canceled a patent being awarded to Mills, and stated that it is reviewing his granted patents again. Mills' corporation has sued the U.S. Patent and Trademark Office for such unparalleled discriminatory actions.

117. James Patterson, "System for Electrolysis of Liquid Electrolyte," U.S. Patent No. 5,372,688, Dec. 13, 1994. See also U.S. Patent Nos. 5,318,675; 5,607,563; 5,036,031; and 4,943,355.

118. Nabil M. Lawandy, "Optical Gain Medium Having Doped Nanocrystals of Semiconductors and Also Optical Scatterers," U.S. Patent No. 5,434,878, July 18, 1995. Lawandy's epochal experiment is described in Nabil M. Lawandy, *et al.*, "Laser action in strongly scattering media," Nature, 368(6470), Mar. 31, 1994, p. 436-438.

119. Franklin B. Mead and Jack Nachamkin, "System for Converting Electromagnetic Radiation Energy to Electrical Energy," U.S. Patent No. 5,590,031, Dec. 31, 1996.

120. Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," Proc. 26th Intersoc. Energy Conversion Eng. Conf. (IECEC '91), Boston, Massachusetts, 1991, p. 370-375. Sweet's solid state vacuum triode used specially conditioned barium ferrite magnetics whose H-field was in self-oscillation. The device produced a $COP = 1.2 \times 10^6$, outputting some 500 watts for an input of only 33 milliwatts. Sweet never revealed his complete ELF self-oscillation conditioning procedure for the magnets. However, in ferromagnets, self-oscillations of (i) magnetization, (ii) spin-waves above spin-wave instability threshold, and (iii) magnons are known at frequencies from about 1 kHz to 1 MHz. For an entry into this technical area with detailed reference citations, see A.G. Gurevich and G. A. Melkov, Magnetization Oscillations and Waves, CRC Press, 1996, p. 279. See particularly Victor S. L'vov, Wave Turbulence Under Parametric Excitation: Applications to Magnets, Springer-Verlag, Berlin, 1994, p. 214-218, 226-234, 281-289.

121. Fogal has also invented and demonstrated to several major communications corporations a process and mechanism for "infolding" EM signals as longitudinal EM waves inside DC potentials, so that essentially unlimited bandwidth can be transmitted through the "interior" of a DC potential. He has also invented the process of "outfolding" the signals again, into an ordinary video signal. Presently a patent has been filed on the process by Fogal, and this

revolutionary new communication process will be heading for the commercial market. By the time this paper is published, the new Fogal communication process should be going into production. As of this writing, it also appears that, being longitudinal EM waves and thus able to propagate "inside" the intense scalar potential, the signals can be transmitted at superluminal speed, often nearly instantly.

122. These include Nikola Tesla, whose patented circuits exhibit energy shuttling (regauging at will) in a fashion similar to a negative resistor, if the circuits are analyzed in an algebra of higher topology than tensor algebra (see Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," *ibid.*).

123. This also includes T. H. Moray, whose work with special multi-contact transistors preceded that of the classical discoverers of the transistor. Moray exhibited a self-powering 50 kW device weighing only 55 pounds, and extracting its energy directly from the vacuum, prior to WW II. See T. H. Moray, The Sea of Energy, 5th Edn., Salt Lake City, 1978 (Foreword by T. E. Bearden). He also sintered his semiconductors while under pressure in giant presses, reminiscent of the production methods found by Chung to allow production of a true negative resistor. A related medical equipment patent is Thomas H. Moray, "Electrotherapeutic Apparatus," U.S. Patent No. 2,460,707, Feb. 1, 1949. Some details of the "Moray valve" may be seen in that patent. There does not appear to be an adequate technical discussion of the Moray device in the literature, since all such discussions have utilized ordinary U(1) electrodynamics at essentially sophomore or junior level.

124. Indeed, classical U(1) electrodynamics is modeled as a field theory upon a flat spacetime. In the more rigorous and general Sachs-Evans unified field approach, this is falsified. In that more fundamental model, EM waves and fields can only propagate through curved spacetime.

125. For that matter, the charged capacitor and the magnet are dipoles. Individually, each extracts and outputs enormous energy flow from the local vacuum, continuously pouring out the extracted energy toward the ends of the universe and thus establishing its fields and potentials by altering the entire ambient vacuum potential of the universe.

126. E.g., see L Mandelstam. [L. I. Mendel'shtam], N. Papalexi, A. Andronov, S. Chaikin and A. Witt, "Report on Recent Research on Nonlinear Oscillations," Translation of "Expose Des Recherches Recentes Sur Les Oscillations Non Lineaires," Tech. Phys. USSR, Leningrad, Vol. 2, 1935, p. 81-134. NASA Translation Doc. TTF-12,678, Nov. 1969. In the 1930s Russian scientists at the University of Moscow and supporting agencies developed and tested parametric oscillator generators exhibiting COP > 1.0. The theory, results, pictures, etc. are in both the Russian and French literature, with many references cited in this particular translation. Apparently the work was never resurrected after WW II. Other pertinent references are L. I. Mandelstam and N. D. Papaleksi., "On the parametric excitation of electric oscillations," Zhurnal Tekhnicheskoy Fiziki, 4(1), 1934, p. 5-29; — "On resonance phenomena with frequency distribution," Z.f. Phys., No. 72, 1931, p. 223; — "Concerning asynchronous excitation of oscillations," Zhurnal Tekhnicheskoi Fiziki, 4(1), 1934, p. TBD; — "Concerning asynchronous excitation of oscillations," Zhurnal Tekhnicheskoi Fiziki, 4(1), 1934; — "Concerning nonstationary processes occurring in the case of resonance phenomena of the second class," Zhurnal Tekhnicheskoi Fiziki, 4(1), 1934. See also A. Andronov, "The limiting cycles of

Poincare and the theory of self-maintained oscillations,” Comptes-Rendus, Vol. 189, 1929, p. 559. See also A. Andronov and A. Witt, , “On the mathematical theory of self-excitations,” Comptes-Rendus, Vol. 190, 1930, p. 256; — “On the mathematical theory of self-excitation systems with two degrees of freedom,” Zhurnal Tekhnicheskioi Fiziki, 4(1), 1934; — “Discontinuous periodic movements and theory of multivibrators of Abraham and Bloch,” Bull. De l’Acad. Ed Sc. De l’URSS, vol. 189, 1930. See also S. Chaikin, “Continuous and ‘discontinuous’ oscillations,” Zhurnal Prikladnoi Fiziki, Vol. 7, 1930, p. 6; — and A. Witt, “Drift in a case of small amplitudes,” Zhurnal Teknicheskoi Fiziki, 1(5), 1931, p. 428; — and N. Kaidanowski, “Mechanical relaxation oscillations,” Zhurnal Teknicheskoi Fiziki, Vol. 3, 1933, p. 1.

127. E.g., see Gabriel Kron, "Numerical solution of ordinary and partial differential equations by means of equivalent circuits," J. Appl. Phys., Vol. 16, Mar. 1945a, p. 173. A true negative resistor appears to have been developed by the renowned Gabriel Kron, who was never permitted to reveal its construction or specifically reveal its development. For an oblique statement of Kron's negative resistor success, we quote: "*When only positive and negative real numbers exist, it is customary to replace a positive resistance by an inductance and a negative resistance by a capacitor (since none or only a few negative resistances exist on practical network analyzers).*" Apparently Kron was required to insert the words "none or" in that statement. See also Gabriel Kron, “Electric circuit models of the Schrödinger equation,” Phys. Rev. 67(1-2), Jan. 1 and 15, 1945, p. 39. We quote: "*Although negative resistances are available for use with a network analyzer,...*". Here the introductory clause states in rather certain terms that negative resistors were available for use on the network analyzer, and Kron slipped this one through the censors. It may be of interest that Kron was a mentor of Sweet, who was his protégé. Sweet worked for the same company, but not on the Network Analyzer project. However, he almost certainly knew the secret of Kron's "open path" discovery and the secret of Kron's negative resistor.

128. It is and has been, however, strongly suppressed by both the scientific community and powerful world financial entities. This latter suppression actions have included assassination, entrapment, harassment, threats to one's family, kidnapping, mysterious disappearance of the inventor and his family, giving an inventor the "offer he cannot refuse," etc. The present author has had his share of experiences from these nefarious operations. The hope, however, is that the scientific community will at long last revise its view of how circuits and loads are powered, realize that all electrical power systems have always utilized electrical energy from the vacuum via the dipole's broken symmetry, and then get on with rapidly solving the present electrical energy crisis.