EM ENERGY FROM THE VACUUM: TEN QUESTIONS WITH EXTENDED ANSWERS

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1. How can we extract usable EM energy from the vacuum, anytime, any place in the universe, and in any amount desired?

It's easy! And yes, it is pure magic in a sense, but it is a also a very rigorous kind of physics. It's a pity that, since Heaviside discovered it in the 1880s, electrodynamicists have largely ignored and arbitrarily discarded it from the energy flow theory for more than a century. They have ignored the broken symmetry of a dipole—proven in particle physics for nearly a half century—in its vacuum flux exchange.

The classical electrodynamics model that is used to design and build electrical power systems does not even include the vacuum interaction itself, much less a *broken symmetry* in the interaction between the active vacuum and the dipole.

By implicitly assuming (erroneously) an inert vacuum in their model, in effect our energy scientists and engineers assume a system that is in equilibrium with its external environment. The Maxwell-Heaviside equations themselves make no such assumption, and prescribe both open dissipative systems having COP>1.0, and equilibrium systems having COP<1.0. After the arbitrary imposition of the Lorenz/Lorentz symmetrical regauging, however, the *reduced* equation subset discards the open dissipative Maxwellian systems and retains only those in equilibrium. Therefore the arbitrarily limited subclass of *selected* Maxwellian systems must obey classical equilibrium thermodynamics with its infamous second law.

On the other hand, if the vacuum interaction with the power system and a broken symmetry in that interaction are included, then the Lorentz condition is broken. One again has a Maxwellian model which includes open dissipative Maxwellian systems having COP>1.0. Rigorously such a system is not required to obey classical equilibrium thermodynamics unless it itself voluntarily forces the Lorentz symmetrical regauging condition. If the system does not self-invoke that Lorentz condition in its use of its collected energy, then *the thermodynamics of systems far from equilibrium in their active environment* rigorously applies. As you know, Prigogine received a Nobel Prize for his contributions to that open system thermodynamics.

Let us demonstrate by simple logic that an EM system having COP>1.0 is permissible. For example, see Robert Bruce Lindsay and Henry Margenau., Foundations of Physics, Dover, New York, 1963, p. 217. We know that the entropy of non-equilibrium conditions cannot be computed, and the entropy of a system not in equilibrium must be less than the entropy of the same system in equilibrium. Thus the energy of an open system not in equilibrium must always be greater than the energy of the same system when it is closed and in equilibrium.

A Maxwellian system obeying electrodynamics with the Lorentz condition applied, is a system in equilibrium. If the system is lossless, its COP = 1.0. Hence the same lossless system in disequilibrium with its active environment can exhibit COP>1.0, since it has additional energy *a priori*.

Although that is a simple set of statements, the statements are quite rigorous. There is no law of nature that prohibits an open EM system in disequilibrium with the active vacuum. Hence there is no law of nature that prohibits and EM system with COP>1.0.

So we are perfectly rigorous in discussing open dissipative EM systems, not in equilibrium in their active vacuum exchange, exhibiting COP>1.0. These are permitted by the Maxwell-Heaviside equations, by the laws of physics, by the laws of thermodynamics (disequilibrium case), and by the conservation of energy law.

Let us examine EM systems with a known, proven broken symmetry in their energetic vacuum exchange.

Every EM system contains dipoles, In particle physics, every dipole is already proven to be just such a broken 3-symmetry in the energetic exchange between the active vacuum and the dipole or dipolarity.

Such a system in disequilibrium in its active environment is *permitted* to exhibit five novel functions: It can (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator inputs (the excess energy is received from the active environment, in this case the active vacuum, (4) power itself and its load simultaneously (all the energy is received from the active environment, in this case the active vacuum, and (5) exhibit negentropy.

None of our present electrical power systems demonstrate these five functions overall, even though they all contain broken symmetries (dipoles). It follows that their system design must include something which excludes such open dissipative system performance. The design does unwittingly exclude such, as we shall see.

2. Okay, suppose we model the vacuum interaction with our electrical power system and a broken symmetry in that exchange. How does that provide those five functions for an open dissipative system far from equilibrium in its exchange with its active environment?

In particle physics—but not yet even added to the EM model—every dipole is already well-known to be a broken symmetry in its virtual particle energy exchange with the active vacuum. The *definition* of broken symmetry means that at least a fraction of the received nonobservable virtual energy from the vacuum is converted into observable energy form and re-emitted in that form. That is a *negative resistor* action—receiving energy in unusable form from the environment and outputting usable energy in the circuit.

Hence the dipole (and any dipolarity such as a scalar potential) is such a *negative resistor*—as is any isolated charge when its clustering virtual charges of opposite sign are included; see the attached paper. The dipole receives EM energy from its active vacuum environment in unusable (virtual) form and outputs it in observable and usable form.

So every dipole *a priori* already performs those famous five functions (see the attached paper) we listed at the end of reply number 1 above. Let us discuss each one of those functions momentarily:

In 1903 Whittaker detailed the exact pattern of the reordering dynamics (function 1), though no one thought of it in that fashion. Function 2 is obvious, since the charges spin continuously and we do not have to separately "power" them. Function 4 is also obvious, since the "load" (in this case the real EM energy output) and the system power (the continuous spinning of the charges) continues freely and indefinitely. Function 3 is obvious, since it is merely a subset of Function 4. And function 5 is performed, because a fraction of the vacuum energy is reorganized into the Whittaker deterministic dynamic structuring, and this reordering spreads from the dipole, once it is formed, at lightspeed in all directions. The reordering and its spreading outwards continues so long as the dipole (i.e., the broken 3-symmetry) remains intact.

3. Well, how can I mathematically prove that all this occurs from merely making a dipole? Particle physics and the virtual state are one thing, but real power on the power line would seem to be quite another thing.

The dipole extracts and receives vacuum energy in *unusable* macroscopic form and ordering, and outputs it in *usable* macroscopic form, with perfect ordering and without the usual quantum mechanic randomness and statistics. This can be understood by applying a long-ignored 1903 paper by the well-known physicist E.T. Whittaker (cited). We just apply Whittaker's decomposition to the scalar potential existing between the ends of the source dipole formed between the terminals of the generator or battery.

When we do, a startling thing emerges. Because the dipole is a broken 3-symmetry, the energy flow symmetry we normally insist upon (i.e., the conservation of energy in 3-space) relaxes to 4-symmetry energy flow (which is conservation of energy in space*time*, not necessarily in *space*. Energy is conserved—but changed in form—between *input energy flow from the time domain (complex plane)* and *output energy flow in 3-space*. We no longer have to conserve energy in 3-space *a priori*, but we only have to conserve it in 4-space. Conservation of energy still applies, but the dipole dramatically and permissibly violates EM energy *3-flow* symmetry.

As Whittaker decomposition shows, the dipolarity will receive (and absorb) a steady harmonic set of longitudinal EM wave energy from the imaginary plane (in the time domain). This received energy

corresponds to what the electrical engineer calls "reactive power". Thus the dipole freely receives a steady input of reactive power from the seething vacuum, because of the dipole's broken 3-symmetry in its exchange with the vacuum.

After absorbing the incoming energy from the vacuum as _reactive power_ , the second half of Whittaker's decomposition shows that the excited charges in the dipole re-emit that energy as real EM energy flow in 3-space, in all directions. We explain that process (due to the 720 degree spin of the charges forming the ends of the dipole) in the attached paper. Briefly, a charge spins 360 degrees in the complex domain, during which time it absorbs the incoming reactive EM power. Then the excited charge spins 360 degrees in real space, where its excitation energy is continuously released in all directions.

Further, there is a rigorous, deterministic, total correlation between the incoming reactive EM energy flow continuously absorbed by the dipole from the vacuum from the complex plane, and the outgoing real EM energy flow continuously emitted by the dipole charges into 3-space.

So the formation of a dipole initiates and launches a _spreading dynamic giant negentropic reordering of a significant fraction of the surrounding vacuum's energy_. This negentropic reordering of vacuum energy continues and the reordered volume spreads from the dipole in 3-space in all directions at the speed of light. In matter present from the beginning of the universe, its dipoles (and charges) have been pouring out enormous energy from the vacuum via this process for some 15 billion years. So long as the dipole remains intact, the reordering continues, the reactive energy input to the dipole from the complex plane continues, and the output energy flow from the dipole in 3-space continues.

Here be energy dragons! Here be energy magic indeed! Here there is negentropic engineering, totally different from the kind of engineering we have all been taught in electrodynamics and in electrical power systems.

Note what this does to the applicability of the second law of _equilibrium_ thermodynamics. The dipole is not in equilibrium in 3-space (there it is a broken 3-symmetry, as is well-known in particle physics). Instead, it is in equilibrium in 4-space but not 3-space. So it does not obey 3-space disordering of the energy; instead, it accomplishes ordering of the vacuum energy. The reordering is free, and a compliment from nature herself. We do not have to fuel or power the process ourselves, once it is initiated. We just have to let the dipole alone and let it remain intact.

We do not have to pay nature to do negentropy for us on a giant scale! We just have to _permit_ nature to do it. We first have to untie her negentropic feet by breaking a little 3-symmetry in the energy flow conservation process. Once we do that, _nature will pay us copiously_ for permitting her to perform her beloved giant reordering of the vacuum energy. In gratitude she will pour out the 3-space real EM energy flow component for us to collect and use as we wish, so long as we do not destroy that little bit of broken 3-symmetry that continues so long as the dipole continues.

4. **Doesn't all this violate the conservation of energy law, and in effect constitute a "perpetuum mobile"?**

Not at all. It is no different from a windmill in a wind, except we have stimulated a crazy energy wind in the time domain which strikes our dipole charges. The charges then transduce this "crazy time-domain energy wind" into a 3-space normal energy wind that we can comfortably intercept, collect and use to power loads.

There is no law of nature that requires us to input the energy to our power system ourselves. In fact, much of the "alternative energy" work—such as wind farms, hydroelectric systems, wave-energy systems, solar cell arrays etc.—is simply the harnessing of such "free energy sources" in nature and using them to provide the inputs to our electrical power system.

Here we have initiated an _already proven_ new natural energy flow source, the active vacuum negentropy once we break some 3-symmetry in the vacuum's energy flow, inducing giant negentropy into the vacuum. This new natural and ubiquitous source of energy flow is analogous to those presently being sought and used in the alternative energy field—except it is available at every point in the universe, and the energy gusher never "runs out". It is just a novel kind that our electrodynamicists have ignored, even though particle physics experiments have proven it long ago.

For example, the AIAS (Alpha Foundation's Institute for Advanced Study) is vigorously pursuing this structuring of the vacuum energy and extracting energy flow from it. We now have nearly 90 papers being carried by DOE on the DOE advanced electrodynamics website http://www.ott.doe.gov/electromagnetic. Many of these papers are already published in leading journals such as Foundations of Physics and Physica Scripta. Many of the others are in the referee process at present, and several others have been approved and are in press (see endnote 19).

Maxwell's theory is purely a material hydrodynamic or fluid flow theory. At least in principle, anything that can be done in fluid flow systems can be done in EM systems because the equations are identical. Just as the environment can have a "free wind" or "free river" for us to use, the vacuum or spacetime environment can have an "electrical energy wind" for us to use. And what I am proposing is how to make a continuing, free energy wind in the vacuum that never ceases.

The broken symmetry effect of the dipole, and the resulting giant negentropy created and spreading in the surrounding vacuum, is just the vacuum's way of providing us with a steady, unchanging, indefinitely-lasting electrical energy wind of great and enduring power. Via the spin of the dipole charges, nature even performs the fundamental transduction in form of the incoming vacuum energy for us, much like the hydroturbines in a hydroelectric facility transform water flow energy into mechanical shaft energy for us.

Our electrodynamicists and engineers have just been napping a little bit for a century. They have not adapted the use of what has been shown by Whittaker for nearly a century, or what has been rigorously proven by the particle physicists for nearly a half-century.

The only oddities about this source of energy is that (1) it comes from the time domain, i.e., from the complex plane, and (2) the spin of the dipole charges absorbs the incoming energy from the complex plane and transduces it into an outflow of energy in real 3-space.

There is no law of nature that requires that energy flow be conserved in three dimensions. If we are working in four dimensions as is normal in physics, then energy is required to be conserved in four dimensions, not three. So we have not violated the conservation of energy law itself. We have permissibly violated the _additional condition_ of conservation of energy in 3-space, but not the basic conservation law in 4-space. Instead of having energy flow 3-symmetry and conserving EM energy 3-flow, because of its broken 3-symmetry the dipole "relaxes" to a more fundamental symmetry mode: symmetry in 4-flow of the EM energy. In that way it can and does receive energy from the fourth dimension and output it in space. And that is the "magic".

In short, to the observer—who observes only 3-spatial entities—the dipole unleashes a _negentropic engineering process_, ongoing and continuous, and fueled by the vacuum energy itself. Once we make the dipole, the 3-space energy flow resulting from it is similar to nature making a current of air in the atmosphere. Only now we have created a great EM energy river in the vacuum (in spacetime). The free energy wind flow flows from the time dimension into the dipole, and thence out into 3-space as long as the negentropic process (the dipole) remains intact. Once the dipole is initiated, we do not have to dissipate any additional energy to sustain the process. In our paper, "Giant Negentropy from the Common Dipole," we have also used this process to resolve the long-vexing problem of how the source charge produces its fields and potentials and the energy in them. One simply considers the clustering virtual charges of opposite sign that surround any "isolated" charge, and use each of the clustering virtual charges with a differential "piece" of the observable charge at the center, and the "isolated" charge becomes a set of composite dipoles, each having a scalar potential between its ends and consisting of the Whittaker structure.

This of course places an entirely different light on the inappropriate notion of "static" fields and "static" electromagnetics. There are equilibrium conditions in electrodynamics, but there is no true electrostatics.

We also have discarded the far too-narrow thermodynamics notion that a system inevitably tends to more disorder with its continuing operation. It does so long as one does not invoke a time-reversal process—and the inflowing phase conjugate Whittaker waves in the complex domain (time dimension) represent a true time-reversal process. So classical thermodynamics and its notion of increasing entropy does not apply. The dipole, once made, initiates a giant reordering of vacuum energy and that reordering proceeds in all directions at the speed of light so long as the dipole is intact. Yet electrical engineers do

not even know it, and do not take advantage of this common "magic" process in their system design. Indeed, as we shall see, *they build only those systems which kill the magic process!*

So once the source dipole is established in the generator (or battery), the dipole continuously receives EM energy from the vacuum in unusable form, transduces it into usable form, and pours it out along the external circuit, filling all space around that circuit with flowing EM energy. The circuit's surface charges intercept *a tiny bit* of that passing giant energy flow. That intercepted bit is diverged into the wires to power the Drude electrons, thereby powering the circuit (its loads and losses).

We can dissipate from the circuit only the energy that enters. So our circuit measurements—being dissipation measurements—will agree with the Poynting component calculation (with the diverged component of the energy flow, that enters the circuit), and hence with Lorentz's little surface integration trick.

5. It seems that the amount of energy extracted from the vacuum by other recognized vacuum energy processes—such as the Lamb shift—is very small. So how much energy is extracted from the vacuum by this dipolarity's giant negentropy process?

Don't discount the tiny Lamb shift! Its *energy density* is greater than the surface energy density of the sun. However, since only a single electron—a feeble charge of only 1.6×10^{-19}—is involved, the total energy is minuscule. But if there were lots more charge involved, the energy could be very large.

In the usual dipole, much more charge is involved. Hence the energy that is extracted from the vacuum by the dipole is *enormous*. A nominal simple circuit's source dipole in its power source (e.g., generator) actually receives and outputs about 10 trillion times as much energy as its conventional external circuits are able to intercept and collect. All the rest of that outpouring of energy fills all space surrounding the external circuit, out to an infinite radius, and is generally parallel to the conductors. Except for a tiny, tiny "sheath" of this energy flow that strikes the surface charges in the circuit conductors and components, that enormous energy flow misses the circuit and is just wasted.

Heaviside discovered the enormity of this nondiverged energy flow in the 1880s, but spoke of it cautiously in terms of the angle of the energy flow component with respect to the conductors. He had no notion as to where it was coming from, and he had no wish to be attacked and destroyed as a perpetual motion nut. But he clearly discovered it; see his original papers (cited in the attached paper).

Poynting never even knew of the giant nondiverged component, or never considered it. From the beginning he only assumed the feeble amount of energy flow that is intercepted by the circuit and diverged into the wires to power the Drude electrons.

Lorentz knew of this giant, startling energy flow component uncovered by Heaviside, but neither he nor Heaviside (nor anyone else) could explain such a startling and enormous flow of energy pouring from the terminals of every battery and generator, and almost all of it missing the circuit and not even being utilized. Further, to advance such a claim would have been professional suicide.

Unable to *solve* the problem, Lorentz just *eliminated* it—reasoning that all that enormous energy flow that missed the circuit entirely and thus did not power anything, was "of no physical significance" (Lorentz's term).

So he simply discarded that huge "Heaviside" component with a neat little integration trick. His little closed surface integration of the energy flow vector itself, around any volume element of interest, discarded all the huge Heaviside *nondiverged* energy flow component while retaining the tiny Poynting *diverged* energy flow component.

One can see a neat little illustration of the energy flow surrounding a circuit, in John Kraus, Electromagnetics, 4th edition, p. 578, Figure 12-60, a and b. We cite a 1902 book by Lorentz himself which shows the trick, although he is believed to have advanced in circa 1889-1990 or so. Kraus shows how much of that available but ignored energy flow can be intercepted at each spatial point by inserting a *unit point static charge*. The more charge one inserts at each point, of course, the more energy one intercepts and diverges at that point.

The cited Bohren experiment proves that the extra energy flow is there and it is real. That experiment outputs some 18 times as much as is input by conventional Poynting "static charge interception" (reaction cross section) calculations only. If one includes the unaccounted nondiverged Heaviside input component that Lorentz discarded, one sees that the extra Bohren energy was input all the time—and it has just been ignored for over 100 years.

6. Are you saying that generators and batteries do not use any of their available energy (the shaft energy we input to the generator, or the chemical energy available in the battery) to power their external circuits and loads?

Precisely! Neither a generator or a battery uses its available energy to add a single watt to the power line. *Batteries and generators use their available energy to make their source dipoles, nothing else*. All that burning of hydrocarbons, usage of nuclear fuel rods, and hydroelectric dams with hydroturbines furnishes energy only to produce the source dipole in the generators. All that destruction of the biosphere does not of itself add a single watt to the power line. Never has, never will.

Let's look at a generator, for example. Typically, we may burn some hydrocarbons to heat water in a boiler and make steam. We may use the steam then to power a steam turbine attached to the shaft of the generator, to input shaft energy into the generator.

As the generator shaft is forcibly turned, it makes a magnetic field inside. In the perfect machine, all the shaft input energy would be converted into this magnetic field energy. This magnetic field then performs work on the internal charges of the generator, to force them apart (positive in one direction, negative in the other) to form the generator's source dipole connected to the generator terminals.

And that is all that the shaft energy input to the generator *does*! That is all that the *generator* does. It receives shaft energy and uses it to make the source dipole, nothing else. It does not add one watt to the power line as a result of all that shaft energy input to it. It just uses that shaft input to make that source dipole.

A battery works analogously. It dissipates some of its chemical energy to force the charges apart (in the chemistry) between the plates. This creates the dipolarity of the plates, where that dipolarity serves as the source dipole. The chemical energy does not add a single watt to the external circuit; but only makes that source dipole.

In each case the source dipole, once made, serves as the negative resistor that receives EM energy from the vacuum from the complex plane, transduces it into 3-space EM energy, and pours out the 3-space energy flow from the terminals, filling all space around the external circuit (out to a radial distance approaching infinity).

7. Then why do we have to keep feeding shaft energy into the generator and keep recharging batteries? How *are* the external circuit and its loads and losses actually powered, if not from the input shaft horsepower to the generator or the chemical energy available in the battery?

First, let me explain that electrical engineers often do not realize the difference between energy flow rate and power. There is no power at all in an energy flow unless there is a rate of changing of that energy flow. No change, no power! An energy flow of a trillion joules per second has zero power unless diverged or changed in some fashion.

Also, our engineers do not calculate (and never have) the actual EM energy flow input. Instead, they calculate only the Poynting component of that energy input. In fact, they usually calculate the *energy dissipation* in the input, and call that the "energy input". It is not.

So then they speak of "drawing power from the generator or battery" which is a gross non sequitur. Rigorously, power is the rate of doing work. Work is the changing of the form of energy. Hence power is the rate at which the form of energy is changed. Also, power obviously exists and is on-going only in that "intercepting and form transducing" element that is doing the change of form of the energy. Most sophomore physics books (I checked a dozen or so) and most electrical engineering texts are grossly in error in their discussion of this area.

The situation is a little better for mechanical energy input, such as shaft energy. Note immediately that the engineering term, "shaft horsepower" already deals only with the dissipation.

But for EM energy input, we have to be very, very careful because our engineers and scientists calculate the dissipation, and that was only the Poynting component of the total EM energy flow input.

So yes, we do have to continuously "feed" energy into our generators and do work on them in the process, so they can continuously perform work on the scattered dipole charges to reform the dipole. In a 100% efficient process, we will have to input as much energy to dissipate on the scattered charges and restore the dipole, as the circuit dissipated to kill the dipole in the first place. We also have to continually recharge the batteries and change their chemistry back to the charged state, because the battery must continually expend chemical energy (changing the chemistry more and more into the discharged state) to restore the dipole that the circuit keeps destroying.

So the reason we have to keep feeding energy in, is simple. *Because of the way we design our electrical circuits!*

Our engineers carefully design every electrical power system to use a closed current loop circuit. In short, each potentialized electron in the external circuit that passes through the external loads and losses, expending its excitation energy there, requires that a *spent* electron be forcibly rammed back from the ground return line, up through the primary source dipole against the potential and against the emf.

Visualize a simple DC circuit: current i is forced against the back emf of the dipole for a given time, *against* potential V, and the same current i in the external circuit goes through the same forward potential drop V for the same length of time. Same power, same length of time, same energy dissipation.).

So every circuit our fellows design and use, expends half its feeble excitation energy—gleaned from the Poynting energy flow component it intercepts—to destroy the source dipole. The other half of the excitation energy is used to power the loads and losses of the external circuit. That means less than half the collected excitation energy is expended in the load. But then to replace the destroyed dipole, we have to input as much additional shaft energy to the generator as it took to destroy the dipole. Hence we always have to input more shaft energy than the work we get out in the loads. In the case of the battery, we have to expend more *recharging* energy than the work we get out in the loads.

Quite simply, whether it is a battery or a generator, killing the dipole is a "discharging" process, while restoring the dipole is a "charging" process. Since our engineers build all the power systems to use half their excitation energy to discharge themselves, then we must input at least that much to recharge them. Every power system our fellows build is such a contraption. Obviously the COP of such a contraption is forcibly guaranteed to be COP<1.0. The circuit actually self-enforces the Lorentz symmetrical regauging condition *during its excitation discharge*.

Once the dipole is made, the excitation of the external circuit is for free! That is rigorously only a change of gauge in the external circuit. In the most advanced theory we have—gauge field theory— *gauge freedom* or the ability to freely change the potential at will, is assumed from the getgo. All electrodynamicists therefore already assume that the potential energy of any electrical system can in theory be changed at will and for free. (In the real world we will have to pay a little switching costs perhaps).

Gauge freedom also applies at any time, including a second time to a circuit whose potential energy we have freely increased in an earlier regauging. In short, in theory we can now regauge this free excess energy by discharging it separately in a load, thereby powering the load freely except for some switching costs. In theory, the COP of this system will be the energy dissipated as work in the load, divided by the energy dissipated in the switching costs. It is accented that objecting to this procedure is an objection stating that gauge field theory is in error.

So if we accept gauge field theory, rigorously it follows that COP>1.0 systems using asymmetrical self-regauging are permissible. Otherwise, all gauge field theory is wrong. Of course, our own view is that the gauge field theorists are correct, and the hoary old EM foundations from the 1880s are in serious error in some aspects and assumptions, as continued and still taught and utilized.

For those befuddled fellows who adamantly oppose those two free asymmetrical regaugings, we will let them argue it out with the gauge field theorists. I think the gauge field theorists will win! Also note that any system that freely receives energy from its environment in fact asymmetrically regauges to an excited energy state. So the electrodynamicist already uses free regauging when he excites the circuit by applying voltage to it.

However, the Lorentz condition requires two simultaneous regaugings which are in perfect opposition force-wise. This means that the net force then is zero, and such a system cannot dissipate energy freely in the load, whether or not the initial regauging energy is free. The conventional circuit design uses symmetrical self-regauging in the discharge of the excitation (regauged) energy in the circuit (i.e., from the circuit back to the vacuum) such that it destroys the dipole faster than it powers the load. And that circuit design absolutely forfeits any ability to produce a COP>1.0 power system.

8. We have been repeatedly informed that extracting useful EM energy from the vacuum will be the most difficult technological accomplishment possible. The consensus of the world scientific community is that such a "vacuum energy" technology cannot be developed before the next century. Why does the scientific community honestly—and obviously so strongly—believe that?

The scientific community is responding to the issue based on the electrical science it presently recognizes. Unfortunately that science—at least with respect to electrical power systems—largely utilizes an electrodynamics that is some 136 years old, with the primary equations unchanged since (1) Maxwell's seminal paper in 1864, published in 1865, (2) Heaviside's restriction of the quaternionic theory of Maxwell to a much simpler vector Maxwell theory (and tensors do not recover the higher quaternion topology), (3) first Lorenz and then Lorentz's further change of the equations to make them mathematically simpler so closed solutions could be available—which arbitrary discarded the entire class of open Maxwellian systems far from thermodynamic equilibrium in their exchange with their external environment, such as with the active vacuum, and (4) Lorentz's arbitrary discard of the vast Heaviside nondiverged EM energy flow component filling all space surrounding every present electrical circuit, which already is extracted by the active vacuum. Further, the impact of Whittaker's 1903 decomposition of the scalar potential into a harmonic set of phase conjugate longitudinal EM wavepairs, where each pair is a longitudinal EM wave in 3-space and its phase conjugate replica wave in the complex plane (in the time domain) was missed because the paper was essentially just ignored. In this way, the negative resistor nature of the dipole—continuously fed EM energy from the time domain, and continuously emitting EM energy in 3-space— was not recognized until recent work by the present author revealed it.

When Maxwell's theory was published, the electron had not been discovered, the atom had not been discovered, the molecule was simply a volumetric thing without structure, and positive charges in the atomic nucleus in a copper wire were not known. The prevailing theory assumed the ubiquitous luminiferous ether filling all space, so that there was not a single point in all the universe—so the theorists believed—where mass was thought to be absent. There were also very few electrodynamicists on Earth, only about three dozen in all. When Maxwell published his book in 1873, Heaviside was just teaching himself calculus and differential equations.

Electricity was considered a thin material fluid flowing from the high pressure (high potential) side to the low pressure (low potential) side. It was thought or visualized to flow through the wires analogous to the flow of a fluid through pipes. The Drude electron gas was obviously unknown, since the electron was unknown. Hence the difference between electron velocity down the wires and the flow of the signal down the wires was unknown, since electron drift velocity was unknown.

Maxwell wrote a *material fluid flow theory*, deliberately designed to (1) capture magnetism and electricity in the same theory, and (2) capture mathematically the gist of Faraday's experiments. Maxwell simply assumed the transverse EM wave in space, from Faraday's notion that his, Faraday's, lines of force were physical and material things under stress, rather like taut strings, and that field perturbations were "twangs" of those "taut strings". That assumption and the fact that the measured electron wiggle waves in the receiving wire antenna are lateral waves (the longitudinally restrained, spinning Drude electrons act as gyros, and precess laterally when force is applied longitudinally) are the only bases for the notion of transverse EM waves in vacuum. Indeed, they are not transverse EM waves at all, but are pseudo-longitudinal EM waves. Note that the vacuum, having an energy density in modern terms, is

therefore a potential. Further, that potential decomposes into Whittaker's harmonic set of longitudinal EM wavepairs, with half incoming into 3-space from the time domain (complex plane) and half outgoing in 3-space. This reveals (1) the negative resistor action of the common potential, and (2) the fact that the vacuum is a plenum of longitudinal EM waves—half of them in the time dimension and coming into 3-space to be received upon the virtual charges of the vacuum, and the other half radiating as a longitudinal EM waveflux in all directions. The modern electrodynamicists have just not yet absorbed the impact of these very recent discoveries.

So the scientific community is still just at the verge of absorbing the impact of these recent findings. Hopefully they will then quickly begin to change the prevailing mindset.

Once that mindset changes, then there is likely to be a great and rapid revolution in electrodynamics, physics, and electrical power systems. The problem of power systems extracting their energy from the vacuum, and powering themselves and their loads, can be solved in four to five years, given the proper scientific team, the mission, and the funding.

9.   If the foregoing is true, then what are we paying the power company for?

The answer may surprise you, and once again one must keep one's sense of humor!

First, we pay the power company to have a giant Sumo wrestling match inside its generators and _lose_.

We pay the power company to waste about ten trillion times as much energy as it catches and utilizes. In other words, we pay it to use only energy interception processes having an incredibly poor efficiency: almost but not quite zero!

We pay the power company so that all that wasted, nondiverged Heaviside energy from so many power systems radiates through the atmosphere and biosphere, continually and weakly interacting with the charges encountered in the atmosphere and in matter (including living bodies), producing a low level background scattering, "heating", and nonlinear phase conjugate EM wave interaction set that does not yet appear in the global warming scientists' calculations or in the repertoire of scientists studying EM biological effects.

We pay the power company (and the universities) to continue to calculate and use the _reaction cross section_ of the field and potential, rather than the magnitude of the _field and potential themselves_, and to believe that they have thereby calculated and accounted for the fields and potentials and their energy. Note that, _a priori_, the amount of energy diverged from a field by a unit point static charge at a point, is not at all the magnitude of the field itself. Neither does the same setup (with divergence of energy flow from a potential around a unit point static charge, where the potential is a flow of EM longitudinal waves, per Whittaker 1903) provide the magnitude of the potential itself. What is diverged from a mighty river of energy—or a set of such rivers—around a "little fixed standard rock" in the river's flow, is not the magnitude of the river!

We pay the power company to continuously use its feeble little bit of collected energy in its power lines to destroy the source dipole in the generator faster than it powers the load.

We pay the power company to burn enormous amounts of hydrocarbons, consume nuclear fuel rods, build massive dams, etc. in order to continuously restore the very dipoles it designs the electrical power systems to destroy faster than they power their loads.

We pay the power company to ignore (1) the proven vacuum interaction with the charges and dipoles in its systems, (2) the giant negentropic reordering of that vacuum energy by a dipole, (3) that vast unaccounted Heaviside nondiverged energy flow component surrounding all its power lines, and (4) the broken symmetry of the source dipole in its violent and energetic exchange with the active vacuum.

We pay the power company (and the universities) to ignore what has already been proven for nearly 50 years in particle physics, and what has been shown by Whittaker for nearly a century.

We pay the power companies to build vast giant interlocking power grids, increasingly vulnerable to manmade incident and natural calamity, so they can continue to design and use the same basic

approach in EM power systems, just varying the individual component subsystems and their design efficiencies, all remaining under COP<1.0.

We pay the power company to guarantee the greatest national difficulty possible when in the future our cities and population centers are hit by professional terrorist attacks and weapons of mass destruction.

We pay the power company to require energy resource companies to have to rip the coal from the earth, extract horrendous amounts of oil from the earth, pollute the environment with hydrocarbon combustion residues and nuclear wastes, in order to fulfill their mission of furnishing electrical power to an ever more electrically-needy and ever-growing earth population.

We pay our universities to continue to teach the "old" electrodynamics and the standard power system models and designs, so that the power companies will have to keep doing the same thing and keep ignoring all the above.

We pay the power companies (and the universities) to not realize that every electrical system and load has been and is powered by EM energy extracted directly from the vacuum via the broken symmetry of the source dipole.

And ultimately we pay the folks who _own_ all that and fund doing all that, several trillion dollars per year in profits to keep the electricity coming this way and this way only.

10.   So what is the bottom line, in your opinion?

First, the conventional electrical power system approach is not the way to run the railroad!

We can do far better than that, and we must do far better than that. The polar ice is melting, the oceans will be rising, the biosphere is seriously polluted, and anyone who doesn't think the weather isn't whacky just hasn't been paying attention. We must provide ever increasing electrical energy, not only to the developed nations but to the developing nations. And we cannot go back to the stone age. Even if we did, there are not enough forests, etc. to support the energy needs of our vast world population very long.

So we cannot turn back the clock to some dimly idealized early history condition.

Further, all the other alternative energy methods are "useful", but they are also *too little and too late.* With the electric power demand curve rising, together with increasing cost of energy and the arguable peaking and eventual shortage of cheap fuel and cheap power, we could be facing a coming collapse of the world economy. Assuming that such a collapse approaches a very few years from now, the financial pressure on all the struggling nations will also be increasing beyond endurance. Desperate nations undertake desperate deeds, and some 25 now have weapons of mass destruction. More are developing such weapons every day.

Somewhere as those nations start to slip into a vast world abyss, in their conflicts they will unleash weapons of mass destruction, including nuclear weapons. A dictator or ten of them will see an opportunity, have the weapons, and move to conquer and take. We point out the use in the Iran/Iraq war of chemical warfare, and the use of such weapons by Saddam Hussein against the Kurds in his own country. History already shows that the weapons, once they are possessed by these nations, will be unleashed.

The old strategic studies showed that, once the mass nuclear destruction balloon is launched, a threatened nation must fire upon its enemies and destroy them before they destroy the nation itself, since effective defenses are not available. This is the dire side of the Mutual Assured Destruction doctrine that we usually do not wish to face: Given the unleashing of the preliminary weapons of mass destruction, a threatened nation must fire on its perception of impending threat in order to try to destroy its perceived foes, else the nation itself will surely be destroyed. If it does not fire on perception, the threatened nation has no chance at all of surviving the full bore exchange is certain to quickly erupt.

In short, what happens once the first balloon goes up, is that everybody prepares in desperation, and everybody fires madly upon perception of the preparations of the others. The resulting Armageddon is indeed the long mass destruction nightmare we have all feared for so long.

Certainly such a dire scenario can occur from causes other than the increasing financial stress brought on by an increasing energy crisis. But the increasing energy crisis will severely augment the desperation of the situation, if it is not solved quickly and solved permanently.

We can solve it quickly and permanently, by taking the energy directly from the vacuum, using the simple giant negentropy mechanism that nature has so generally provided, and which we have only recently realized.

The entire energy problem can be solved totally and permanently in five years, given the proper funding and a crash scientific effort. But it requires a rather dramatic change of scientific mindset, beginning at the top with agencies such as the National Academy of Sciences, the National Science Foundation, the Department of Energy, and the U.S. National Laboratories—as well as in the universities, the leading think tanks, and the leading private research organizations.

With the problem solved, we can implement it with a crash program as well. We can then begin to clean up the biosphere while providing copious electrical energy, cheaply, anywhere in the world including in the developing nations. We can begin to dramatically reduce the hydrocarbons burned, the nuclear fuel rods spent, and the hydroelectric dams needed.

We can have agile, powerful electrical cars with great performance, whose batteries never need recharging.

We can have self-powering trains and ships, all powered by energy from the vacuum.

We can have self-powering electrical power systems, taking all their energy from their local active vacuum, and powering themselves and their loads simultaneously.

We can have a set of distributed decentralized power systems and areas, with easy back-up generators of enormous power, to raise the survivability and restorability of the systems to a very high level. These systems will have graceful degradation curves rather than the present catastrophic failure curves, in case of attack by mass destruction weapons.

It's a doable, and it can be done quickly with a great new Manhattan type project. We need to do it, and we need to do it as rapidly as humanly possible.

We only have the biosphere and our own civilization to save.

References:

1.   T. E. Bearden, "Giant Negentropy from the Common Dipole," Proc. IC-2000, St. Petersburg, Russia,, July 2000 (in press); — "On Extracting Electromagnetic Energy from the Vacuum, " *ibid.*, (in press).

2.   E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Math. Ann., Vol. 57, 1903, p. 333-355; — "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 latter paper initiated what is called superpotential theory.

3.   James Clerk Maxwell, "A dynamical theory of the electromagnetic field," Phil., Trans. Roy. Soc. Vol. 155, 1865, p. 71, 459. Presented in 1864. This was Maxwell's definitive presentation of his theory. Also in The Scientific Papers of James Clerk Maxwell, edited by W. D. Niven, Dover, New York, 1952, Vol. 1, p. 526-604.

4.   James Clerk Maxwell, A Treatise on Electricity and Magnetism, Oxford University Press, Oxford, 1873. Third Edition, Volumes 1 and 2, unabridged, Dover Publications, New York, 1954.

5.   J. H. Poynting, "On the transfer of energy in the electromagnetic field." Phil. Trans. Roy. Soc. Lond. A, Vol. 175, 1884, p. 343-361.

6.   J. H. Poynting, "On the connexion between electric current and the electric and magnetic inductions in the surrounding field," Proc. Roy. Soc. Lond., Vol. 38, 1984-85, p. 168.

7.   Oliver Heaviside, "Electromagnetic Induction and Its Propagation," The Electrician, 1885, 1886, 1887, and later. A series of 47 sections, published section by section in numerous issues of The Electrician during 1885, 1886, and 1887.

8.   Oliver Heaviside, Electromagnetic Theory, 3 vols., Benn, London, 1893-1912. Second reprint 1925.

9.   Oliver Heaviside, "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," Phil. Trans. Roy. Soc. Lond., 183A, 1893, p. 423-480.

10.   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 Poynting vector around a closed cylindrical surface surrounding a volumetric element. Lorentz is believed to have done this circa 1889-1990.

11.   W. K. H. Panofsky and M. Phillips, Classical Electricity and Magnetism, Addison-Wesley, Reading, MA, 1962, 2nd edition, p. 181; W. Gough and J. P. G. Richards, European J. Phys., Vol. 7, 1986, p. 195.

12.   J. D. Jackson, Classical Electrodynamics, 2nd Edn., John Wiley & Sons, New York, 1975, p. 237.

13.   T. E. Bearden, "On the Principles of Permissible Over Unity EM Power Systems," J. New Energy, 4(2), Fall 1999, p. 16-39; — "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," J. New Energy, 3(2/3), 1998, p. 12-28; — "Use of Asymmetrical Regauging and Multivalued Potentials to Achieve Overunity Electromagnetic Engines," J. New Energy, 1(2), Summer 1996, p. 60-78; — "Regauging and Multivalued Magnetic Scalar Potential: Master Overunity Mechanisms," Explore, 7(1), 1996, p. 51-58; — "The Master Principle of EM Overunity and the Japanese Overunity Engines," Infinite Energy, 1(5&6), Nov. 1995-Feb. 1996, p. 38-55; — "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; — Energetics of Free Energy Systems and Vacuum Engine Therapies, Tara Publishing, Internet node www.tarapublishing.com/books, July 1997.

14.   T. E. Bearden, "Energy Flow, Collection, and Dissipation in Overunity EM Devices," Proc. 4th Intern. Energy Conf., Academy for New Energy, Denver, CO, May 23-27, 1997, p. 5-51. In Figure 5, p. 16 the fraction of the Poynting energy flow that is intercepted and collected by the circuit is roughly shown to be on the order of 10^{-13} of the entire Poynting energy flow available.

15.   D. K. Sen, Fields and/or Particles, Academic Press, London and New York, 1968, p. viii. Quoting: *"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics."*

16.   John D. Kraus, Electromagnetics, Fourth Edn., McGraw-Hill, New York, 1992.   Figure 12-60, a and b, p. 578 shows a good drawing of the huge Poynting energy flow filling all space around the conductors, with almost all of it not intercepted and thus not diverged into the circuit to power it, but just "wasted."

17.   J. D. Jackson, "Surface charges on circuit wires and resistors play three roles," Am. J. Phys., 64(7), July 1996, p. 855-870. See also Mark A. Heald, "Energy flow in circuits with Faraday emf," Am. J. Phys., Vol. 56, 1988, p. 540-547 ; "Electric fields and charges in elementary circuits," Am. J. Phys., 52(6), June 1984, p. 522-526.

18.   T. E. Bearden, "Dark Matter or Dark Energy?", J. New Energy, 4(4), Spring 2000, p. 4-11.

19.   P. K. Anastasovski, T. E. Bearden, C. Ciubotariu, W. T. Coffey, L. B. Crowell, G. J. Evans, M. W. Evans, R. Flower, S. Jeffers, A. Labounsky, B. Lehnert, M. Mészáros, P. R. Molnar, J. P. Vigier, and S. Roy, "Derivation of the Lehnert field equations from gauge theory in vacuum: Space charge and current," Found. Phys. Lett., 13(2), APR 2000, p.179-184; — "Classical electrodynamics without the Lorentz condition: Extracting energy from the vacuum," Physica

Scripta 61(5), May 2000, p.513-517; — "Derivation of a Locally Gauge Invariant Proca Equation from U(1) and O(3) Gauge Theory Applied to Electrodynamics: Acquisition of Photon Mass and Rest Energy from the Vacuum," submitted to Physica Scripta; — "Energy Inherent in the Pure Gauge Vacuum," submitted to Physica Scripta; — "Electromagnetic Energy from Curved Spacetime," submitted to Optik; — "Operator Derivation of the Gauge Invariant Proca and Lehnert Equation: Elimination of the Lorentz Condition," Found. Phys., 39(7), 2000, p. 1123-TBD (in press); — "Schrödinger Equation with a Higgs Mechanism: Inherent Vacuum Energy," submitted to Found. Phys.; — "Spontaneous Symmetry Breaking as the Source of the Electromagnetic Field," submitted to Found. Phys.; — "Effect of Vacuum Energy on the Atomic Spectra," Found. Phys. Lett., 13(3), June 2000, p. 289-296; — "Vacuum Energy Flow and Poynting Theorem from Topology and Gauge Theory," submitted to Physica Scripta; — "Runaway Solutions of the Lehnert Equations: The Possibility of Extracting Energy from the Vacuum," Optik, 2000 (in press). See T. E. Bearden, "Extracting and Using Electromagnetic Energy from the Vacuum," in M. W. Evans (ed.), Contemporary Optics and Electrodynamics, Wylie, 2001, 3 vols. (in press), comprising a Special Topic issue as vol. 114, I. Prigogine and S. A. Rice (series eds.), *Advances in Chemical Physics*, Wylie; — "The Unnecessary Energy Crisis: How to Solve It Quickly," Position Paper , Association of Distinguished American Scientists, June 2000; — "On the Principles of Permissible Over Unity EM Power Systems," J. New Energy, 4(2), Fall 1999, p. 16-39; — "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," J. New Energy, 3(2/3), 1998, p. 12-28; — "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. See also Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," Proc. 26th Intersoc. Energy Conversion Engineering Conf. (IECEC '91), Boston, Massachusetts, 1991, p. 370-375.

20.   T. D. Lee, ., Particle Physics and Introduction to Field Theory, Harwood, New York, 1981, p. 380-381.

21.   R. L. Lehrman, "Energy is not the ability to do work," Physics Teacher, Vol. 15, 1973, p. 15.

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

23.   David Linden, Editor in Chief. Handbook of Batteries, Second Edition, McGraw Hill, New York, 1995.

24.   Colin A. Vincent and Bruno Scrosati, Modern Batteries: An Introduction to Electrochemical Power Sources, Second Edition, Wiley, New York, 1997.

25.   Robert Bruce Lindsay, "The concept of energy and its early historical development," Foundations of Physics, 1(4), 1971, p. 383-393; — and Henry Margenau, Foundations of Physics, Dover, NY, 1963.

26.   D. Hilbert, Gottingen Nachrichten, Vol. 4, 1917, p. 21. Quoting: *'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.'*

27.   Ludvig Valentin Lorenz, "On the identity of the vibrations of light with electrical currents," Philosophical Magazine, Vol. 34, 1867, p. 287-301. In this paper Lorenz gave essentially what today is called the Lorentz symmetrical regauging. H. A. Lorentz later performed the present symmetrical regauging of Maxwell's equations, and it has been adopted since that time.

28.   W. Misner, K. S. Thorne, and J. A. Wheeler, Gravitation, W.H. Freeman, San Francisco, 1973.

29. Paul Nahin, Oliver Heaviside: Sage in Solitude, IEEE Press, New York, 1987; — "Oliver Heaviside," Scientific American, 262(6), June 1990.

30. Gregoire Nicolis, Nicolis, "Physics of far-from-equilibrium systems and self-organization," Chapter 11 in Paul Davies, Ed., The New Physics, Cambridge University Press, Cambridge, 1989, p. 316-347; — and I. Prigogine, Exploring Complexity, Piper, Munich, 1987.

31. Ilya Prigogine, From Being to Becoming: Time and Complexity in the Physical Sciences, W. H. Freeman and Company, San Francisco, 1980.

32. S. Olariu and I. Iovitzu Popescu, "The Quantum Effects of Electromagnetic Fluxes," Reviews of Modern Physics, 57(2), Apr. 1985, p. 339-436. Full discussion of the Aharonov-Bohm effect and hundreds of references.

33. Wolfgang Panofsky and Melba Phillips, Classical Electricity and Magnetism, Second Edition, Addison-Wesley, Menlo Park, CA, 1962, third printing 1969, p. 181-183.

34. David M. Pepper, "Applications of Optical Phase Conjugation," Scientific American, 254(1), Jan. 1986, p. 74-83; — "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(2), March/April 1982, p. 156-183.

35. Melba Phillips, "Classical Electrodynamics," in Principles of Electrodynamics and Relativity, Vol. IV of Encyclopedia of Physics, edited by S. Flugge, Springer-Verlag, 1962.

36. Pierre St. James Russell, "Power conservation and Field Structures in Uniform Dielectric Gratings," Journal of the Optical Society of America A, 1(30, Mar. 3, 1984, p. 293-299.

37. R. Podolny, Something Called Nothing: Physical Vacuum: What Is It?, Mir Publishers, Moscow, 1986, p. 181. In mass units, the energy density of the virtual particle flux of vacuum is on the order of 10^{80} grams per cubic centimeter.

38. H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-Point Energy," Physical Review A, 40(9), Nov. 1, 1989, p. 4857-4862. Among other things, includes Puthoff's self-regenerative cosmological feedback cycle.

39. Lewis H. Ryder, Quantum Field Theory, Second Edition, Cambridge University Press, 1996, p. 147+. Covers the four polarizations of the photon.

40. Mendel Sachs, Annals of Physics, Vol. 6, 1959, p. 244; — General Relativity and Matter, Reidel, 1982. In the latter paper, Sachs provides a great generalization of general relativity and electrodynamics reaching from the quarks and gluons to the entire universe.

41. Semiz, Ibrahim, "Black hole as the ultimate energy source," American Journal of Physics, 63(2), Feb. 1995, p. 151-156.

42. 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).

43. G. I. Shipov, A Theory of Physical Vacuum: A New Paradigm, Moscow, 1994. Page 123-124 gives Shipov's three types of physics and physicists.

44. M. P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, Cambridge, 1993, p. 127.

45. Diederik Wiersma and Ad Lagendijk, "Laser Action in Very White Paint," Physics World, Jan. 1997, p. 33-37.

46. C. S. Wu, E. Ambler, R. W. Hayward, D. D. Hoppes and R. P. Hudson, Physical Review, Vol. 105, 1957, p. 1413.

47. Richard W. Ziolkowski, "Exact Solutions of the Wave Equation with Complex Source Locations," Journal of Mathematical Physics, 26(4), April 1985, p. 861-863.

48. Editorial, "The Transfer of Energy," The Electrician, Vol. 27, July 10, 1891, p. 270-272. The notion of energy flow through space did not even exist in physics, at the time Maxwell formulated his theory in the 1860s. Several years after Maxwell died in 1879 of stomach cancer, the concept of energy flowing through space was formulated by Heaviside and independently by Poynting. Heaviside published first [as documented by this reference], but not prestigiously. Poynting published not long after, in a prestigious journal.

49. I. J. R. Aitchison, "Nothing's plenty: The vacuum in modern quantum field theory," Contemporary Physics, 26(4), 1985, p. 333-391. A very good view of the active vacuum.

50. T. W. Barrett, "Sagnac Effect: A Consequence of Conservation of Action Due to Gauge Field Global Conformal Invariance in a Multiply-Joined Topology of Coherent Fields." in T. W. Barrett and D. M Grimes. [Eds.] Advanced Electromagnetism: Foundations, Theory, & Applications. World Scientific, River Edge, New Jersey, 07661, 1995, p. 278-313. See also Terence W. Barrett, "Maxwell's theory extended: Part 1: Empirical reasons for questioning the completeness of Maxwell's theory – effects demonstrating the physical significance of the A potentials." Annales de la Fondation Louis de Broglie, 15(2), 1990, p. 143-183; "Maxwell's theory extended: Part 2: Theoretical and pragmatic reasons for questioning the completeness of Maxwell's theory." Annales de la Fondation Louis de Broglie, 15(3), 1990, p. 253-283.

51. R. P. Bauman, "Physics that textbook writers usually get wrong," Physics Teacher, Vol. 30, 1992, p. 264. Criticizes writers of textbooks for confusing the relationship between work, energy, and force and gives specific examples.

52. J. O'M. Bockris, "Overpotential: a lacuna in scientific knowledge," Journal of Chemical Education, 48(6), June 1971, p. 352-358. Introduces overpotential theory. The energy that exists at minute "double layers" in contact, which act as tiny capacitors with extremely small separation of plates, is enormous and far greater than what the power engineer meets in his normal engineering practice. See also J. O'M Bockris and A. K. N. Reddy, Modern Electrochemistry, Vol. 1&2, Plenum Press, 1970, particularly Chapter I, which deals with overpotential theory.

53. Craig F. Bohren, "How can a particle absorb more than the light incident on it?" American Journal of Physics, 51(4), Apr. 1983, p. 323-327. Under nonlinear conditions, a particle can absorb more energy than is in the light incident on it. Metallic particles at ultraviolet frequencies are one class of such particles and insulating particles at infrared frequencies are another. See also 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.

54. A. M. Bork, "Vectors versus quaternions — the letters in *Nature*," American Journal of Physics, Vol. 34, Mar. 1966, p. 202-211.

55. Jed Z. Buchwald, From Maxwell to Microphysics, University of Chicago Press, Chicago and London, 1985.

56. Mario Bunge, Editor, Problems in the Foundations of Physics, Springer-Verlag, Berlin and New York, 1971. Also see Mario Bunge, Foundations of Physics, Springer-Verlag, New York, 1967. Quoting p. 182: *"...the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."*

57. William B. Burford III and H. Grey Verner, Semiconductor Junctions and Devices: Theory to Practice, McGraw-Hill, New York, 1965. Chapter 18: Point-Contact Devices. Our remark is that the manufacturing processes for the point-contact resistor can be adjusted and controlled to produce a true negative resistor; i.e., where the transistor emits current against the voltage.

58. H. B. G. Casimir, "On the attraction between two perfectly conducting plates," presented at a meeting of the Royal Netherlands Academy of Arts and Sciences on 29 May, 1948. Published in the same year in Proc. K. Ned. Akad. Wet., vol. 51, 1948, p. 793.

59.   Shoukai Wang and D.D.L. Chung, "Apparent negative electrical resistance in carbon fiber composites," Composites, Part B, Vol. 30, 1999, p. 579-590. Although the authors were apparently forced to use the term "apparent" negative resistance, they document experiments showing that the manufacturing process could be controlled to produce true negative resistance where the current moves against the voltage. This is not to be confused with "differential" negative resistance such as is exhibited by the tunnel diode etc.—where the component gives some current back against the voltage, but all the while is consuming far more energy than it is returning. The Chung resistor produces a rigorous true negative resistance process, but it has apparently been cloitured and the lid clamped on it. Nonetheless, it only takes one small white crow to prove that not all crows and black. This is a rigorous white crow.

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

61.   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."*

62.   M. J. Crowe, A History of Vector Analysis: The Evolution of the Idea of a Vectorial System, University of Notre Dame Press, Notre Dame, Indiana, 1967.

63.   P. Drude, Ann. Physik, Vol. 1, p. 566; Vol. 3, 1900, p. 370, 869.

64.   Einstein, Albert, "Foreword," in Max Jammer, Concepts of Space: The History of Theories of Space in Physics, Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

65.   P. V. Elyutin, "The Quantum Chaos Problem," Sov. Phys. Usp., Vol. 31, No. 7, 1988, p. 597-622.

66.   G. Falk, F. Herrmann, and G. Bruno Schmid, "Energy forms or energy carriers?" American Journal of Physics, 51(12), Dec. 1983, p. 1074-1077.

67.   M. Faraday, Experimental Researches in Electricity and Magnetism, Dover, 1965. A Dover reprint of Faraday's three volumes of 1839, 1844, and 1855.

68.   Feynman, Richard P., Robert B. Leighton and Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley, New York, Vol. I, 1963, p. 2-4. Feynman defines the electric field not in terms of force per se, but in terms of its potentiality for producing a force only when a charge is present for the force to be developed upon.

69.   Richard Feynman, "Space-Time Approach to QED," Physical Review, 76(6), 15 Sept 1949, p. 769-789. Amongst other things, discusses the problem of time-polarization and longitudinal polarization (of photons). See also Richard Feynman, Quantum Electrodynamics, 1961, 1963. Among other things, discusses the "sum over four polarizations" of photons and such. The term "Gupta-Bleuler" is the formalism that has grown up around this problem.

70.   S. Firrao, "Physical Foundations of Self-Organizing Systems Theory," Cybernetica 17(2), 1984, p. 107-124. Deals directly with the contradiction between the law of increased entropy and the fundamental hypothesis of any theory of self-organizing systems. The conflict is resolved by a rigorous criticism of the law of increased entropy. It is the present assumptions evoked in the so-called law of entropy that are erroneous. Comment: Consider the giant and continuing negentropy induced by formation of a simple dipole, e.g.

71.   William Jay Fogal, "High Gain, Low distortion, Faster Switching Transistor." U.S. Patent No. 5,196,809, Mar. 23, 1993; — "High Gain, Low Distortion, Faster Switching Transistor." U.S. Patent No. 5,430,413, July 4, 1995. The Fogal transistor can—among other very interesting things—be made to function as a true negative resistance.