

# BEDINI'S METHOD FOR FORMING NEGATIVE RESISTORS IN BATTERIES

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**Abstract.** We informally explain the method Bedini has used for some years in forming negative resistors on the plates in storage batteries, at the interface between the heavy lead ion current and the external circuit's electron current. As is well-known in particle physics, any dipolarity — including any scalar potential — is a broken symmetry in the virtual flux of vacuum, even though the vacuum interaction is not included in the classical electrostatics used to design EM power systems. Dipole asymmetry means that the dipole receives disordered energy from the vacuum, orders some of it, and outputs that fraction as observable energy flow in all directions. It follows that any potential and any dipole (with its potential between its two end charges) is a true negative resistor *a priori* and can be so used in circuits. In 1903 Whittaker further showed the bidirectional longitudinal EM wavepair composition of the scalar potential, such as the potential between the two end charges of a dipole. The potential is therefore a *negentropic reorganization of the vacuum energy* into a deterministic set of bidirectional energy flows. By producing an excess negative resistor potential on the battery plates and using the potential's bidirectionality, Bedini overpotentializes the ion current in charging mode and simultaneously overpotentializes the circuit electron current in back-emf load-powering mode, charging the battery while simultaneously powering the circuit. The system becomes an open system far from thermodynamic equilibrium in its vacuum exchange, and permissibly produces COP > 1.0. Lenz's law is then employed to further increase the energy collected from the vacuum and dissipated in the system. Bedini's method obeys the laws of physics and thermodynamics, and is replicable by any competent laboratory.

## Introduction

Inventor John Bedini has kindly given his permission for me to explain his use of the lead acid battery and how he gets the vacuum to contribute excess energy to the battery and to the circuit. We very informally discuss the pertinent battery features and how Bedini uses them and switches them in his units, and why he does it the way he does. We point out the specific processes that are involved in his methodology, and why he can use a negative resistor [1] in a lead acid battery to produce COP>1.0 in perfect compliance with the laws of physics, thermodynamics, and the conservation of energy law. One must use a combination of electrostatics and particle physics to grasp these processes and mechanisms, because classical EM theory does not include the active vacuum interaction, even though it has been clearly proven (theoretically and experimentally) in particle physics for decades.

In principle, generators can also be designed to utilize Bedini's negative resistor techniques. Bedini has successfully built a few such systems, but that is not discussed in this paper.

## Electrical Energy Extracted from the Vacuum by Negative Resistors Powers Every Electrical Load [2]

Vacuum energy already powers every electrical circuit and every electrical load today, and always has done so from the beginning. Contrary to the received view, negentropic extraction [3] of copious usable EM energy from the vacuum is the easiest thing in all the world to do, and it is ubiquitous to all our circuits and power systems. All the coal, oil, and natural gas ever burned in powerplants added not a single watt to the powerline. All that energy input from the fuel combustion was used only to continuously restore the source dipoles in the generators, dipoles that our scientists and engineers unwittingly design the external circuits to keep destroying. The source dipole, once established, was and is a "negative resistor" of enormous power that has powered every electrical circuit and load from the beginning.

As we shall see, Bedini discovered how to make and use a *negative resistor* right inside the battery itself.

## "Asymmetrical Regauging" Is Also Creating and Using a Negative Resistor

Every electrodynamicist already assumes (and utilizes) the fact that one can freely change the potential energy of any EM system, at will. It's called "regauging". In electrostatics, regauging can be as simple as changing the potential (voltage) on a circuit or component. E.g., Jackson's text [4], and any other important EM book one chooses, apply arbitrary Lorentz "regauging" to the Maxwell-Heaviside equations, changing them to a new set erroneously said to be identical to the former equations in every way. They are not. Specifically, that change (*symmetrical* regauging by Ludvig Valentin Lorentz [5] in 1867 and later by H.A. Lorentz), re-invokes the symmetry barrier to nature's readily available negentropy. Symmetrical regauging of the Maxwell-Heaviside equations discards all open Maxwellian systems far from thermodynamic equilibrium with the active vacuum — i.e., those systems that have been *asymmetrically* regauged (excited), and then *asymmetrically* discharge their regauging excitation energy. In short, Lorentz regauging arbitrarily discards all overunity EM systems, including those that could permissibly capture and use energy from the active vacuum to power themselves and their loads simultaneously. *A priori*, overunity Maxwellian systems must be far from thermodynamic equilibrium in the vacuum flux — much as a windmill is out of equilibrium in the wind's energy exchange with it.

## In a Storage Battery Two Major Currents of Differing M/Q Ratios Are Isolated From Each Other

First, to understand John's work one must be aware that there are *several* currents in a lead acid battery [6], not just one. For our purposes we will need just two: the heavy lead-type ion current in the battery, and the electron current in the battery at the plates but commuting into the external circuit.

Note particularly that the electrons communicate between the inside of the battery (e.g., the plates) and the external circuit, but the lead ions do not. There is thus an interface and a sharp separation between the electron current and the ion current.

Here's the point researchers are missing. Check the *mass-to-charge ratio* of each of the two currents. The lead ions' m/q ratio is several hundred thousand times the m/q ratio of the electrons, as I recall. For our purposes here, all we need to know is that the m/q ratio for the lead ions is very much bigger than the m/q ratio for the electrons.

So there is obviously a hysteresis (time delay) in the response of the massive ion current to far less massive electron currents that interact and try to change the ion current and its momentum. This time-delay in ion response to electron urging can be adroitly manipulated and used to cause the vacuum to add energy to the ions and also to the electrons. In short, the delay can be manipulated to freely "regauge" the system, freely changing its potential energy, and dramatically increasing how much potential energy is available for battery recharging and how much is available for powering the external circuit (loads and losses).

Instead of thinking of the energy John inputs to the battery as the "powering" energy, one must think of it as "triggering" and "timing" energy which initiates certain other key negentropic interactions to freely occur. The resulting negentropic interactions then add substantial additional energy to the ions in the ion current and the electrons in the electron current, for free or nearly so. In short, John "switches" and "triggers" certain kinds of vacuum exchange interactions, including the highly specialized formation of a negative resistor in the battery itself. He then "triggers" that negative resistor in certain ways to increase its functioning even further.

John's method does the following: (1) It forms a true negative resistor in a most unexpected way, inside a common lead acid battery, (2) it uses that negative resistor to extract excess energy from the vacuum and furnish it both to the ions in charging mode and to the electrons in load powering mode, and (3) it adds several other stimuli which increase the amplification of the negative resistor and further enhance the effect, increasing the excess energy extracted from the vacuum and collected in the battery-charging process and also in the circuit-powering process.

Specifically, the delay in ion response can be manipulated to place the battery in ion current recharging mode while the signal pulse electrons are simultaneously placed in external circuit powering mode. By manipulating the hysteresis and adroitly timing the electron pulses and pulse widths, one can break the forced Lorentz symmetry of the excitation discharge in a usually closed current loop containing both the battery's source dipole and the external load. This is possible since John's method deliberately opens the loop so that the vacuum energy enters freely, increasing the potentialization (energy collection) upon the ions and upon the electrons as well.

Suppose we "hit" a battery's terminals with a very sharp leading edge rise of a pulse of electrons and potential. Let us assume the "hit" is in the "battery-charging" mode. The electrons drive in instantly, trying to force the heavy ions to start moving in the charging direction. For a moment the lead ions just sit there, and then very slowly (compared to the electrons!) start to reluctantly move in the recharging mode. During that "ion response lag" time, the electrons continue to furiously rush in and pile-up on the plates. The charge density sharply increases on the plates in that pile-up where the charges are "squeezing" together (clustering). Now we have a much higher potential suddenly rising in the squeezed charge cluster, because of the increased charge density arising there.

Now we need to examine the properties of this powerful new potential that has been created.

### Unique Properties of the "Scalar" Potential

In 1903 Whittaker [7] showed us that a "scalar" potential is not at all what they taught and still teach in EM theory. If one hasn't read Whittaker 1903, one will need to do so.

As Whittaker shows, the scalar potential is a harmonic set of bidirectional longitudinal EM wavepairs, where each pair of bidirectional longitudinal waves (LWs) is a phase conjugate pair. In short, a "scalar" potential *identically is* a multivectorial, multiwave entity — but comprised of longitudinally polarized EM waves, and those waves come in bidirectional pairs. Since in each phase conjugate pair one wave is "time-forward" and the other is "time-reversed" [8], time-reversal and time-forward perturbations occur paired and simultaneously in nature's electrodynamicity. This "simultaneously organized duality" is erroneously omitted, however, in core Maxwellian electrodynamicity theory.

So the "scalar" potential is not even a scalar entity. Since Whittaker 1903, the proof has been in the literature nearly a century and it has just been ignored.

### All Scalar Potentials are Changes to (Regaugings to) the Vacuum Potential

The QM vacuum contains and is a virtual particle flux (that's one way to model it) and thus contains energy. It is (or can be modeled as) a special kind of "scalar" potential. Every EM potential is in fact a change to the vacuum energy density. Any increased EM potential in a circuit is a negentropic change to the ambient vacuum potential or to some intermediate potential that is. Rigorously, any EM potential produced in a circuit is a special kind of resistor, since extra bidirectional, flowing EM energy *from* the vacuum (for a positive potential, which is a negative resistor) or *to* the vacuum (for a negative potential or potential drop, which is a positive resistor) has been added to the circuit. However, electrodynamicists have not recognized that regauging can produce a true negative resistor. Very large bidirectional energy flows (very large potentials) can be freely added to the circuit at any time from a negative resistor (increased positive potential). But to use these negative resistors so that we extract and use energy from them, we have to learn how to more carefully use the bidirectional nature of negative resistor potentials so that we adroitly apply them in opposite directions simultaneously.

We were not taught to calculate the potential itself, but only its reaction cross section. We have been and are taught to calculate only how much energy is diverged from the potential, around a little unit point static charge (assumed), and that little "swirl-around" energy is then supposed to be "the potential". That is, the amount of energy in that little swirl is supposed to be the magnitude of the potential itself. It isn't. The little swirl-around is the energy diverged from the potential. Calling that "the magnitude of the potential" is analogous to mistaking a tiny little whirlpool in a river as the entire river. It is a similar error.

For more than a century electrodynamicists have erroneously "defined" the scalar potential "at a point" as the amount of energy diverged from it around a little fixed unit point static charge at that point. The amount of energy "swirled or diverted from all those bidirectional LWs around a little unit point static charge" fixed at a point, does indeed have a scalar magnitude. For fixed conditions, there's a fixed amount of energy in the "swirl-around" at any moment. But that "magnitude of the energy in the swirl" isn't the potential; it's what's diverted from the potential.

Obviously it's a major non sequitur to mistake "the" potential for a tiny fraction of itself [9].

As a set of bidirectional LWs, the potential is an organized ensemble of mighty, rushing rivers of EM energy, with paired rivers flowing in opposite directions. From those rushing rivers of energy comprising any nonzero "static" potential, one can collect as

much energy as one wishes, just by adding more intercepting/collecting charges. The equation is known and very simple:  $W = \phi q$ , where  $W$  is the total energy collected (diverged) from a potential of reaction cross section  $\phi$ , upon intercepting charges  $q$ . Fix the  $\phi$  to a constant value, then add as much  $q$  as is needed to have  $W$  reach any value one wishes. One can collect a gigajoule of energy from a millivolt, e.g., given sufficient intercepting charges  $q$ . The "magnitude" of the potential entity itself is not fixed at any point, because the potential is a set of continuous energy flows involving the entire vacuum of the universe. Once the negative resistor is established, the negentropically reorganized vacuum continues these bidirectional rivers of EM energy indefinitely, or until the negative resistor is destroyed.

### Using the Bidirectional Nature of the Scalar Potential

Anyway, back to our battery that we just "popped" with an electron pulse. Now we have a higher potential in that pile-up of electrons onto the interface with the ions, urging the ions forward. The potential energy being collected on those ions (i.e., diverged around them from the potential's multiwaves) is given by  $W = \phi q$ , where  $W$  is the energy collected from the *new* and *dramatically increased* potential with reaction cross section  $\phi$ , upon charges  $q$  — in this case, upon the ions. And, simultaneously, *also upon the piled up electrons on the circuit side of the battery plate*, because the waves comprising the potential run in both directions.

Set a potential in the middle of a transmission line, and it takes off at high speed in both directions simultaneously, without diminution [10], thereby revealing its bidirectional vectorial nature. The new, increased potential — from Bedini's negative resistor pile-up at the interface between electrons and ions in the battery — rushes away in both directions simultaneously into the battery onto the ions and out into the external circuit onto the electrons.

But that increased potential at the pile-up is a change to the ambient potential of the vacuum. It is *part of* the vacuum and a *negentropic reorganization* of it, reaching across the universe in all directions (or speeding out there in all directions at light speed).

Since the internal LW waves comprising the increased potential at the pile-up are bidirectional, we have *added energy* both to the electrons out there in the circuit and to the ions in there in the battery. On the circuit side of the plate and its negative resistor, a back-emf has been formed from that plate out into the external circuit. Since the electrons react (relax and move) so much faster than the ions, we can now be drawing power in the external circuit and its load, due to the instant response of the overpotentialized electrons to the back-emf between the pile-up negative resistor and the external circuit, while we are still urging those overpotentialized ions into motion in a recharging direction by the forward emf upon the charging ions.

We have thus broken the *Lorentz symmetrical discharge regauging* of the freely excited system, which is an absolute requirement for achieving COP > 1.0.

For the purist: As is well-known, the electrons individually move longitudinally down a conductor *on the average* with only a very small drift velocity, often on the order of only a few inches per hour. Most of their movement is lateral, due to their gyroscopic spin and the emf forces acting on the electrons as longitudinally restrained gyros. However, that average "drift" is comprised of an enormous distribution of electron velocities, collisions, etc. So what we have done is dramatically change that distribution underlying the drift velocity. The "current" in a circuit is admittedly not as simple as the physical movement of electrons like marbles through a hollow pipe, even though loosely one usually uses that kind of language because Maxwell used material fluid flow theory (hydrodynamics) in establishing his electrostatics [11].

In another IC-2000 paper [2], we point out that there is no such thing as an "isolated charge" anyway, when one considers the shadowing virtual charges of opposite sign in the vacuum that cluster around it. That is already well-established in QM theory. So an "isolated charge" really is a set of dipoles, where each dipole is comprised of a piece of the observed charge and one of the clustering virtual charges. Each of those dipoles contains a potential between its ends, and thus identically generates a bidirectional LW flow across the universe, altering (and structuring and organizing) the entire vacuum.

In particle physics, it has been known for more than 40 years that any dipole is a broken symmetry in the fierce virtual energy exchange between the active vacuum and the dipole charges. Nobel Prizes were awarded for these discoveries. By the definition of broken symmetry, this means that *some* of that virtual disordered [12, 13] energy continuously absorbed from the vacuum by the dipole's charges, is *not* radiated back as disordered virtual photons. Instead, it is *self-ordered* by the charges. Open systems not in equilibrium with their active environment — in this case the active vacuum — are permitted to do that, and a negative resistor dipole is such an open system in disequilibrium with the active vacuum. So the *re-ordered* component of the energy emitted from the charges is radiated back as *observable* EM field energy flow, which does interact macroscopically and observably with charges.

Rigorously, this "charges pile-up" negative resistor [14] at the plate interface between electrons and ions has *asymmetrically self-regauged the system including both the recharging ions inside the battery and the electron current out in the external circuit now forced into powering mode*. The reorganized vacuum has added excess energy to the entire system, the excess being energy which was extracted from the vacuum by that pile-up of charges, each with its associated clustered virtual charges, so that the charge pile-up acts as a cluster of dipoles and therefore as a cluster of negative resistors.

We have specified a process which asymmetrically self-regauges the system, using excess energy from the vacuum. The increased potential at the pile-up is in fact a direct change to the entire vacuum. It is a negentropic organization of the entire surrounding vacuum. To the system the change in the vacuum is negentropic because the vacuum energy has been organized into a bidirectional set of flows. Such negentropic self-organization is permissible in an open system not in equilibrium with its external active environment [15]. All this is based on rigorous, proven physics, but it is not in the hoary old classical electrostatics, which contains a great many foundations errors and omissions.

The set of bidirectional energy flows involving the entire vacuum and comprising that increased potential at the pile-up, represents a re-organization of the local vacuum to a more ordered energy state. In short, *negentropy*. The pile-up of charges and its associated potential (negentropic reorganization of the vacuum) constitute an *active negative resistor*.

This is the way that John creates a negative resistor directly inside a lead acid storage battery and in several other kinds of batteries also. The pile-up becomes a true negative resistor, extracting additional biwave flowing energy from the external vacuum. The negative resistor *receives* energy from the vacuum in that half of the unobserved internal LWs that flow from every point in external space to the pile-up. The negative resistor then sends that organized energy out into the "circuit" in that half of the potential's

internal LWs that flow out into the battery and in the opposite direction into the external circuit and on out to every other point in the universe.

One should again check Whittaker 1903 and think about that extra "pile-up" potential as a harmonic set of bidirectional EM longitudinal wavepairs, until one understands this active negative resistance effect clearly.

The permissible, justified, scientific result is that the energy of the system is freely and dramatically increased (the system is regauged) from the negentropic vacuum. The ions in that increased energy flow into the battery take on more energy than we ourselves "input", with the excess being taken from the reorganized vacuum by the action of the negative resistor formed at the pile-up. The charges in the pile-up took on more energy, taken from the vacuum, and the higher potential also flows at the speed of light back out the terminals along the conductors, potentializing the surface charges and *increasing the intercepted energy diverged into the conductors by the surface charges*. Since a back-lash emf exists from the higher potential at the pile-up and the initial potential out in the external circuit, electron current flows in the external circuit (1) in circuit-powering mode, and (2) with greater energy collected upon the electrons from the increased Poynting energy flow diverged into the circuit conductors.

John puts in some electrons and potential and makes a negative resistor — in the process, he negentropically reorganizes the surrounding vacuum energy. The action of the negative resistor then overpotentializes both the battery-charging ions and the circuit-powering electrons, dephasing the one from the other by 180°. The vacuum furnishes the extra potential energy. So John now has lots more energy in the circuit than he himself put in, both to recharge the battery and power the load.

The net result is that the system receives additional bidirectional energy flow from the negentropic vacuum, courtesy of having produced a negative resistor and tricked the active vacuum to momentarily give it lots of excess energy (potential energy). It collects some of that excess energy upon both the recharging ions and the circuit electrons back-forced to power the circuit. Note that the formation of the negative resistor actually produced in the external circuit a powerful "back emf" which is of the circuit-powering type, even though in the battery the "forward emf" ion current is still moving and accelerating in the battery-charging direction — exactly opposed to the direction of the external circuit's electron current [16].

So the timing and negative resistor effect simultaneously introduce additional energy extracted from the vacuum to (1) the battery charging process, and (2) the load powering process in the external circuit.

### **Enhancing the Negative Resistor and Increasing the Extra Energy Collection**

Then we deliberately cut off the pulse sharply, with the ions now moving in the charge direction and with the electrons in the external circuit powering the load. The sharp cutoff rate produces a very interesting effect here also, if we end it just precisely while most of the pile-up (and higher potential) still exists at the plate-ion interface. In that case, Lenz's law applies due to the sharp cutoff and it aids us, since momentarily the negative resistor potential is *even further* dramatically increased by the Lenz reaction! So *even more* potential energy momentarily surges out onto the circuit electrons in the "powering the circuit" mode, and *even more* potential energy simultaneously surges onto the ions in the "charging the battery" mode.

The result of this second effect is that (1) the negative resistor is again increased, (2) even more energy is furnished from the vacuum to the battery-charging process, and (3) even more energy is furnished from the vacuum to the load-powering process.

In short, the system suddenly and remarkably increases the negative resistor effect, self-regauging itself for the second consecutive time, and increasing the excess energy extracted from the vacuum!

This second surge of excess energy comes directly from the negentropically reorganized vacuum, from the suddenly increased negative resistor, via those suddenly increased bidirectional longitudinal EM wave energy flows between the pile-up and every point in all the surrounding space. That's what a bidirectional set of wavepairs *means*; observable energy flows from the pile-up (source dipole) to every point in external space, and from every point in external space virtual (complex) energy flows to the source dipole.

That is the second case where we cause the external circuit to be "regauged" and change its potential energy freely, and we cause the internal ions to be "regauged" and change their potential energy freely.

### **Difference Between Conventional Operation and Bedini's Operation**

We accent that electrodynamicists already assume that any EM system can freely change its energy at any time; it's called "regauging". It is inexplicable that electrodynamicists have not focused upon actually producing self-regauging circuits which *asymmetrically* discharge their freely increased energy, as John has done, so that the dissipated energy is used to recharge the battery while also powering the load. Instead, the electrodynamicists continue to give us *closed unitary current loop* regauging circuits which *symmetrically* discharge their freely increased energy, so that half the excitation energy is dissipated to destroy the negative resistor source dipole of the generator or battery while the other half of the excitation energy is dissipated in the external loads and losses.

On the other hand, during the negative resistor phases of operation, John uses half the excess regauging energy from the negative resistor to *restore* the battery (source) dipole, and uses the other half to power the load and losses simultaneously. So he *asymmetrically* discharges the free excitation energy received from the vacuum via the negative resistor.

### **A Third Effect: Ion Current Overshoot**

But back to John's battery process. Now we have the Lenz effect pulse finally removed and the ions moving in charging mode but slowing down now. Since the Lenz law effect dies rapidly, we have a rapid resumption of "draw" of electrons from the pile-up into the external circuit to power it. But for a bit, the heavy recharging ions only start to slow and have not yet stopped completely. They "overshoot" because of their sluggishness, and keep on charging the battery a moment longer. During this third moment, the external circuit is still being powered even though the battery is still in charging mode. The electron pile-up is in fact momentarily acting as a discharging capacitor to power the external circuit.

When all these "excess energy" mechanisms are added, one finds that excess energy can be collected from the vacuum by the negative resistor and used appropriately to produce a system with a permissible overall COP>1.0 performance. The dramatic difference in John's method — during its negative resistance phases — and the conventional method, is that in John's method the same

current through the load *does not* pass back through the back emf of the source dipole negative resistor to *continually destroy* it. On the contrary, he inverts the phase of the current through the source dipole negative resistor to *continually restore* it.

### **Additional Schemes and Variations Are Possible**

There are several other schemes that can be used at this point. If the follow-on pulsing etc. is matched to again initiate the effects discussed, one can continue to draw power in the circuit while charging the battery, etc. for about a succession of the three periods of time: (1) the initial hysteresis pile-up, formation of the negative resistor, and associated effects, (2) the following Lenz law reaction, increase of the negative resistor, and associated effects, and (3) the follow-on period of simultaneous charging the battery and powering the circuit from the pile-up while the overshoot of the ions is still slowing and ending.

One trick John sometimes uses is to time the next pulse front to arrive just at the time that the ions are almost but not quite stopped in their "overshoot" charging mode and are preparing to reverse into discharge mode (following the electrons in the external circuit, which are already in that mode). With the exact timing, the whole situation starts over. There are other variations that John has also used and found effective.

In developing this methodology, over a period of years John built a variety controllers and timers, and experimented with a variety of pulses, pulse widths, and timing to get it all just right for a specific battery of interest. He had one little battery-powered motor — an inefficient little beast with only about 35-40% normal efficiency — which continuously "ran off the battery" seemingly (actually, off the excess energy from the negative resistor created and manipulated in the battery) for a couple of years. The motor represented a "load" continually being driven by the excess energy extracted from the vacuum by the negative resistor continually created in the battery. He recharged the battery and ran the motor directly off vacuum energy, using the precise set of negative resistor effects just discussed.

### **John's Negative Resistor Approach Has Been Replicated**

John has freely shared his work with many researchers. E.g., Bill Nelson [17], an excellent microwave switching engineer, visited John and observed some of John's devices working. Nelson reasoned correctly that the motor was just a load and played no part in producing the excess energy. So Nelson and another engineer used an electric light bulb as the load, adjusted the pulses and timing appropriately, and produced a little unit which kept its battery charged while continuously illuminating the light bulb. John shared his research with Jim Watson [18], who succeeded in developing a version that powered a much larger motor (8 kW) which he demonstrated at one of the International Tesla Conferences. Watson and his family were later to mysteriously drop out of all contact, so that even his own financial backer could not find him. Ron Cole [19] visited John's lab often, and Ron and John built several successful and similar devices together.

### **Additional Pulsing and Timing Variations**

There are several other powering schemes that can be worked out, using the negative resistor created inside the battery by splitting the current phases. E.g., with the ions moving in discharge mode and the circuit being powered, one can again introduce a sharp voltage pulse of electrons for charging, onto the circuit. This of course invokes Lenz's law, dramatically increasing the powering of the circuit and the energy upon the ions driving the circuit powering. Now the pile-up occurs even stronger, because the ions keep bearing down in charging mode with increased energy, while the electrons are forced to keep boring in much more densely to oppose them, yet on the other end the electrons are even more strongly powering the circuit momentarily because of the increased regauging energy. So the pile-up becomes even higher than before, increasing the potential of the pile-up even more due to the "charge squeeze" effect being greater. In other words, we make an even greater "negative resistor" at that pile-up. This will greatly amplify the potential out into the circuit, and also greatly increase the potential on the "powering" ions, so that the ions have more energy to give to the pile-up and to the circuit, and so do the electrons in the circuit. Again, when the "back-popping" pulse sharply cuts off on the trailing edge, one gets a Lenz law effect of *further* increase, etc.

There are a great variety of useful excess energy schemes which can be worked out and applied, all using the excess energy freely obtained from the vacuum by the negative resistor created and manipulated bidirectionally in the battery.

Once one understands John's negative resistor effect and its bidirectional actions, how one increases it, and how one sustains it or repeats it rapidly, then one can adjust that motor (or other load) and that battery to function as a self-powering system, perfectly permissible by the laws of physics and thermodynamics. Because of the negative resistor effect and its extraction of excess energy from the vacuum [3, 12], this open dissipative system can output more energy than the chemical energy that is dissipated in the battery. In fact, the chemical energy is not dissipated, but remains because of battery recharging when the timing and negative resistance effects are properly adjusted. Then everything just runs off the vacuum energy from the negative resistor.

The point is this: The system uses two major currents greatly differing in their momentum and responses, that can be exploited to get these negative resistor effects. So why do all our power system theorists just continue to assume a "simple current" in and through the battery? If one ignores the duality of currents and  $m/q$  ratios, one will just mush over any transient negative resistor effect and the effect will not help, because one will get it wrong as much as one gets it right.

But if we know what is happening in there, and if we deliberately manipulate the phenomena *as John Bedini has done for years*, we can make a battery recharge itself at the same time that it is powering the external circuit, because of a negative resistor formed in the battery and properly manipulated. Actually the energy extracted from the surrounding negentropically organized vacuum is powering both the battery's recharging action and the circuit's loads and losses.

### **A Two-Battery System is Very Practical**

The Bedini negative resistor effects can and will occur in a battery that is almost completely discharged, and John has also demonstrated such specific negative resistor formation and operation in a nearly uncharged battery for a sustained period of time.

For ease in building and timing the system, John often prefers to use two batteries and switch between them. He will charge one as ostensibly an additional part of the load, but all the while adjusting his pulses in the charging process to dramatically open the

process and get the injection of a lot of excess vacuum energy in there via similar phenomenology to what we described above. Meantime, the other battery is powering the circuit normally.

Then he just switches the batteries in their functioning. Now he recharges the first battery, including evoking negative resistor effects in it, while powering the circuit and its loads from the second, recharged battery in conventional fashion. He *organizes* the vacuum, and then the amount of excess charging energy he tricks the vacuum into giving him through the negative resistor in the recharging battery, is "free" energy he can then use to power the system when he switches the recharged battery into system-powering position. He continues to alternate the batteries in this fashion, which yields a self-powering open dissipative system, freely extracting all its energy from the active vacuum. In that case, he makes the charging battery charge a lot faster by the negative resistor effects than just with the simple energy he inputs in his pulsing and in his "normal charging currents" to the battery. He "opens" that battery-charging process and subsystem the way we described, so that the vacuum furnishes the recharging input energy.

### **Remarks On the Thermodynamics of the Bedini Method**

Here are our comments for the skeptics who love to quote the second law of classical thermodynamics. Classical thermodynamics is *equilibrium* thermodynamics. While the system is open and receiving excess energy from the vacuum, it is far from equilibrium and does not have to obey the old *equilibrium* thermodynamics with its infamous second law [20]. Indeed, classical thermodynamics *does not even apply*, including the second law. Here also is a magic truth: The energy of an open system not in equilibrium is always greater than the energy of the same system in equilibrium [21]. Bye-bye second law of thermodynamics for non-equilibrium systems. Such systems are in an excited state and must give up energy to restore their equilibrium.

In John's systems, the thermodynamics of a system far from equilibrium with its active environment (in this case, the active vacuum) rigorously applies. *The formation of the negative resistor also negentropically reorganizes the surrounding vacuum itself, so that a portion of its energy flows are no longer random and statistical but are organized and deterministic.* As is well-known in disequilibrium thermodynamics, an open disequilibrium system is permitted to (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator himself inputs (the excess is just taken from the active environment, in this case the vacuum), (4) power itself and a load also (in that case, all the energy is taken from the active environment, in this case the active vacuum), and (5) exhibit negentropy. John's devices have exhibited all five effects for years.

The laws of physics and thermodynamics already permit this to happen. We just have to correct the foolish old flawed notion in electrostatics of what powers the external circuit. Batteries and generators do not use the energy input to them (generator shaft energy) or available to them (chemical energy in the battery) to power the external circuit! We fully explain that in a second paper [2]. The chemical energy available in a battery and the shaft energy input to a generator are dissipated only to restore the source dipole that our *closed unitary current loop* power systems keep destroying by design.

No laws of nature, laws of physics, or laws of thermodynamics are violated by John's novel negative resistor approach. The conservation of energy law is obeyed at all times, as of course is recognized for open dissipative systems. As an example, Ilya Prigogine was awarded a Nobel Prize for his contributions to nonequilibrium thermodynamics of systems similar to those we are discussing.

One can make an overunity system whenever one wishes, with adroit use of a lead-acid battery (or two of them) where one pays meticulous attention to the production and use of a negative resistor inside the battery itself. The science is there and it is correct. It is already present in physics, but it isn't in the seriously flawed classical electrostatics. The full basis has been in the textbooks for decades, but it has not been applied by EM power system designers. Instead, they continue to ignore the active vacuum and ignore the creation and manipulation of negative resistors in batteries by current splitting and adroit manipulation.

How many readers have thought of using the appreciably different response times of the electron current and the ion current? How many professors have thought of it? How many textbooks mention it? What EM text points out that a scalar potential is actually a set of bidirectional longitudinal EM wave energy flows, conditioning and organizing the entire vacuum? What paper in a scientific journal contains it? One gets the point after only a moment's reflection.

### **What Is Required To Develop This New Approach Into a Full Energy Technology**

For the interested scientists, advanced engineers, and strategic planners: What is needed to make all this quite rigorous is the development and usage of a dual instrumentation system. A proper instrumentation system is required to measure and portray the ion current in the battery and its actions, and simultaneously to measure and portray the electron current in there at the interface. Then one can add the standard instruments to monitor the electron current, voltage, phase angles, and power in the external circuit.

To get those two "internal" instrumentation systems, some *electrochemists* are required who know about measuring things like that, know about overpotentials on electrodes and plates and such, understand all the internal chemical and ion reactions including their energetics, and have worked out measurement techniques for such matters. To an electrical engineer, the problem usually appears unsolvable (many, e.g., have no knowledge of overpotential theory, or of double surfaces theory, or differentiating multiple current types in a battery, etc.).

What is needed is a straightforward and well-funded scientific project by a good scientific team, first to develop the instrumentation and procedures, and then to perform full experimentation to thoroughly explore and measure the phenomenology. Then the leading theorists can produce a good theoretical model, including of the interaction between vacuum energy and the circuit, while the developers give us a good measurement and instrumentation system for precisely measuring such systems. Once we get the experimentally-fitted theoretical model and we have the instrumentation system, then we're off and running with applied engineering, to design and build self-powering battery-powered systems (actually as open systems adroitly extracting and using energy from the ubiquitous vacuum) on a massive scale for the world market.

Major universities and laboratories should fund such work as a matter of great scientific priority. So should the U.S. National Science Foundation and National Academy of Sciences, the Russian Academy of Sciences, the U.S. Department of Energy, the private research institutes, the Environmental Foundations, etc. If they do so, then we'll all have overunity devices powering our

automobiles and homes and factories straightaway. And we will also take a giant stride toward cleaning up the pollution of the biosphere.

### Why Scientists Have Misunderstood How Electromagnetic Systems Are Powered

Again we stress one point above all else: Batteries and generators do not use their internal energy — that we input to them or that they possess — to power their external circuits! The reader should not miss the importance of this statement. All that the entropic dissipation of the shaft energy input to a generator does, or entropic dissipation of the chemical energy available in a battery does, is perform work upon the internal charges to separate them and form the negative resistor source dipole. Not a single joule of that dissipated generator shaft energy or that battery's dissipated chemical energy goes out onto the power line. Every electrical circuit and electrical load is now and always has been powered by energy extracted directly from the vacuum by the source dipole acting as a negative resistor due to its known broken symmetry in the fierce vacuum energy flux.

To clearly understand this, we must temporarily set aside the 136-year old flawed electrostatics (Maxwell's seminal paper was given in 1864), and turn to particle physics, because the founding electrodynamicists did not have an active vacuum in the equations, and it still isn't in there.

In the latter 1950s, particle physicists discovered and experimentally proved broken symmetry, and also found that every dipole is a broken symmetry in the continuous virtual energy exchange between vacuum and dipole charges. The very definition of "broken symmetry" means that something *virtual* has become *observable*. This means that part of that fierce, virtual, disordered [12] energy continually absorbed by the end charges of the dipole, is not re-radiated as virtual, disordered energy — but as observable, ordered energy. In short, the ubiquitous source dipole is in fact a ubiquitous negative resistor *par excellence*.

The source dipole, *once made*, is a true negative resistor that freely extracts *observable, usable* field energy from the vacuum, and copiously pours it out through the terminals of the generator or battery. The outflowing energy moves at light speed through all space surrounding the conductors of the external circuit, and generally parallel to them. It's a tiny bit convergent into the wires, because in the "sheath" or boundary layer of the flow right down on the surface of the conductors, that part of the flow strikes the surface charges and gets diverged into the wires to power up the electrons and the circuit.

Every electrical circuit and every electrical load is and always has been powered by energy extracted directly from the vacuum by the negative resistor source dipole. That statement is fully justified in particle physics, but not in electrostatics. The electrodynamicists and leaders of the scientific community have refused to change the flawed foundations and gaps in EM theory, even though a great deal has been learned since 1867 that substantially changes the foundations assumptions used originally to construct the theory.

The energy extracted by the source dipole from its negentropically reorganized vacuum, sprays out of the terminals of the battery or generator, filling all space around the external conductors. A good illustration of this incredible energy flow is shown by Kraus [22]. The magnitude of the extracted energy flow is so great as to numb the imagination. In a simple little circuit, it is about  $10^{13}$  times as much as is intercepted in that little "sheath flow" by the circuit and diverged into the circuit as the Poynting component to power it. It is little wonder that the enormity of that total energy flow extracted from the vacuum by the source dipole was bewildering and highly embarrassing, back there in the 1880s.

And therein lies one of the greatest scientific *faux pas* of all time.

### How the Energy Flow Theory Became Muddled and Confused

Energy flow through space was discovered independently by Heaviside [23] and Poynting [24] and at about the same time. Poynting only thought of, and accounted, the feeble little component of energy flow that actually entered the circuit — in short, the energy in that "little sheath or strip" flow right down on the surface of the conductors. He never even imagined all that nondiverged, nonintercepted energy component missing the circuit entirely and just being wasted. But Poynting published prestigiously, while Heaviside published more obscurely, and the theory of EM energy flow was named after Poynting.

Heaviside realized the entire energy flow [25], including the huge nondiverged component that entirely misses the circuit — the component that Poynting missed. Heaviside also corrected Poynting on the overall flow direction (Poynting missed it by 90 degrees) [25]. Note that Maxwell was already dead at the time.

Then the great Lorentz entered the energy flow picture, and confronted a massive problem. How was one to account for the inexplicably enormous nondiverged Heaviside energy flow component that was pouring forth from those terminals? And why did the circuit only catch such a feeble little Poynting fraction of the overall energy flow? That Heaviside energy flow output is far greater than even a great number of power systems contained or were thought to output. At the time there was absolutely no conceivable way to account for the enormous magnitude of the nondiverging energy flow component. However, Lorentz could see that the Poynting component fit the circuit measurements because it entered the circuit and was dissipated in the circuit. He could also see that the Heaviside component did not enter the circuit and so played no further part in circuit operation.

So Lorentz hit upon a stratagem. He *eliminated* the problem rather than solving it. He reasoned that the *nondiverged* Heaviside component of the energy flow was "physically insignificant" [Lorentz's term] because it was not used in the circuit and did not even enter it. So he integrated the energy flow vector itself around a closed surface surrounding any little volume of interest. Voila! That little trick discarded that bothersome huge nondiverged Heaviside component of the energy flow. It's physically still there around every circuit, but the circuit does not catch it and the electrodynamicists just continue to ignore it as "physically insignificant". Lorentz's trick retained the *Poynting component only*. But since that is the energy that enters the circuit and is collected by it, then it will be the energy that the circuit dissipates in its losses and loads. So it will match our instrumental circuit measurements, *since we measure dissipation*. I have a 1902 reference by Lorentz [26] where he did that little integration trick, but it is in a book so he very probably did it in an earlier scientific paper which I have yet to locate.

Following Lorentz, the electrodynamicists just arbitrarily threw away far more available EM energy associated with every circuit than they retained [27]. All the electrodynamicists fell into line, and they are still in the same line after a century, marching along to Lorentz's cadence [28]. The neglected Heaviside energy flow is still physically there as a special negentropic organization of the

vacuum surrounding every circuit, *just waiting to be used*. E.g., if we retroreflect the passed Heaviside energy flow component, we can send it back across the circuit's surface charges again and catch some more of it. Do it iteratively lots of times — as in intensely scattering optically active media — and we will have asymmetrical self-regauging and what has been called "lasing without population inversion" [29, 30]. Or just resonate an intercepting charge — as per Letokhov and Bohren — and it will sweep out a greater geometrical reaction cross section and collect additional energy from the Heaviside component (18 times as much more energy as an identical but static particle collects). Letokhov has published in many journals on this subject since 1957. In an article in Contemporary Physics Letokhov [31] has freely called such excess energy collection and emission a process for a "Maxwell's demon" — in other words, a special kind of negative resistor.

True overunity systems and negative resistors have been built and demonstrated by several inventors and scientists such as Bedini, Golden, Nelson, Watson, Letokhov, Bohren, Chung, Kron, Sweet, etc. They do work, and in fact John can demonstrate one at any time. But instead of valid scientific attention and courteous scientific treatment, the scientists and inventors who have pioneered this legitimate overunity area have often been hounded, persecuted, vilified, etc. Careers of legitimate scientists attempting to scientifically investigate this area have often been ruined.

### **A Change In the Scientific Mindset Is Needed**

What is needed is *not* another group of grasping "vulture capitalists" and stock scam artists seeking a fast fortune by selling stock and licenses to the gullible public. What is needed is for the organized scientific community to face its responsibility and its serious errors in electrodynamics, and (1) correct the terribly flawed classical electrodynamics as a matter of the highest scientific priority, including at the foundations level, (2) fund legitimate overunity EM power system investigators, scientists, engineers, and serious inventors before they produce the final demonstration model; just as they have funded hot fusion researchers for decades without the process ever adding a single watt to the power line, (3) set aside at least 1% of the energy research budget for high priority vacuum-energy-powered systems and phenomenology research, and (4) recognize that conventional leading institutions which are bastions of the present theory have zero experience, zero expertise *and usually zero institutional tolerance* for the new overunity EM systems area. They do not have, and do not even wish to develop, any legitimate theory of permissible EM power systems as open systems in disequilibrium with the active vacuum, freely using vacuum energy via the creation and manipulation of internal negative resistors.

The scientific community — including the leading scientific journals and scientific associations — now must honestly face its energy and biospheric responsibilities and reassess its adversarial position on overunity EM power systems. For decades the community has been a major part of the vacuum energy problem, not part of the vacuum energy solution. It already intercepts, controls, "cuts up," prepares and sends down the energy research budget packages, which all those research professors, sharp grad students, and sharp young postdocs must seek funding from, in fierce competition. The scientific community has already *pre-determined* what shall and what shall not be allowed as permissible EM power system research. And its woeful past record as an adversary of overunity EM power systems speaks for itself. Its years of neglecting and opposing practical electrodynamically-initiated vacuum energy extraction have resulted in the ever-increasing pollution of the planet and a threat to the life and survival of every species, including the human species itself.

### **Without the Source Dipole As a Negative Resistor, Science Implies Innumerable Perpetual Motion Machines**

Classical EM excludes the interaction of the vacuum in its power system theory, and implies that the "source charge" freely creates all that field energy and potential energy reaching across the universe in all directions, and creates it right out of nothing. Yet parts of this same community habitually label the serious open dissipative system EM researcher as a "perpetual motion machine" lunatic. This is an ad hominem attack and has nothing to do with science, scientific method, or scientific critique. Besides, in our very worst nightmares, we overunity energy researchers could not begin to advocate such a vast array of perpetual motion machines as does the present scientific establishment, which implicitly advocates every source charge in the universe as a perpetual motion machine of the grossest kind, ignoring a resolution of the source charge problem that has been available for almost half a century in particle physics.

Many skilled scientists have tried and are trying to advance electrodynamics and correct its flaws. These scientists included or include Nobelist Feynman and the renowned John Wheeler, as well as many others such as Evans, Barrett, Cornille, Lehnert, Yang, Mills, Vigier, de Broglie, etc. When Maxwell constructed his theory, the electron and atom and atomic nucleus had not been discovered. The three dozen or so electrodynamicists worldwide all believed in the material ether, so to them there was no point in all the universe where mass was absent. A "charge" was just a piece of electric fluid, nothing more, nothing less. Maxwell wrote a material fluid flow theory, and he also left out half the energy, half the wave in space, etc. because he omitted Newtonian third law reaction. Mechanics and electrodynamics continue to omit one of the most fundamental principles of all nature: that *the observed effect acts back through the observation process upon the unobserved cause*. This principle does appear, however, in general relativity. But in mechanics and electrodynamics, as a result of this terrible omission, Newton's third law remains an effect without a cause, mystically appearing out of nowhere and producing that half of the energy and effect that Maxwell erroneously omitted.

### **A Final Word On Entropy**

Simply put, entropy refers to increasing energy disorder, where disorder is the effect. However, the back-reaction of the effect upon the cause, omitted from mechanics and electrodynamics [32] but present in general relativity [33], has not been taken into account. That principle means that each time there is a disordering of energy, there is *simultaneously* a reordering of an equal amount of energy. Entropy and negentropy occur as twins, simply from the occurrence of the potential as a harmonic set of bidirectional phase conjugate pairs of longitudinal EM waves. We usually apply one set of those waves (the forward time set) and ignore the second set (the time-reversed set or phase conjugate set).

In every experiment where an incoming EM wave from space affects a receiving wire antenna, not only do the Drude electrons recoil, but also the positive nuclei recoil with equal energy, though highly damped because of the enormous m/q ratio of the nuclei. Eerily, hundreds of thousands of scientists and engineers have been taught to measure the Drude electron recoil and state they are

measuring the "incoming wave" disturbance. Not so. They are measuring the effect of half of the interaction; the other half of the cause omitted by Maxwell interacted with the time-reversed nuclei, and produced the Newtonian third law recoil forces. Every scientist will acknowledge the accompanying recoil of the nuclei, then will mystically invoke a demon who stands in the wire, observes the disturbance of the electrons, and kicks the nuclei equally and oppositely. A similar situation occurs in a wire transmitting antenna, where the recoiling nuclei also perturb the surrounding spacetime with equal energy as do the perturbed Drude electrons. *Equal energy perturbation* of ST means equal ST curvature perturbation. So *two* ST perturbation waves are launched simultaneously, not one. One is a time-forward wave, the other is a time-reversed wave, and they are paired together.

One can also consider it from another viewpoint: The vacuum is a giant potential, which means it can inherently be decomposed into Whittaker's bidirectional longitudinal EM wavepair sets. *A priori* any perturbation of the vacuum must disturb those bidirectional waves, thereby producing bidirectional wavepair disturbances, not "plucked string" waves. There are no taut physical strings in the vacuum! Maxwell omitted the time-reversed half of the vacuum disturbance, because the atom, nucleus, and electron had not even been discovered at the time, and because he *assumed* the taut string wave *a priori*, following Faraday's lead [34, 35]. Maxwell's reasoning was just that Faraday's taut string "lines of force" under tensile stress were what were perturbed.

### In Conclusion

We have explained what Bedini is doing in that lead acid battery, and why his COP > 1.0 systems really do work. He has done enormous experimentation for years. He has built many units which exhibited the overunity effect by creating and using a negative resistor in the battery, and some which also exhibited the self-powering effect. With a little proper scientific funding and support, a team of scientists working with Bedini can quickly produce working overunity EM power systems, the theoretical model, and the instrumentation system. Bedini-type systems are easily and cheaply produced in conventional manufacturing plants. Development and availability of such Bedini-type negative resistor systems will start a rapid, world-wide resolution of the so-called "energy" problem. That will also start a rapid clean-up of this suffering biosphere, which is now being poisoned and destroyed by hydrocarbon combustion waste products at an ever-increasing rate. It will also revolutionize the living standards of the developing nations and peoples.

In spite of the previous and present vilification of the overunity researchers by the scientific community, I have great faith in the scientific method, once it is unshackled and permitted to function and be funded. But just now, the scientific community continues to impose seriously flawed theories and approaches upon the laboratories and scientists, and actively blocks the innovative overunity EM power systems research that could save this planet and humanity. Science can do better than that, and science must do better than that. Else in a few more decades none of the rest of the scientific works will matter anyway, as the nature we are now destroying turns upon this upstart humanity and destroys us all.

We thank the reader and the leaders of the IC-2000 Congress for bearing with this informal write-up and explanation of Bedini's negative resistor method for overunity and self-powering battery-driven systems. We believe it is of great importance — to the experimenters, the inventors, the scientists, the nations of the Earth, and every human being on this planet.

### REFERENCES

1. We define a negative resistor as any component or function or process that receives energy in unusable or disordered form and outputs that energy in usable, ordered form, where that is the *net* function performed. We specifically do not include "differential" negative resistors such as the tunnel diode, thyristor, and magnetron which dissipate and disorder more energy overall than they order in their "negative resistance" regimes.
2. See Thomas E. Bearden, "On Extracting Electromagnetic Energy from the Vacuum," Proceedings of the IC-2000.
3. Herein lies one of the greatest principles in physics. To produce entropy, one must do work, which eventually produces disordering due to the imperfection of devices for changing the form of energy in forward time. Hence one must "pay" the universe in order to wrestle nature and force her to disorder and disorganize energy, thereby producing entropy. On the other hand, nature loves to reorganize her energy at a moment's notice that she should do so! Given the slightest chance, nature will freely and gladly reorganize the entire vacuum energy, simply if *allowed* to do so by opening a little asymmetry (porthole) through which she can pour out copious organized excess energy! In that case, nature massively produces negentropy, gratefully *paying us* with unlimited energy flow for making that little porthole and allowing her to perform her beloved negentropic reorganization. In our "brute force" entropic terms, negentropy is "negative work", which equates to freely receiving excess organized energy from nature for allowing her the opportunity to reorganize the universal vacuum energy. So negentropy itself costs nothing at all; you always get it for free, but you also must make provisions to accept the free energy flow through the porthole opened by a little entropic work. All one has to entropically "pay" for is to create the conditions (i.e., the negative resistor conditions) that allow nature to suddenly reorganize *as she is always attempting to do and being restrained by symmetry!* Paying to make a simple little dipole, a potential difference in a circuit component, etc. does require that we entropically pay a little to make the negative resistor. Once made, the negative resistor allows nature a "porthole" through which to furnish us copious organized energy, from the massive reorganization of the entire vacuum energy that nature immediately and joyously performs. We have thus uncovered the real secret for what Nobelist Lee was seeking in his view of "vacuum engineering". See T.D. Lee., Particle Physics and Introduction to Field Theory, Harwood, New York, 1981, p. 380-381. Also, on p. 383 Lee points out that the *microstructure* of the scalar vacuum field (i.e., of vacuum charge or the vacuum potential) is not utilized. Lee was unaware of Whittaker's 1903 work and the ease by which the vacuum will reorganize into bidirectional longitudinal EM wave energy flows, by producing a simple dipolarity. So he essentially missed the negentropic approach to vacuum engineering, while seeking an entropic approach. Lee's own thoughts on engineering the vacuum are given in Lee, *ibid.*, "Chapter 25: Outlook: Possibility of Vacuum Engineering," p. 824-828.
4. J. D. Jackson, Classical Electrodynamics, second edition, , Wiley, New York, 1975, p. 219-221.
5. 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.

6. For the chemistry and currents of the battery, see any good battery reference, such as Colin A. Vincent and Bruno Scrosati, *Modern Batteries: An Introduction to Electrochemical Power Sources*, Second Edition, Wiley, New York, 1997.
7. E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," *Mathematische Annalen*, Vol. 57, 1903, p. 333-355.
8. In each bidirectional LW wavepair, if one does not wish to think of time-reversal, one may conceive of the inward converging phase conjugate replica wave as an EM wave in the complex plane. Since the process of observation selects only entities in the real plane, this "backwards-traveling" EM longitudinal wave in each of the wavepairs is nonobservable, so long as it is "covered" by the real plane outward going wave half. When reacting with a dipole, it appears that the forward-time half of the wavepair reacts with the negatively charged end of the dipole, and the complex plane (or reversed-time) half of the wavepair reacts with the positively charged end of the dipole. Since the positive charge is also a conjugate charge, the product of the interacting conjugates (positive charge and arriving complex LW) gives a negative sign for the production of forces and fields. In short, this is what generates Newton's third law in physical colliding bodies and in physical interactions. It is this "splitting of the biwave pairs" comprising a scalar potential that represents a giant negentropic reorganization of the entire vacuum potential. When a dipole is formed at a particular location, then from that dipole the resulting negentropic reorganization of the universal vacuum potential speeds outward in all directions at the speed of light.
9. Of course there is nothing wrong with calculating the reaction cross section of the potential, which must be done when one assesses the energy diverted from it by an intercepting/collecting charge. What is wrong is calling the calculated entity the potential itself.
10. That is, in a perfect conductor. In free space, the diminution of the potential varies with the radial distance from the negative resistor, so that the magnitude of  $\phi$  at any point is inversely proportional to the radial distance  $r$  of that point from the negative resistor.
11. E.g., quoting Sir Horace Lamb, *Hydrodynamics*, 1879, p. 210: "*There is an exact correspondence between the analytical relations above developed and certain formulae in Electro-magnetism... Hence, the vortex-filaments correspond to electric circuits, the strengths of the vortices to the strengths of the currents in these circuits, sources and sinks to positive and negative poles, and finally, fluid velocity to magnetic force.*"
12. Actually the energy being absorbed by the dipole charges is *not* disordered, contrary to the conventional view which has been conveniently repeated here. Instead, we now understand something that has not been included in quantum mechanics or particle physics: the virtual energy of the vacuum is negentropically Whittaker-biwave-ordered by the potential of any charge. Only the "denuded" charge shucked of its fields is assumed in conventional EM absorption theory, and it is assumed *a priori* that no biwave ordering and flow dynamics has been created in the surrounding vacuum energy. The conventional "flux in a 3-space" view we now believe to be an invalid model, and at best a first approximation. The surrounding virtual energy flux in the vacuum around the dipole has been organized into Whittaker bi-wave flow patterns by the negative resistor potential of the dipole (as it also is for those dipoles constituting any "isolated charge" when its clustered virtual particles of opposite sign are considered). This fundamental change appears to have profound impact upon the foundations of quantum mechanics, but further discussion is beyond the scope of this paper. In our personal view the Whittaker biwave negentropic reorganization of the vacuum energy surrounding the negative resistor dipole changes the very concept of a "frame", and adds a new function partially comprising the absorption process, photon interaction, etc. We believe the negentropic reorganization of the vacuum by a potential associated with a dipole introduces a reorganization of the topology of the frame itself, and we hypothesize that spacetime, scalar potential, and the virtual flux of vacuum are all one and the same entity so that when one "face" of this common entity is reorganized deterministically then so are all its "faces".
13. This actually bears directly on the unresolved self-interaction problem, and in fact leads to its resolution. The missing massive multiwave self-organization of the vacuum virtual particle flux by the charge — considered more properly with its clustered virtual charges as a set of dipoles — is what has necessitated the false inclusion of interacting "point" charges interacting with random energy fluctuations, and modeled without their associated self-fields and self-potentials. The missing associated self-fields and self-potentials are inserted by the missing negentropic, deterministic reorganization of the surrounding vacuum. That organization is identically what is called the "self fields" and "self-potentials" of the interacting charge. For a statement of the unresolved problem, see David Hestenes, "Zitterbewegung in Radiative Process," in *The Electron: New Theory and Experiment*, David Hestenes and Antonio Weingartshofer, Eds., Kluwer Academic Publishers, Boston, 1991, p. 21-36. Quoting p. 33: "*The electron in the Dirac theory is an emasculated charged particle, stripped of its own electromagnetic field, like a classical test charge. The central problem of quantum electrodynamics... is to restore the electron's field and deduce the consequences. This is the self-interaction problem. Whether, in the ultimate solution to this problem the electron will emerge as a true singularity in the field or some kind of soliton... is anybody's guess. One thing is certain, though, the problem is nonlinear. And if quantization is a consequence of this nonlinearity... then the self-interaction problem can never be solved with standard quantum mechanics; a more fundamental starting point must be found.*" We propose the missing multiwave negentropic reorganization of the surrounding vacuum, by any charge as a set of dipoles, as the solution to the problem.
14. Again for the purist, whether a positive or negative potential is a negative resistor depends upon the type of primary current assumed in the circuit. Using the "conventional" electrical engineering view of positive current in the circuit, then a "positive" potential represents a negative resistor and a negative potential represents a potential drop or positive resistance. When assuming electron current, then a "negative" potential represents a negative resistor and a positive potential represents a "potential drop" or positive resistance.
15. See again endnote 3. Because of the bidirectionality of the energy flows in the potential, we "think backwards" and consider that, thermodynamically, the "external environment" for the vacuum consists of the physical circuit and system ensemble. Hence when we "open the system or circuit" and produce a disequilibrium thermodynamically in the system's energy exchange with the vacuum, we also open the "vacuum system" thermodynamically and produce a disequilibrium in its energy exchange with the physical system. That makes the vacuum a thermodynamic system far from thermodynamic equilibrium with the system, in which case the vacuum is freely permitted to (1) self-order, (2) self-oscillate or rotate, (3) output (to the system) more ordered energy than is input to it, (4) "power itself" and its "system load" simultaneously, and (5) exhibit negentropy.
16. We point out but do not further elaborate, that in any semiconducting medium some very interesting negative resistor effects can be obtained by considering the hole current and the charge current as both being overpotentialized in a bidirectional negative resistor manner.
17. The present author had many private communications from Engineer Nelson for several years.
18. Up until the time of the mysterious withdrawal or disappearance of Watson and his family, both the present author and Bedini had a great many private communications with Watson.

19. Again, we have had a series of private communications with Engineer Cole over many years.
20. See I. Prigogine, "Irreversibility as a symmetry-breaking process," *Nature*, Vol. 246, Nov. 9, 1973, p. 67-71. Quoting, p. 70: "*Entropy...cannot in general be expressed in terms of observables such as temperature and density. This is only possible in the neighbourhood of equilibrium... It is only then that both entropy and entropy production acquire a macroscopic meaning.*"
21. E.g., see Robert Bruce Lindsay and Henry Margenau, *Foundations of Physics*, Dover, NY, 1963, p. 217. When a system departs from equilibrium conditions, its entropy must *decrease*. 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 or in equilibrium, since the equilibrium state is the state of maximum entropy.
22. 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."
23. For a formal statement, see Oliver Heaviside, "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," *Phil. Trans. Roy. Soc. Lond.*, 183A, 1893, p. 423-480. This followed previous publications several years earlier by Heaviside; e.g. in *The Electrician*, beginning in 1885.
24. J.H. Poynting, "On the transfer of energy in the electromagnetic field," *Philosophical Transactions of the Royal Society of London*, Vol. 175, Part II, 1885, p. 343-361.
25. Quoting Oliver Heaviside, *Electrical Papers*, Vol. 2, 1887, p. 94: "*It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire... Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire.*" In short, Heaviside recognized that the energy flow component actually entering the circuit was only a tiny fraction of the entire energy flow going on outside the conductors.
26. H.A. Lorentz, *Vorlesungen über Theoretische Physik an der Universität Leiden*, Vol. V, *Die Maxwellsche Theorie (1900-1902)*, Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. Figure 25 on p. 185 shows the Lorentz concept of integrating the energy flow vector around a closed cylindrical surface surrounding a volumetric element.
27. In fact, they discarded that vast negentropic reordering of the surrounding vacuum that is accomplished by the source dipole negative resistor, once the dipole is formed.
28. For a typical example, see J.D. Jackson, *Classical Electrodynamics*, Second Edition, Wiley, New York, 1975, p. 237. Following Lorentz, Jackson disposes of the huge nondiverted Heaviside component of the energy flow in space around a circuit, that misses the circuit entirely and is not intercepted and diverged so is wasted, with these words: "*...the Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences.*" A moment's reflection reveals that this statement is a particular case of the more fundamental statement that any organized vacuum field energy flows that miss the circuit and are not diverged, have zero divergence. The conclusion that this has no physical consequences is a non sequitur.
29. For a summary of this rapidly developing field, see Diederik Wiersma and Ad Lagendijk, "Laser Action in Very White Paint," *Physics World*, Jan. 1997, p. 33-37.
30. Appropriate references for this section are cited in Thomas E. Bearden, "On Extracting Electromagnetic Energy from the Vacuum," *ibid.* endnote 15.
31. V.S. Letokhov, "Laser Maxwell's Demon," *Contemporary Physics*, 36(4), 1995, p. 235-243.
32. Actually it is introduced in a purely descriptive manner as the Newtonian third law reaction, without any cause.
33. In general relativity, the cause (change in the curvature of spacetime) reacts upon mass-energy to generate a change in the mass-energy (a change on the effects side of observation). Also, any change in the energy density of the effects side of the observation process, also generates a corresponding change in the causal (spacetime curvature) side as well.
34. Faraday regarded the material ether as real, and the field (which he gave us) also a material entity. He also successfully combined magnetism and electricity. He resurrected a much older notion of "lines of force" from the 1200s, and applied it to represent the magnetic force field in space. He regarded his "lines of force" as material "string-like" entities under tension. Consequently he regarded electromagnetic perturbations in the ether as "pluckings" of his "taut strings" lines of force.
35. James Clerk Maxwell, *Preface to the First Edition, A Treatise on Electricity and Magnetism*, third edition, Vol. 1, Dover Publications, New York, 1954, p. viii-ix. Maxwell vowed to not even read the literature of the mathematics of electricity and magnetism until he had studied Faraday's work.