THE SOURCE CHARGE PROBLEM:
ITS SOLUTION AND IMPLICATIONS.

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THE OBSERVATION: EVERY CHARGE FREELY POURS OUT REAL EM ENERGY IN ALL DIRECTIONS, WITH NO *OBSERVABLE* ENERGY INPUT.

- A fixed isolated charge produces a set of associated fields and potentials in its surrounding space. The fields arise and spread outward from the charge in all radial directions at light speed, from the moment of creation or separation of the charge.
- EM fields in space are comprised of photons. A photon in space is moving at the speed of light c.
- Hence the charge continuously emits real, observable photons in all directions, in motion at light speed c and pouring outward.
- This steady outpouring of observable photons establishes and continuously replenishes the associated "static" fields and potentials, expanding outward at light speed.
- Hence all "static" EM fields are actually steady state dynamic energy flows, in the manner pointed out by Van Flandern {1} when he states:

  "… we must distinguish two distinct meanings of the term 'static'. One meaning is unchanging in the sense of no moving parts. The other meaning is sameness from moment to moment by continual replacement of all moving parts. We can visualize this difference by thinking of a waterfall. A frozen waterfall is static in the first sense, and a flowing waterfall is static in the second sense. Both are essentially the same at every moment, yet the latter has moving parts capable of transferring momentum, and is made of entities that propagate."

- Experiment establishes there is no *observable* energy input to the source charge. Yet charges pour out energy and establish all EM fields, potentials, and their energy.
  - Classical EM and electrical engineering models *accept* that the associated charges are somehow the sources of all EM fields, potentials, and their energy.
  - But the models assume the charges *create* those fields and potentials and their energy, *from nothing at all*, because they assume there is no energy input to the charge.
- Thus present electrical power engineering uses a seriously flawed EM model that assumes total violation of the conservation of energy law.

THE PROBLEM: EITHER THE REQUIRED *NONOBSERVABLE* ENERGY INPUT MUST BE MODELED OR THE ENERGY CONSERVATION LAW IS FALSIFIED.

- Sen {2} states:

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

- Bunge {3} stated:

  "In order to keep Maxwell's second order equations and at the same time discard its advanced solutions in a consistent way one must add the hypothesis that the charged

bodies are the sources of the e.m. field—a hypothesis that is taken so much for granted that it is hardly stated explicitly."

- Bunge also stated {4}:

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

- Kosyakov {5} bluntly states:

  "A generally acceptable, rigorous definition of radiation has not as yet been formulated." ..."The recurring question has been: Why is it that an electric charge radiates but does not absorb light waves despite the fact that the Maxwell equations are invariant under time reversal?" {6}

THE SOLUTION: THE CHARGE CONTINUOUSLY ABSORBS *VIRTUAL* (SUBQUANTAL) PHOTON ENERGY FROM THE VACUUM, COHERENTLY INTEGRATES IT, AND RE-EMITS IT AS *REAL OBSERVABLE* PHOTONS.

- In 1957, particle physicists discovered the basis for solving the problem.
  - Lee and Yang {7} strongly predicted broken symmetry in 1956-57.
  - Wu and her colleagues {8} experimentally proved it in Feb. 1957.
- It was a great revolution in physics. With unprecedented speed the Nobel Committee awarded the Nobel Prize to Lee and Yang the very same year, in Dec. 1957.
- In the nearly half century since then, that revolution and its implications have not migrated across the university campus from the physics department to the electrical engineering department, to convince the department and its professors of the urgent necessity to update and extend their seriously flawed and archaic EE model.
- In particle physics, every charged particle polarizes the vacuum around it. The charge is surrounded by virtual charges of opposite sign, resulting in a dipolar ensemble and a highly energetic exchange between charge and active vacuum.
- The asymmetry of opposite charges (and thus of any dipolarity) is a *proven broken symmetry* {8}.
  - For a broken symmetry that is discovered, something virtual has become observable {19}. In this case, that "something that has become virtual" is virtual energy received from the vacuum.
  - *Virtual* EM energy from the vacuum is continuously input to the charge's polarization ensemble, absorbed as a differential change in mass by the charged mass, coherently integrated as that differential mass change, and then re-emitted as *observable* EM energy.
- Coherent integration of disordered virtual energy into observable energy is a process for consuming positive entropy and producing negative entropy, as follows:
  - The charged particle ensemble *continuously absorbs* disordered virtual photon energy from its seething vacuum energy exchange.
  - The energy dE of each virtual energy photon absorbed is transformed into a virtual change dm in the *mass* of the charged particle, by $(dE)/c^2 = dm$.
  - Since mass is *unitary*, its successive virtual changes dm_i integrate unitarily (*coherently*) as $dm = dm_1 + dm_2 + ... + dm_i + ...$. This process *reorders* the absorbed disordered energy, but as a summation change dm of mass-energy until the quantum threshold is reached.
  - When sufficient virtual mass-energy change dm is accumulated, there is sufficient mass-energy excitation $\Delta E = (dm)c^2$ for emitting an *observable* photon.

- o Incessantly perturbed by vacuum fluctuations (zitterbewegung), once the quantum threshold (ΔE) is reached the excited charged particle abruptly and forcibly decays by emitting a real, observable photon. At that moment, coherent integration of virtual energy into observable energy has been accomplished.
- To model the process, a new geometry and group theoretic methods are required.
  - o This does not correspond to Klein's geometry and methods {9}, but it corresponds to the far more modern and complete Leyton geometry and methods {10}. The electrical engineering model is still based on Klein's geometry and methods.
  - o In Klein geometry, a broken symmetry at a given level loses the symmetry information for that level and *reduces* the overall symmetry.
  - o In Leyton geometry, a broken symmetry at a given level does not lose the symmetry information, and it also generates a new symmetry at the next higher level. Hence it *increases* the overall symmetry. This is necessary, in order for a negative entropy process to exist and for it to absorb and coherently integrate disordered vacuum virtual energy into real, observable, ordered EM energy.
  - o Leyton's discovery of the resulting *hierarchies of symmetry* {10a} is thus another giant revolution ticking away in physics.
- "Static" EM fields and potentials are actually freely flowing, nonequilibrium steady state energy currents. Freely catching the energy from this energy flow and using it—without affecting or killing the source of the flow—requires special provisions:
  - o For use of this "free" flow of energy transduced from the vacuum by the charge, the energy must be transferred from the source without work; i.e., the form of the energy that is transferred to the collector must remain the same when it is collected.
  - o Hence one must intercept and collect the energy in "static" field and "static" potential form, in the intercepting/collecting circuit.
  - o This means that the Drude electrons in the receiving circuit must be pinned during the energy transfer so that no flow of current occurs during that transfer process. In that way, *the energy is transferred from the source in work-free manner, by asymmetric regauging of the receiving circuit alone.*
  - o Then the external source of the potentialization must be disconnected from the receiving part of the circuit, and a load inserted in the receiving circuit as well as preferably a one-way gate (diode) also.
  - o During this "potentialized working circuit completion" process, the Drude electrons remain pinned, so these operations are current-free. Static conditions must continue to be held while the "working circuit for powering the load" is assembled as an entity separate from the original source of potentialization, with the collector circuit and its prior potentialization (asymmetrical regauging) being a part of the new assembly.
  - o The Drude electrons must then be *unpinned*, so that current can and does flow because of the emf developed by the overpotentialization condition.
  - o Then as current now flows, the excess potential energy of the former receiving circuit portion is dissipated in the load to power it freely. There is no related back emf (due to load powering) through the original, now-separated source of the potentialization.
  - o In this way energy freely received from an external source of potential is separately shuttled into the receiving circuit as *work-free energy transfer only*. Then the collected potential energy is *separately* dissipated from the

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receiving circuit in its inserted load and gating, without using half that free potential energy to destroy the dipolarity of the *original* external source.

- The main principle is this: *The primary source of free potential energy flow should only be used to furnish potential to a collector in the absence of current. The potentializing "external receiving circuit" should never dissipate that energy with the original source of energy still connected. The collector circuit collects energy only in a pure energy transfer situation, never in a "power" situation. When the collector circuit dissipates its collected energy to power the load, the original source of potential must never be connected.*

- The charge ensemble (and any dipole) is a magic "ratchet" for consuming disordered virtual state energy of the vacuum and producing ordered observable state energy in space.
  - The charge produces a *continuous negative entropy interaction*, of the kind shown theoretically possible by Evans and Rondoni {11}.
  - This dramatically revises and extends the present incomplete second law of thermodynamics, which has admitted only *positive entropy* interactions. Now it must admit *negative entropy* interactions as well.
  - It solves the old "heat death" problem of thermodynamics {12}.
  - It also solves the major problem of thermodynamics today: its temporal asymmetry {13}.

- It is ridiculously easy to extract real EM energy from the seething vacuum—*all* one wishes, *whenever* one wishes, *anywhere* one wishes. Just assemble some charge or make a dipole, and let it alone. It will extract and pour out transduced EM energy from the vacuum, continuously, so long as it exists. The original source charges of the universe have been doing that continuously, for some 17 billion years.

- The only energy "crisis" is how to effectively intercept, collect, and utilize the steady EM energy flow to power the circuit and its loads, without destroying the source dipolarities and thereby shutting off the free flow of EM energy from the vacuum. Obviously, that is an energy problem our scientific community and our electrical power community *are not* addressing. We have a "scientific dogma" crisis, not a physical energy crisis.

REGAUGING AND ENERGY CONSERVATION:

- In quantum field theory, gauge freedom is an axiom. It is widely assumed by electrodynamicists and physicists.
- By gauge freedom, one can freely change the potential—and thus the potential energy—of an EM system at any time, as one wishes.
  - In earlier history of electrodynamics, the potentials were considered to be mathematical figments and not physically real.
  - Only the fields were regarded as "real".
  - So long as the net fields of the system were unchanged, the system was considered to be "the same" regardless of change of potential (and thus regardless of its change of potential energy).
  - For simply changing a system potential (regauging the equations) that resulted in an increase in the system's potential energy, and without *net change* in the overall force field, no question of the conservation of energy was raised—and such questions are still ignored.
    - We know of no text which points out that regauging a system's equations implies a free change in the potential energy of the system involved.

- ▪ We also know of no text which then details *from whence comes* the excess free regauging energy so universally assumed and utilized by the electrodynamicists.
        - ▪ Leyton's hierarchies of symmetry, however, do provide the answer.
- In the Maxwell-Heaviside equations, "symmetrical" regauging {14} is the simultaneous changing of two potentials—A and ϕ—but just so that the two free translation force fields also produced are equal and opposite. Thus the *net resultant* translation force field change is zero, even though the stress of the system has been increased by the presence of the new equal and opposite forces fighting each other.
- If one wishes, asymmetrical regauging—such as changing the magnitude of the system's electrostatic scalar potential (its voltage) alone—can be used.
    - o As previously stated, if no current is permitted to flow, this asymmetrical regauging (increasing the voltage alone) does freely increase the potential energy collected in the asymmetrically regauged system. It is done without performing work, since—as an example—mere voltage amplification in the absence of current does not of itself involve any work. Instead, it is pure asymmetrical regauging, and "for free" under the gauge freedom axiom.
    - o The local ambient vacuum is actually a very high electrostatic scalar potential, taken only as a *reference zero potential*. In other words, other potentials are measured with respect to being a change in that ambient local vacuum potential.
    - o Note that "the" potential as such is not absolutely defined; only the difference between two potentials is defined (and then only for their difference in point intensity of their composite energy flows). Hence the change of potential "in the circuit" actually is a change in the local potential intensity of the vacuum. That is a free asymmetrical regauging of the vacuum itself, and the "excess energy" connected with the regauged system comes directly from the regauged vacuum.
    - o We strongly stress that "the potential" itself does not appear in EM equations. Only the "point intensity" of the potential—i.e., of its composite energy flows {24}—appears and is calculated and used. Similarly for "the" EM field: Only its point intensity appears and is used.
- One concludes that the vacuum can be and is asymmetrically regauged at will, in a local region, thereby producing excess usable EM potential energy in a system located in that region. "Flow of potential energy through space" actually refers to *transmitting a change of the local potentialization of space (vacuum) itself.*
- One further concludes that the source charge is the fundamental and most basic EM system that performs that asymmetrical regauging of the local vacuum potential. And it also does it continuously and "for free".

TECHNICAL RESULT: THE SOURCE CHARGE ENSEMBLE OBEYS THE CONSERVATION OF ENERGY LAW (FIRST LAW OF THERMODYNAMICS), BUT TOTALLY VIOLATES THE PRESENT FORM OF THE SECOND LAW. SOURCE CHARGES FREELY FURNISH ALL OBSERVABLE EM FIELD ENERGY AND EM POTENTIAL ENERGY IN THE UNIVERSE, EXTRACTING AND TRANSDUCING IT FROM THE LOCAL SEETHING VACUUM'S VIRTUAL ENERGY.

- The dipolarity of the charge's polarization ensemble continuously (i) consumes positive entropy of the virtual state vacuum, and (ii) produces negative entropy in the observable state.
- *In every electrical circuit, power system, or EM device*: In any system, the local EM fields, potentials, and their energy are formed by the changes in the intensity of the EM energy being extracted and reordered directly from the altered local vacuum *by the associated source charges and dipolarities in that system*. The charge produces the transduction function; the altered vacuum intensity furnishes the energy freely.
- Thermodynamically the charge ensemble is a nonequilibrium steady state (NESS) system. The charge is the first known physical EM system continuously producing purely negative entropy in accord with the theoretical demonstration of Evans and Rondoni {11}.
- *All* EM systems are powered by energy from the local vacuum, and always have been {15}.
- Cranking the shaft of a generator is not what powers its attached external circuit.
- Dissipating chemical energy in a battery is not what powers its attached circuit.
- Burning hydrocarbons, building dams and windmills, and using nuclear fuel rods have nothing to do with *directly providing the actual EM energy from the immediate vacuum to the attached external circuits, the power grid, and external loads.*
- The charges and dipolarities in those circuits, grid, and loads freely provide that service, as "gushers" of continuously flowing EM energy transduced from the seething vacuum. *All the rest is just to switch the intensity of the vacuum's interactions with the local ions and charges and dipoles in the circuit or system.*

THE ELECTRICAL POWER ENGINEERING SITUATION: ELECTRICAL ENGINEERING DEPARTMENTS, PROFESSORS, TEXTS, AND ELECTRICAL ENGINEERS ARE UNAWARE OF WHAT ACTUALLY POWERS A CIRCUIT.

- The power engineering EM model erroneously assumes an inert vacuum, a flat spacetime, and thus an "inert external environment". In the model there is no such thing as "usable energy from the vacuum"—any net receipt of energy from the vacuum to the system is totally excluded from the discipline and the model.
- This terrible error continues even though the active vacuum and its exchange with all charges and ions has been thoroughly proven in particle physics for decades {16,17}.
- It continues nearly a half-century after proof of the asymmetry of opposite charges {8} (of any dipolarity) in their virtual particle flux exchange with the vacuum.

THE RESULT: THE MONSTROUS, CENTRALIZED POWER ENGINEERING GRID AND SYSTEM. WITH ITS INSATIABLE DEMAND FOR POWER AND FUEL, THIS SYSTEM GENERATES EVER INCREASING DESTRUCTION OF THE BIOSPHERE.

- Conventional engineering procedure *only* builds and deploys electrical power systems that (i) continuously destroy their own dipolarity and thus (ii) continuously destroy their extraction of energy from the local vacuum by reducing the activity of the local vacuum itself. And (iii) the conventional systems do it faster than they power their loads.
- The burning of hydrocarbons, use of nuclear fuel cells, building of dams and windmills, etc. escalates relentlessly, increasingly strangling the planet.
- The entire scientific community considers it primarily from the flawed standpoint of the power engineer. Even the National Academy of Sciences, National Science Foundation, and National Academy of Engineering do not realize what actually powers an electrical circuit or the power grid. All assume they do, of course—but they also unwittingly assume that every EM field, EM potential, and joule of EM energy in the universe is and has been freely created from nothing at all, by its associated source charge(s).
- Borrowing a phrase from Nikola Tesla—who gave us AC power in the first place—the present national electrical power situation is *"one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history."*

IMPLICATION: A NATIONAL POWER SYSTEM HEADED FOR DISASTER.

- Electrical professors and departments adamantly refuse to update their model.
- The National Academy of Sciences, National Science Foundation, National Laboratories, Department of Energy, and our universities still have not grasped the source of the energy that powers every electrical power system, circuit, and device.
- Electrical power engineers falsely assume that, except for the solar cell taking its energy from conventional solar radiation, one cannot build an electrical analogy to a windmill powered by "free EM energy winds" in space or vacuum. They are quite wrong. {18}.
- Every EM field and potential is already a steady state "EM energy wind" system, established and maintained by the asymmetry of the associated source charges.
- Every charge is already a "vacuum energy wind" system directly analogous to a special "solar cell". The charge's steady energy flow output is freely powered by virtual energy continuously furnished by its active vacuum environment. Every charge *proves* that such systems are not only possible but also ubiquitous. It is the scientific dogma that is flawed, not nature.
- Energy is not conserved by accounting for mass systems and observable energy alone, but by accounting for mass systems, observable energy, the active vacuum, and the virtual energy exchanges between active vacuum and mass systems.
- As Nobelist Lee {19} put it: *"Since nonobservables imply symmetry, any discovery of asymmetry must imply some observable. The experiment of Wu, Ambler, Hayward, Hoppes and Hudson… established the asymmetry between the positive and negative signs of electricity."*

- Lee {20} also briefly considered some basic ideas for directly engineering the vacuum. Ironically, Lee himself apparently did not see the source charge solution and its revolutionary implications to power systems and power engineering.
- The power company uses the energy content in fossil and nuclear fuels to crank the shaft of the generator. This forcibly separates the opposite charges in the generator and its external circuit, forming a source dipolarity. By its asymmetry of opposite charges, every dipole in that dipolarity then continuously extracts EM energy directly from its local vacuum, and pours it out to form the associated field and potential energy available in the circuit to power the loads and losses.
- In the standard closed current loop system, half the energy collected from the vacuum by the external circuit is used only to drive the spent charges through ground return back to the generator and through the back emf of its source dipole. This forcibly scatters the separated opposite charges and destroys the dipolarity, quenching the free extraction of EM energy from the local vacuum.
- The other half of the collected energy in the external circuit is dissipated in the losses and loads of the external circuit itself. So less energy is used to power the load than is used to destroy the source dipolarity.
- To get more energy from the vacuum, it is necessary to again restore the source dipolarity in the generator and external circuit. To force the opposite charges back apart, at least as much shaft energy must be input to the generator again, as was used to destroy its dipolarity.
- Hence greater mechanical energy must continually be input to the shaft of the generator than is dissipated in the loads. The standard closed current loop circuit guarantees COP < 1.0 operation. *The only reason for this insane operation is because the circuit is built specifically to require it and self-enforce it.* <u>*Nature*</u> *does not require it.*
- Thus our power engineers only build power systems that destroy their "free extraction of vacuum energy" process faster than they use *some* of the vacuum-furnished energy to power their loads. We must pay to continually crank the generator shaft to restore the dipole *that the circuit is designed to continually destroy.*
- We pay the power company to deliberately engage in a giant wrestling match inside its generators and *lose.* This is the real reason for the increasing energy crisis.
- Hence the giant pollution of the biosphere continues unnecessarily, the power meter stays on our homes and offices unnecessarily, and the gas meter stays on the gas pump unnecessarily. But the energy cartels continue to reap a bonanza around the globe.
- There is not now—and there never has been—a single electrical engineering department, professor, or textbook that knows and teaches what really powers an electrical circuit.
- Neither the scientific community—the National Academy of Sciences, National Science Foundation, etc.—nor the Department of Energy has a single funded and determined program to understand how to better utilize the free-flowing vacuum energy already powering all circuits and power systems. *None of them even realizes what powers the grid system. None of them realizes that up to a trillion times as much Heaviside energy flow* {21,22} *is unaccounted and wasted, as the Poynting energy flow* {23} *that is accounted and utilized.* The proof that any EM field or potential is a set of longitudinal EM wave energy flows is given by Whittaker {24}.
- Jackson {25} at least adds that the Poynting vector is arbitrary and a curled energy flow component could be added. But he also states it would "have no physical

significance". That latter statement is true only in a flat spacetime condition and only when the "assumed unit point charge" at each point in space is static rather than self-resonating. The Bohren experiment {22a} produces COP = 18, and indeed the entire field of "negative resonance absorption of the medium" violates Jackson's assumption. However, scientists in the "negative resonance absorption" area of optics do not discuss COP>1.0, but only discuss the change in reaction cross section.

- The seriously flawed advice of our scientific community to our government's energy decision makers is that "more of the same energy means" is what is required. Were it not so tragic to humanity and to the biosphere, it would be a cosmic joke.

- With only that flawed scientific advice available to him, President Bush is struggling to (i) allow updating old polluting power plants without additional pollution controls, (ii) allow drilling wherever oil and gas are to be found, (iii) massively increase the grid transmission lines and the number of power plants feeding it, (iv) go for fuel cells as an intended answer to the transport problem, and (v) consider building additional nuclear power plants. He has been offered no other viable choice.

- Coal is probably going to become the immediate power fuel of choice. Recently some 65% of our oil needs were filled by foreign sources. Most of that comes from unstable regions of the world. The clear danger of foreign-induced U.S. economic disaster is obvious.

- Meanwhile, the grid is "splintered", its "control" is highly disorganized and also splintered (often depending on "courtesy call" from one separated part to another). Parts often compete against each other, there is no central regulating and enforcement authority, maintenance and reliability have been scavenged, etc. As a massive system of potentially clashing servomechanisms, almost everything in the handbook for servomechanism control theory is violated by the present grid. The grid is highly unstable, terribly vulnerable, and its main "protection" is abrupt shutdown of power plants, refineries, etc. to try to prevent their damage. Even the clocks throughout the system are not all synchronized.

- Together with an aging grid with one of the poorest servomechanism control systems imaginable, the August 14, 2003 severe blackout in New York, Ohio, and Canada—and others in England, Spain, and Italy— are just the beginning.

- The recall of the governor of California for the energy disaster last year is also just the beginning, as an angered citizenry holds its political leaders accountable for bureaucratic bungling, splintering of control and responsibility, corporate profiteering, lack of liability controls and enforcement, etc.

- We need not ask for whom the warning bell tolls. It tolls for us, and it warns of an eventual great grid disaster, potential economic collapse of the U.S., and perhaps potential economic collapse worldwide. It also warns of the increasing spawning of energy wars and terrorism, in addition to ever increasing poisoning of our biosphere, strangling of species, induction of diseases, and global warming.

References:

1. Tom Van Flandern, <u>Phys. Lett.</u> <u>A</u>, Vol. 250, Dec. 21, 1998, p. 8-9.
2. D. K. Sen, <u>Fields and/or Particles</u>, Academic Press, London and New York, 1968, p. viii.
3. Mario Bunge, <u>Foundations of Physics</u>, Springer-Verlag, New York, 1967, p. 173. Note that this also assumes the source charge freely creates—out of nothing at all—its associated EM fields and potentials and their energy, in total violation of the conservation of energy law.
4. *Ibid.*, p. 176.
5. B. P. Kosyakov, "Radiation in electrodynamics and in Yang-Mills theory," <u>Sov. Phys. Usp</u>. 35(2), Feb. 1992, p. 135, 141.

6. H. D. Zeh, <u>Physical Basis of the Direction of Time</u>, Fourth Edition, Springer-Verlag, 2001 gives a very thorough discussion of time's arrow in some detail, including time reversal.

7. T. D. Lee, "Question of Parity Conservation in Weak Interactions," <u>Phys Rev.</u>, 104(1), Oct. 1, 1956, p. 254-259; — and Reinhard Oehme and C. N. Yang, <u>Phys. Rev.</u>, 106(2), 1957, p. 340-345; — <u>Phys. Rev</u>. 106(6), June 15, 1957, p. 1371.

8. C. S. Wu *et al.*, <u>Phys. Rev.</u>, Vol. 105, 1957, p. 1413.

9. Klein's geometry and group theoretic methods have driven particle physics development since 1872. See Felix Klein, "Vergleichende Betrachtungen über neuere geometrische Forschungen," 1872; also see I. M. Yaglom, <u>Felix Klein and Sophus Lie: Evolution of the Idea of Symmetry in the Nineteenth Century</u>, Birkhäuser, Boston, MA, 1988.

10. Leyton has extended Klein's geometry and group theoretic methods. See (a) Michael Leyton, <u>A Generative Theory of Shape</u>, Springer-Verlag, Berlin, 2001. For the importance of Leyton's geometry and new methods, see (b) T. E. Bearden, Fact Sheet, "Leyton's Hierarchies of Symmetry: Solution to the Major Asymmetry Problem of Thermodynamics," Aug. 22, 2003.

11. D. J. Evans and Lamberto Rondoni, in their "Comments on the Entropy of Nonequilibrium Steady States," <u>J. Stat. Phys.</u>, 109(3-4), Nov. 2002, p. 895-920 theoretically show such systems possible, but felt that real physical systems could not do it. *The charge does it.*

12. Numbers of scientists have objected to the old "heat death" prediction of the second law anyway. E.g., Steinmetz had this to say: *"The second law of thermodynamics is well founded on our experience. The reasoning from this law as to the death of the universe is logical. At the same time, the conclusion that the universe must run down is not reasonable. If the universe is eternal, has existed since infinite time, then it should have run down an infinite time ago. But if it is not eternal, but had a beginning, what was before? How could energy begin without offending the first law, that of the conservation of energy? Thus, in the final reasoning, we arrive at a contradiction."* Quoted from Charles P. Steinmetz, "The Second Law of Thermodynamics and the 'Death' of Energy, with Notes on the Thermodynamics of the 'atmosphere'," <u>General Electric Review</u>, Vol. 15, July 1912.]

13. E.g., Price states it this way: *"…the <u>major</u> task of an account of thermodynamic asymmetry is to explain why the universe as we find it is so far from thermodynamic equilibrium, and was even more so in the past."* (p. 36). And again: *"A century or so ago, Ludwig Boltzmann and other physicists… attempted to explain the temporal asymmetry of the second law of thermodynamics. …the hard-won lesson of that endeavor—a lesson still commonly misunderstood—was that the real puzzle of thermodynamics is not why entropy increases with time, but why it was ever so low in the first place."* (p. 78). Quoted from Huw Price, <u>Time's Arrow and Archimedes' Point</u>, Oxford University Press, 1996, paperback 1997. Our comment is that Leyton's extension of Klein geometry to produce Leyton's hierarchies of symmetry is the formal solution to the long-vexing time asymmetry problem of thermodynamics. The second law has simply been incomplete, and has erroneously not included negative entropy systems and interactions such as the source charge and its continuous production of negative entropy.

14. See J. D. Jackson, <u>Classical Electrodynamics</u>, 3rd Edn., Wiley, New York, 1999, p. 240-246 where Jackson shows the application of Lorentz symmetrical regauging of Maxwell's equations for the vacuum. Jackson states that the new set of regauged equations is equivalent in all respects to the Maxwell equations—which is false. The regauging has altered the stress energy density of the local spacetime and thus curved space. For a static situation, this is a relativistic rotation of frame. But classical EM assumes a flat spacetime, so it ignores the changes of local energy density of spacetime, etc. that have been made. In so doing, Lorentz-regauged classical EM does not allow the active vacuum (local curvature of spacetime) to furnish excess usable energy to the Maxwellian system, but arbitrarily discards it by arbitrarily assuming violation of energy conservation (the system potential energy was altered, but the actual environmental "source" of the regauging energy was arbitrarily discarded. This means that the standard symmetrical regauging in classical EM assumes total violation of the conservation of energy via either the destruction of energy or the creation of energy—or both simultaneously. Also see again endnote {3} and our comment on the implicit assumption of energy conservation violation by the source charge.

15. Rigorously, the "absorption" of potential energy by any intercepting charge placed in a potential (actually, in a potential intensity since that is what is used) is naught but the change in the intensity of the immediate vacuum's exchange with that particle—and thus a change of the particle's consumption of disordered virtual energy from the vacuum and a corresponding change of its production of ordered observable energy spreading in surrounding space.

16. E.g., see Willis E. Lamb Jr. and Robert C. Retherford, "Fine structure of the hydrogen atom by a microwave method," Phys. Rev., 72(3), Aug. 1, 1947, p. 241-243. Lamb received the 1955 Nobel Prize in physics jointly with Polykarp Kush for experiments measuring the small displacement later called the "Lamb shift" of 0+ne of the energy levels in atomic hydrogen. Before one writes off the very tiny Lamb shift as inconsequential, its energy density is greater than the energy density of the surface of the sun.

17. E.g., see 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 Proceeding, Koninklijke Nederlandse Akademie van Wetenschappen, Amsterdam, vol. 51(7), 1948, p. 793-796. This observable effect of the attraction of two plates is the result of interaction with the vacuum energy.

18. Some scientific papers dealing with extracting energy from the vacuum are (a) M. W. Evans, T. E. Bearden, and A. Labounsky, "The Most General Form of the Vector Potential in Electrodynamics," Found. Phys. Lett., 15(3), June 2002, p. 245-261. This paper contains the giant negentropy of the common dipole, proposes a solution to the dark energy problem of astrophysics, and clearly shows vacuum energy currents; (b) M. W. Evans, P. K. Anastasovski, T. E. Bearden _et al._, "Runaway Solutions of the Lehnert Equations: The Possibility of Extracting Energy from the Vacuum," Optik, 111(9), 2000, p. 407-409; (c) — "Classical Electrodynamics without the Lorentz Condition: Extracting Energy from the Vacuum," Physica Scripta, 61(5), May 2000, p. 513-517; (d) — "The Aharonov-Bohm Effect as the Basis of Electromagnetic Energy Inherent in the Vacuum," Found. Phys. Lett. 15(6), Dec. 2002, p.561-568; (e) — "Effect of Vacuum Energy on the Atomic Spectra," Found. Phys. Lett., 13(3), June 2000, p. 289-296; (f) — "Operator Derivation of the Gauge Invariant Proca and Lehnert Equations: Elimination of the Lorenz Condition," Found. Phys., 30(7), July 2000, p. 1123-1129; (g) — "Explanation of the Motionless Electromagnetic Generator with O(3) Electrodynamics," Found. Phys. Lett., 14(1), Feb. 2001, p. 87-94; (h) — "Explanation of the Motionless Electromagnetic Generator by Sachs's Theory of Electrodynamics," Found. Phys. Lett., 14(4), Aug. 2001, p. 387-393; (i) T. E. Bearden, "Extracting and Using Electromagnetic Energy from the Active Vacuum," Modern Nonlinear Optics, M. W. Evans (Ed.), Second Edn., Vol. 2, p. 639-698.

19. T. D. Lee, Symmetries, Asymmetries, and the World of Particles, U. Wash. Press, Seattle, 1988, p. 11.

20. (a) T. D. Lee, "Is the Physical Vacuum a Medium?", Trans. N.Y. Acad. Sci., Series II, Vol. 40, Sep. 15, 1980, p. 111-123. See also (b) T. D. Lee, Particle Physics and Introduction to Field Theory, Harwood, New York, 1981. On p. 380-381, Lee shows how there is no symmetry of matter alone, but only of matter and vacuum. Lee's own indication of the possibility of using vacuum engineering is given in "Chapter 25: Outlook: Possibility of Vacuum Engineering," p. 824-828.

21. See (a) 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. See also (b) Oliver Heaviside, "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," Phil. Trans. Roy. Soc. Lond., 183A, 1893, p. 423-480.

22. Two scientists—Heaviside and Poynting—independently and simultaneously discovered energy flow through space, after Maxwell was already dead. In a circuit, the energy flow is in space outside and surrounding the conductors, and some of the energy flow is diverged into the conductors to power the electrons and hence power the circuit.
    Poynting never considered anything but that linear-flowing diverged component of energy flow

that powers the circuit. Heaviside, on the other hand, also discovered a huge additional curled component of the energy flow, far greater in magnitude than the minuscule Poynting linear-directed flow that gets diverged into the circuit.

Since local spacetime is usually approximately flat, the divergence of the curl is zero, and the giant Heaviside curled component doesn't interact with anything. But when the Heaviside flow component is accounted, every generator and battery outputs an energy flow often a trillion times as great as their minuscule accounted Poynting energy flow.

No one in the 1880s and 1890s could explain what could possibly be the source of such a stupendous energy flow of such peculiar form. Circa the 1890s, Lorentz reasoned that the Heaviside curled component "has no physical significance" since it did not interact. So he integrated the energy flow vector itself around a closed surface assumed around any volume element of interest. This trick neatly disposes of the nondiverging Heaviside component, while retaining the diverged Poynting component. Today there does not appear to be any conventional scientist in the scientific community who realizes the existence and reality of the Heaviside curled energy flow component.

However, the Bohren experiment actually proves the existence of that giant component, and it produces 18 times as much Poynting energy output as the Poynting energy flow component one inputs to the process. See (a) 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. 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 (b) 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. The Bohren experiment is repeatable and produces COP = 18.

Notably, scientists in the field of negative resonance absorption do not mention COP, but only account for a change of reaction cross section of the "absorbing" charge—thereby (of course!) changing the fundamental definition of "field intensity" and "potential intensity" which are conventionally defined in terms of the energy absorbed by a static unit point charge assumed at the point of interest. The field itself (as compared to its "point intensity" by some assumed standard) is a set of differential functions of two bidirectional longitudinal EM wave flows, while the electrostatic scalar potential itself is a single set of bidirectional longitudinal EM wavepairs—as shown by E. T. Whittaker {24a, 24b}.

Toward the end of his life, Heaviside realized the gravitational implications of his curled energy flow giant, and produced a draft theory of electrogravitation based on it. See (c) H. J. Josephs, "The Heaviside papers found at Paignton in 1957," IEE Monograph No. 319, Jan. 1959, p. 70-76. See also (d) E. R. Laithwaite, "Oliver Heaviside – establishment shaker," Electrical Review, 211(16), Nov. 12, 1982, p. 44-45. For implications to the concept of dark energy (both positive and negative), see (e) T. E. Bearden, Energy from the Vacuum: Concepts and Principles, Cheniere Press, Santa Barbara, CA 2002, Chapter 3: Giant Negentropy, Dark Energy, Spiral Galaxies and Acceleration of the Expanding Universe.

23. J. H. Poynting, "On the transfer of energy in the electromagnetic field," Phil. Trans. Roy. Soc. Lond., Vol. 175, Part I, 1884, p. 343-361; — "On the Connection Between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field," Phil. Trans. Roy. Soc. Lond., Vol. 176, Part II, 1885, p. 277-306.

24. (a) E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Math. Ann., Vol. 57, 1903, p. 333-355; (b) — "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 was published in 1904 and orally delivered in 1903. Note: On p. 368 of the latter paper mid-page, Whittaker's equation for the y-component of vector-potential "a" is missing the exponent "2" on the del operator.

25. J. D. Jackson, *ibid.*, 2nd Edn., John Wiley & Sons, New York, 1975, p. 237.