

# ***NOTES AND REFERENCE***

On The Fogal Transistor

Commentary and Analysis by Tom Bearden

1.

One must consider the "imperfections" in our present "smoothed" theoretical models. In attempting to explain the unorthodox functioning of the Fogal semiconductor, we are invoking phenomenology from what would be a higher topological model, or a model which is a *superset* of the accepted models. It follows that, in the higher topology, many things will become possible that were not possible in the basic "smoothed" model of lower topology.

This is particularly true in electromagnetics, where Maxwell's 20 quaternion equations in 20 unknowns were arbitrarily reduced -- primarily by Heaviside and Hertz -- to a vector set of some four equations (variables separated) or two equations (potential form, variables not separated). In reducing the topology so severely, the present EM model is only a small subset of nature's EM. Further, suppose one performs an EM analysis of a circuit in a higher topology algebra -- e.g., quaternion algebra, which has a higher topology than tensors. We will then find many functions that circuits actually perform, which will not show in even the most sophisticated tensor analysis. For the proof that inventors -- such as Tesla -- sometimes capture and utilize such hyperfunctioning which present electrodynamicists have not comprehended, see:

***T.W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory"***  
*Annales de la Fondation Louis de Broglie*, 16(1), 1991, p. 23-41.

For another refreshing look at the far frontiers of still-developing EM theory, see:

***T.W. Barrett and D.M Grimes, [Eds.], "Advanced Electromagnetism: Foundations, Theory, & Applications"***  
World Scientific, (Singapore, New Jersey, London, and Hong Kong), Suite 1B, 1060 Main Street, River Edge, New Jersey, 07661, 1995.

This line of thinking leads to a very useful tool in qualitatively analyzing novel results obtained in experiments with multiple nonlinear components. *Barrett, 1991, ibid.* shows us that we can expect nonlinear optical functioning of "ordinary-appearing" circuits as one of the primary higher-topology effects that will usually be observed. Hence when one encounters unusual phenomena in novel circuits, one of the first rules is to look for the nonlinear optical functioning of the pieces of the components, at other than optical frequencies. *This will often prove to be highly useful, and the primary way to search for the hidden mechanisms involved in higher topology EM functioning beyond the realm of vectors and tensors.* Of course, then the results of the qualitative evaluation must itself be evaluated against the hard experimental data for consistency or inconsistency.

2.

See *Barrett, 1991, ibid.* for the proof. As an example, when charge blocking is applied or partially applied, circuits can often perform optical functions even without the presence of optical materials. From our own work it appears that the hidden variable EM inside the scalar potential -- as shown by Stoney and Whittaker [to be covered later in these notes] -- easily acts in a fashion prescribed by nonlinear phase conjugate optics theory, even when the frequencies are well below the optical region and even in the ELF region.

We accent that it is well-known that there exists radiationless transport of energy between excited and nonexcited atoms, particularly in semiconductors, where in some cases it has been referred to as the interference of reactive EM field components. E.g., see:

***A.A. Kolokolov and G.V. Skrotskii, "Interference of reactive components of an electromagnetic field"***

*Sov. Phys. Usp.*, 35(12), Dec. 1992, p. 1089-1093.

Speaking of this type of interference, Kolokolov and Skrotskii state, "As a result an interference flux of energy in a new direction is formed, where energy transport for the original waves can be completely absent."

Further, it is now known that extremely large second-order susceptibilities can be obtained in charge-blocking asymmetric quantum wells in semiconductors. This has been predicted to lead to the emergence of new properties in such semiconductors, such as double resonance enhancement, and even fully solid-state parametric oscillators. E.g., see:

***E. Rosencher et al., "Quantum engineering of optical nonlinearities"***

*Science*, Vol. 271, Jan. 12, 1996, p. 168-172.

It would appear that the forefront of semiconductor work on quantum wells and charge trapping is groping toward the type of capability already possessed by the patented Fogal semiconductor.

3.

We emphasize that the notion of energy flow through space did not even exist in physics, at the time Maxwell formulated his theory in the 1860s. The concept of energy flowing through space was formulated by Heaviside and independently by Poynting, after Maxwell had already been dead for a decade. Heaviside published first, but not prestigiously. Poynting published not long after, in a prestigious journal. Hence the theory bears Poynting's name, as does the energy flow vector. But Poynting himself credited Heaviside as being first.

The point is, electrodynamicists were already completely focused upon the energy dissipation in a circuit, well before Maxwell developed his theory. Succeeding generations of electrodynamicists

have maintained essentially the same focus in circuits. We produce *power* (rate of energy dissipation) electrical engineers rather than *energy transport* engineers.

4.

As is well-known, a magnetic dipole or an electric dipole produces a continuous flow of Poynting energy. What is *not* included in EM theory is that -- from particle physics, not classical EM theory! -- the dipole is a *broken symmetry* in the violent virtual particle flux exchange between the vacuum and the charges comprising the ends of the dipole. Since the magnetic or electric charge is a broken symmetry, it is a "gate" that extracts energy from the vacuum, and it also produces something observable (the Poynting energy density flow  $\mathbf{S}$ , *since there is no other candidate!*) If an external circuit is attached to the dipole, that extracted energy density flows along the outside of the conductors of the circuit as the Poynting energy density flow  $\mathbf{S} = \mathbf{E} \times \mathbf{H}$ . This Poynting energy density flow continues, whether or not the circuit has current  $dq/dt$  flowing in it. It flows, e.g., from the source to the ends of an open circuit, *and on out into space from there*. In a given circuit, the  $\mathbf{S}$ -flow along the outside of the conductors enters the conductor radially, interacting with the electrons [ $\mathbf{S}$  is composed of altered virtual photon flux (VPF) of the immediate vacuum, and all electrically or magnetically charged particles bathed in it, interact with that altered VPF].

The interaction of  $\mathbf{S}$  with the conduction electrons in the conductor increases their potential (their flux exchange rate with the local vacuum). In turn, this locally increased  $\phi$  is greater than the  $\phi$  further down the conductor, and this produces (amongst other things) a longitudinal gradient  $\nabla \phi$  and therefore a longitudinal  $\mathbf{E}$ -field via  $\mathbf{E} = -\nabla \phi$ . This potential gradient (longitudinal  $\mathbf{E}$ -field) produces the begrudging, very sluggish drift current and Slepian flow  $\mathbf{j}\phi$ , where the  $\phi$  is continually established and maintained by the transverse entry of the violent  $\mathbf{S}$ -flow. That is, in the  $\mathbf{S}$ -flow there exists an  $\mathbf{E}$ -field, where  $\mathbf{E} = -\nabla \phi$ . Thus the  $\mathbf{S}$ -flow *contains and produces* the  $\phi$  that "bathes" the conduction electrons in the circuit, and produces their collected (Slepian) energy density flow  $\mathbf{j}\phi$  that is being dissipated from the collecting current loop. It can be shown that nominally only about  $10^{-13}$  or so of the *actual* Poynting  $\mathbf{S}$ -flow is "collected" in this manner and dissipated in the circuit by the Slepian energy density flow  $\mathbf{j}\phi$ . E.g., see:

***T.E. Bearden, "Maxwell's equations, regauging, and overunity systems"***  
Explore, 7(3), 1996, Fig. 4, p. 60.

See: Bearden, *ibid.*, Fig. 3, p. 59 for the graphic depiction of what "collection" of energy by electrons actually consists of: It is a *dynamic, ongoing* process requiring the Poynting flow; it is *never* a static collection in "chunks" as it is treated in normal physics and electrodynamics. As Bohm stated, "There are no things, only processes."

Exact methods of increasing the energy collection rate in circuits, materials, and media and using it to provide overunity coefficient of performance are given in:

***T.E. Bearden, "Energetics Update and Summary"***  
Explore!, 1997 (in publication).

Experimental verification of these mechanisms, and verified processes (such as Anti-Stokes radiation, the Letokhov-Lawandy effect, the Patterson effect, etc.) are included to demonstrate the experimentally proven use of the principles to produce permissible systems with overunity coefficient of performance, without violating the laws of physics or of nonequilibrium thermodynamics.

5.

In modern field theory, even a "static" field is known to have angular momentum, a dynamic quantity. E.g., see:

***W. Shockley and R.P. James***  
Phys. Rev. Lett., Vol. 18, 1967, p. 876.

For a simple example, see:

***H.S.T. Driver, "Angular momentum in static electric and magnetic fields: A simple case"***  
Am. J. Phys. 55(8), Aug. 1987, p. 755-757.

In fact, a force can be regarded as a flow of momentum, and torque can be regarded as an angular momentum current. See:

***F. Herrmann and G. Bruno Schmid, "Momentum flow in the electromagnetic field"***  
American Journal of Physics, 53(5), May 1985, p. 415-420.

So when we speak of "electric field" and "magnetic field" -- whether static or dynamic -- we should be aware that such static concepts actually represent an ongoing dynamic process.

In quantum field theory, one may regard the magnetic field of the magnet, e.g., as the flow of virtual photons from -- by convention -- the north pole to the south pole. We stress that the north pole (positive magnetic charge) represents a broken symmetry in the virtual photon flux of vacuum, and this asymmetry is the source which extracts and gates the energy in the magnetic field. Actually, the "negative magnetic charge" south pole (which is just a time-reversed north pole) is *also* an asymmetry in the VPF of vacuum, and consequently it is a source of virtual *antiphotons*, and so *a flow of antiphotons* also flows from the south pole to the north pole. Another way of saying that, is that the two poles of the magnet form a dipole, and the south end of the dipole is known to be time-reversed with respect to the north end, and vice versa. Thus there are two energy flows from the magnet, not one, and these flows in the so-called "lines of force" are interlocked. In 1996-97 Stoney showed that any scalar potential (which would include the magnetostatic scalar potential existing between the two poles of the magnet) can be decomposed into a series of bidirectional wavepairs. See:

***G. Johnstone Stoney***  
Phil. Mag. Vol. 42, Oct. 1896, p. 332; Phil. Mag. Vol. 43, 1897, p. 139, p. 273, p. 368.

In 1903 Whittaker beautifully completed and extended Stoney's approach, to show that a scalar potential decomposes into a harmonic series of hidden bidirectional EM wavepairs, where each wavepair is composed of a wave and its true phase conjugate replica wave (its antiwave). See:

***E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics"***  
*Mathematische Annalen*, Vol. 57, 1903, p. 333-355.

If we now invoke a "strong" interpretation of the Stoney-Whittaker work, then the bidirectional hidden photon/antiphoton flows of the magnet actually are mutual phase conjugate replicas of each other. So they must continually form and unform coupled photon/antiphoton pairs, as the photons and antiphotons pass through each other. However, a photon/antiphoton couplet has spin 2 and so the continually forming and unforming couplets are thus *gravitons*. Relative spatial movement of the hidden wavepairs of this "magnetic field" with respect to a conductor introduces a *phase splitting* of the graviton, and the photon half interacts with the electrons in the conductor to produce the well-known magnetic induction, while the antiphoton half interacts in the nucleus of an atom in the conductor, producing the well-known Newtonian recoil.

This Newtonian 3rd law recoil was inadvertently omitted from basic EM theory by Faraday's assumption of the EM field in space as *composed of* physical taut strings (his "lines of force") without any accompanying *string holders*. In other words, Faraday had already *conceptually* discarded Newton's third law from his notion. That notion is false because *no taut string exists in nature without external tensile forces pulling on the string*. In other words, a taut string must have a "string holder" to provide the tensile forces. When the string is plucked to yield transverse string-waves, waves of equal and opposite energy -- though highly damped in magnitude because of the great mass of the "holder" medium -- are inevitably produced in the body of the holder. Both the string wave and the holder wave "slap" the surrounding medium simultaneously, with equal injection of virtual photons. The dually perturbed medium then vibrates according to its own degrees of freedom, not that of the string. Maxwell merely *assumed* the transverse string wave that resulted from Faraday's view of physical lines of force as actual "taut strings," with no consideration of the "holder" producing the tautness or of the antiwave that occurs in the body of the inevitable string holder. So Maxwell also unwittingly discarded the string holder and the equal-energy antiwave.

Thus Maxwell's EM theory failed to capture Newton's third law, which almost universally occurs in our EM field experiments, but which must presently be *mystically* invoked by electrodynamicists as "Oh, yes, that's Newton's third law reaction!", without any notion of an EM *cause* for the reaction. In quantum field theory, all mechanical forces are caused by the absorption and emission of virtual photons. So if Newton's third law appears, being a mechanical force it must have resulted from the same (virtual photon interaction) type of mechanism, but from antiphotons. A single photon interaction can be shown to also initiate Newtonian reaction; hence it must have been accompanied by an erroneously omitted antiphoton. This logical reasoning also establishes the presence of the antiphotons and the antiwave, accompanying the "conventional" EM wave in the vacuum. The so-called "photon" interaction in most cases is a graviton interaction anyway! Else it's interaction could not induce Newtonian recoil.

In short, *Faraday and Maxwell erroneously threw out exactly half of the electromagnetics, the electromagnetic waves, the force fields, and the EM energy!* Neither Heaviside, Hertz, nor Gibbs did anything to restore the missing electromagnetics, which if anything was just swept under the rug in the ubiquitous "Oh, yes, that's Newtonian third law recoil!" The end result was to discard the unification of EM and gravitation, which appears immediately whenever the missing half of classical EM theory is restored. Succeeding generations of electrodynamicists have not corrected this colossal error.

6.

Contrasted to a normal standing wave whose amplitudes add, we stress here a fundamental difference in the bidirectional wavepair element of the Stoney-Whittaker decomposition of the scalar potential. Each wavepair is composed of a wave and its antiwave (phase conjugate replica or PCR). Now electrically (in terms of electrical force) the wave and its PCR *superpose* spatially, they do *not* "add magnitudes" spatially! This is now just the well-known (but poorly named!) *distortion correction theorem* in phase conjugate optics. The wave and its antiwave twin are antiphased in time, so that *along the time dimension only*, the absolute values of their *time* components would add.

But their magnitudes do not add spatially! Quite simply, such a spatial *superposition-without force magnitude addition* of an EM wave and its true phase conjugate replica constitutes a *standing gravitational wave*. The main effect has been shifted to the time dimension, rather than the spatial dimensions.

Now suppose we insist that the distortion correction theory applies not only to waves, but also to the photons comprising them. In that case the antiphotons comprising the antiwave and the photons comprising the wave are performing a most interesting dance: The passage of the two waves *precisely through each other spatially*, as they travel in opposite directions (as perceived by the external observer), must result (from a spatial observation) in the continual coupling and decoupling of photon/antiphoton couplets. But such a couplet is a massless spin-2 entity and therefore a *graviton*. So coupled *gravitons* comprise this gravitational wave, each graviton of which is continually forming and unforming. In short, gravitation and electromagnetics are continually turning one into the other, in this "standing wave". Here is where electromagnetics and gravitation unify -- and it is precisely this area that was discarded unwittingly by Faraday and Maxwell when they discarded the string holder and its antiwave.

7.

We point out that, as is well-known in particle physics, the electron is not a simple unitary  $q_e$ . *Charge should not be used as a fundamental unit in physics!* In fact, in a standard elementary model the electron consists of a bare negative charge (note that electric charge is *undefined* in physics!) which attracts near to it a screen of virtual positrons from the vacuum's virtual particle flux. In fact, the positive screen immediately around the electron partially shields the negative charge from being felt away from the system. In many experiments particle physicists must correct the *measured* charge of

an electron (i.e., through its positive screen) to agree with the "bare" charge actually existing as the electron-behind-the-screen. Further, we may take one of those average virtual screening positive charges, consider it coupled to a small portion of the inner bare electron charge, and Voila! *The electron system -- defined as its "bare" constituency and its associated vacuum exchange constituency -- is also a set of dipoles.* Since any dipole is a broken symmetry in the virtual flux of the vacuum, these broken symmetries "extract and gate" part of the virtual photon flux (VPF) exchange of the electron with the surrounding vacuum, sending the extracted energy back out from the electron asymmetry as a continuous Poynting energy density flow, *from the electron system-as-a-source.* This outwardly transmitted energy flow comprises the *self-potential*  $\phi_e$  of the electron, and the gradients of  $\phi_e$  constitute what is called the "**E**-field" of the *electron charge as a generating source of energy flow.* An electron (and any other electrical or magnetic charge) is already a *free-energy generator*, driven by its asymmetry in the vacuum VPF. This is why collections of charges are "sources" of a scalar potential, and of the gradients of that potential which we refer to as **E**-fields. In addition, the electron is spinning (quantum mechanically it must spin through  $720^\circ$  to make one full loop!) and so its "swirl" creates what we call its *magnetic spin.*

Note that we have been using VPF in the particle view. We can just as easily decompose the self-potential  $\phi_e$  of the electron into Stoney/Whittaker biwaves. We can place the electron in an "artificial" potential, where we have deliberately assembled the biwaves in a given deterministic pattern or *template.* Placed in that artificial potential, the internal SW structures of the artificial potential and of the electron self-potential will diffuse, since the structured (dimensioned) artificial potential furnishes part of the VPF interactions generating the  $\phi_e$ . In that manner one violates the present physics notion (assumption) that all electrons are identical. That assumption is not necessarily true. This *dimensioning* (deterministic SW structuring) of the self potential of charges, is the fundamental driving mechanism behind homeopathy, e.g., which has never been given sufficient theoretical attention by the scientific community except in the "normal" theoretical approach. The normal theoretical model does not contain -- and in fact excludes by assumption -- the *templating* effect for the EM hidden variables utilized by homeopathy. The point is, one can indeed affect the chemistry, hydrogen bonding, and other aspects by just such deliberate templating of massless electrical charge (of the potential).

Such a templating forms a vacuum engine, where one has structured (and interested) curvatures of the local spacetime. For a discussion of vacuum engines and their rigorously demonstrated use to cure terminal tumors and infectious diseases in rats, see:

***T.E. Bearden, "Vacuum Engines and Priore's Methodology: The True Science of Energy-Medicine. Parts I and II"***

Explore!, 6(1), 1995, p. 66-76; *ibid.* 6(2), 1995, p. 50-62.

When we place an electron in a different potential (which after all is just a change to the local vacuum potential), we alter the rate of VPF exchange between the electron and the vacuum because *now the electron is embedded in an altered VPF.* In other words, we alter the dipoles comprising the *electron system*, and we alter the "massless electrical charge" of the *electron system.* In turn, that alters the rate of Poynting flow **S** that these dipoles produce from the vacuum, by their asymmetry. The massless (i.e., the VPF exchange) of an electron is not quantized, contrary to the conventional

assumption of its quantization! The self-potential  $\phi_e$  (i.e., the massless charge of the electron) is discretized as a function of its VPF with the vacuum, which can be altered at will simply by altering the local vacuum potential (i.e., placing the electron in a different potential). In the ambient (standard) vacuum, the discretized VPF value is standard, and so the electron *appears* to be charge-quantized because then the discretized value of its  $\phi_e$  does not vary.

The point is, a flowing current  $dq/dt$  in a conductor is not at all just the simple thing it is treated as, in classical electromagnetics (CEM). It is instead a highly dynamic system of free energy generators comprised of many different kinds of movements, levels, asymmetries, energy exchanges, and interaction changes simultaneously. Classical EM (and even quantum electrodynamics) are gross simplifications and extremely high level averaging of the much deeper, complex physics and dynamic structuring of the vacuum that are actually occurring, along with a myriad of Poynting energy flows!

8.

The bare electrical charge constantly interacts with, and is an asymmetry in, the vacuum's violent virtual photon flux. Any scalar potential is an alteration of this vacuum flux. Hence an electron placed in a potential sees either a higher or lower VPF interaction rate, depending upon whether the extra potential is positive or negative. The asymmetry of the *electron system* thus gates additional or less Poynting flow energy, with a resulting stronger or weaker **E**-field accordingly.

9.

"Drain away" just means that, as the collected charges that are the generating source of a given potential move away, then the potential being generated decreases because the electron system is now in an area of decreased potential and therefore decreased VPF. This is why and how an electron in a current  $dq/dt$  through a load (voltage drop) "gives up" its "collected energy." An electron only possesses "excess collected energy" when it is in an excess potential and its associated VPF, which increases the asymmetry of the *electron-vacuum-interaction system* and causes it to emit excess  $\phi$ , **E**, and **S**.

In a circuit, charge generators in a current moving away from a collection of charges (a source) constitute component sources subtracted from the overall source dipole, with the inflow of charges on the return line replenishing those charges. The internal nonlinearities of the source, however, and the resulting excess electron collisions result in some losses, creating the "internal resistance" of the source. The so-called "power" furnished by the battery of generator (source) is what is required to return those scattering charges back to their dipolar separations. In other words, all the source has to furnish energy for, is to continually replenish the scattered dipole charges. By charge blocking, one can eliminate or dramatically reduce the scattering of the dipole charges, by reducing the current flow. In that case the dipole alone will furnish (freely) the Poynting energy flow **S** that it continuously extracts from the vacuum, using the mechanism we specified for the *electron system*.

10.

In a circuit, those moving electrons together with their interacting excess potential  $\phi$  constitute the Slepian current  $\mathbf{j}\phi$ . In turn,  $\mathbf{j}\phi$  represents the rate at which "collected" (i.e., excess) energy density is being dissipated in the current loop; specifically, it does not represent anywhere near the rate of the actual energy flow  $\mathbf{S} = \mathbf{E} \times \mathbf{H}$ .

11.

In conventional superconductivity research, the objective is on moving electrons or Cooper pairs, rather than moving the energy. It would seem to be much better (and far easier!) to move the Poynting energy flow, rather than the charges! It is far beyond the scope of this paper to expound the higher topology actually involved in circuits and nodal systems, and the fact that present electrostatics has eliminated one of the major types. We simply refer to a most important reference for what we are speaking of. See:

***Gabriel Kron, "Four abstract reference frames of an electric network"***

IEEE Transactions on Power Apparatus and Systems, PAS-87(3), Mar. 1968, p. 815-823.

See particularly:

***Gabriel Kron, "Invisible dual (n- 1)-networks induced by electric 1-networks"***

IEEE Transactions on Circuit Theory, CT-12(4), Dec. 1965, p. 464-470.

Circa 1962 Kron wrote in a paper, "The frustrating search for a geometrical model of electrodynamic networks," journal unknown, p. 111-128, the following words:

*"Unfortunately most developments in theoretical physics include local (field) concepts only; while practical engineering is dominated by global (network) concepts. Even in geometry the global point of view has been pressed only during the past few decades, so that the discovery of any point of contact between engineering problems and geometry in-the-large is difficult, and often impossible at the present stage of development. These pages relate a succession of failures and successes encountered by the author in his long search for a geometry in-the-large, (a topological model) that enables the formulation of a "Unified Theory of Engineering and Physics" for a large class of problems in applied electrodynamics. Engineering is considered to differ from physics mainly in the nature of the reference frames and transformation tensors... used. Of course, a temporary success of an analogue may follow only after a string of countless trial-and-error failures -- as all 'unifiers' are so well aware...."*

And on p. 114 Kron gave the result of his decades of search as follows:

*"...the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in*

*which currents could be made to flow in branches that lie between any set of two nodes. (Previously -- following Maxwell -- engineers tied all of their open-paths to a single datum-point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which created 'lamellar' currents... A network with the simultaneous presence of both closed and open paths was the answer to the author's years-long search." [Underlining emphasis added].*

It is the thesis of one of the present authors (Bearden) that *the Fogal charge-barrier semiconductor will ultimately be found to partially function in Kron's final mode involving simultaneous open and closed paths.*

12.

This DC potential is held on the input plate because of the nonlinear phase conjugate action of the optically-active material comprising the dielectric of the electrolytic capacitor. What is not commonly known is that, in the hidden internal Stoney-Whittaker channel, all nonlinear materials can be optically active at all frequencies. The potential on the entry plate is comprised of such hidden bidirectional waves, per Stoney-Whittaker, and therefore hidden "optical effects" can occur far below optical frequencies, including even at ELF frequencies. The end result is that one must apply some version of overpotential theory, from the well-known theory of double surfaces, because of the hidden optical activity of the tantalum dielectric. One must also "very finely tune" the spacings, geometry, etc. of the components inside the simplified circuit, in order to evoke the overpotential theory. As is well-known, once the overpotential theory is evoked and utilized, exceedingly tiny current changes -- such as on the highly controlled bleed-off resistor -- can in turn gate and control far larger currents and very high fields across the double surface interface. E.g., see:

***J. O'M. Bockris and A.K.N. Reddy, Modern Electrochemistry***  
Plenum Press, Vol. 1 & 2, 1970

...for a comprehensive introduction to the double surface theory and to overpotential theory in particular. For a succinct synopsis of the overpotential and its importance, see:

***J. O'M. Bockris, "Overpotential: a lacuna in scientific knowledge"***  
Journal of Chemical Education, 48(6), June 1971, p. 352-358.

Most electrical engineers are unaware of this overpotential theory and its importance, although the modern solid state physicist is aware of it, as well as the importance and peculiarities of double surface effects.

13.

It seems that one function of Bill's careful tuning of the geometry, parameters, etc. of the bleed-off in the transistor, is actually to create and sustain this AC oscillation. For some of our later comments,

we can replace this 500 MHz oscillation wave with two special Whittaker scalar potentials, per Whittaker 1904. Then each of those decomposes into the hidden Stoney-Whittaker biwave pairs, by Whittaker 1903. The end result is that a condition of slight disequilibrium is maintained on the plate, and hidden pump waves are created and sustained.

14.

Actually this standard view is not quite complete. Any change of **E**-field automatically produces a **B**-field, and vice versa. Further, the flow of either of the several kinds of massless displacement currents (such as  $d\mathbf{E}/dt$ ,  $d\phi/dt$ , and  $d\mathbf{P}/dt$ ) can also create a magnetic field. It is well-known that the electrons themselves do not actually cross the gap between the plates of a capacitor; instead, one or more -- usually several -- of the displacement currents move across the capacitor gap via material distortion of the dielectric molecules. The movement of the bound charges in the distorting dielectric is a "bound current," but it impels electrons from the receiving plate on out into the external circuit conductor attached to it. It is also well-known (and it has even been measured) that these displacement currents in capacitors do make magnetic fields. In my opinion Fogal has adapted the bypass resistor and the included electrolytic capacitor as a very highly tuned system that:

- (i) controls and uses additional "bleed-off" currents that are mostly massless displacement currents rather than current  $dq/dt$ ,
- (ii) creates and utilizes weak magnetic fields by these massless currents,
- (iii) blurs the "separate states" between the charges into overlapping states, which seemingly produces what formerly has been labeled "tunneling" but without physical passage of electrons,
- (iv) applies and utilizes the overpotential theory to control (and block) up to  $10^5$  to  $10^6$  or more times as much current (and potential) as the device must "draw" in the double surface area,
- (v) increases the usable Poynting flow from the double surface area by increasing the field strength via the overpotential mechanism, and thus
- (vi) dramatically increases and passes the Poynting flow  $\mathbf{S} = \mathbf{E} \times \mathbf{H}$  of the charge-barrier area on through the transistor, processing it in the circuitry beyond.

We specifically point out that altering the potential  $\phi$  across a double surface area, while blocking  $dq/dt$ , rigorously constitutes *asymmetrical regauging* of the circuit area involved, rather than the *symmetrical* regauging commonly used -- by assumption -- in classical electrodynamics to separate the variables of the two Heaviside-Maxwell equations that Heaviside produced as his vector reduction of Maxwell's theory (potential form). The ordinary symmetrical regauging [which is actually two simultaneous asymmetrical regaugings, such that one produces an equal and opposite excess force as produced by the other] used to separate variables thus discards the extra **E**-field and overpotential effect that Bill produces and utilizes. Note that he is violating a standard "symmetrical regauging" assumption arbitrarily imposed upon Maxwell's CEM theory, not the fundamental theory itself. Nonetheless, electrical engineers with the symmetrically and arbitrarily regauged Maxwellian equations firmly in their minds cannot usually comprehend the mechanism used in Bill's charge-barrier technology.

15.

A very complicated function happens simultaneously in the paralleled tantalum capacitor. The DC potential across the tantalum can be decomposed via Stoney/Whittaker into hidden bidirectional EM waves. These cover the full spectrum up into the optical region, and serve as "pump waves" in the nonlinear optical sense. These "hidden inner waves" pump the tantalum, which is well-known to be optically active.

Consequently the tantalum becomes a pumped phase conjugate mirror (PPCM) *in the inner, hidden channel inside the DC potential*. The various signals entering the plate constitute "signal wave" inputs to the PPCM, which scavenges most of the energy from its pump waves to produce amplified phase conjugate replicas (PCRs). Suddenly the ordinary "bleed-off" of the charging plate becomes very complicated indeed! An *amplified* countereffect now exists, and acts upon the resistor. This "underdamped" corrective response results in an amplified "blocking" effect upon resistor bleed-off and an AC oscillation.

With such an effect imposed upon it, the resistor-tantalum system has become not just a load and a capacitor, but a negative resistance and an oscillating source! The response is exactly like a guidance and control system that uses underdamped correction of errors. *Such a feedback system is already well-known to oscillate.*

A very complicated set of pinning, blocking, and phase-conjugating actions ensue. The overall result is that the tantalum capacitor-resistor combination now is functioning not only as a capacitor with a bypass resistor, but as a completely different kind of negative resistance oscillator system. In effect, the entire region becomes a sort of *oscillating quantum well*, in which the potential builds up and is amplified, so that its gradient also increases and is amplified, all the while oscillating. This complex system also passes the Poynting energy flow, even though much of the normal  $dq/dt$  passage is now blocked. The result is that, during this region of operation, the transistor shifts into a predominately self-amplifying (i.e., self-regauging asymmetrically) Poynting generator, while creating an effective oscillating quantum well *and a special kind of Josephson junction*. The capacitor/bypass resistor/transistor element system becomes largely an optically-acting device rather than an ordinary current-acting device.

We believe that, to completely layout and verify all the pieces of this complex system operation, a highly qualified laboratory team will be required, and work by some of the best theoreticians will also be required. The team will also need to contain members familiar with the electrochemical electrode concepts of the overpotential, as well as quantum physicists thoroughly familiar with quantum well theory and behavior, in addition to optical physicists familiar with nonlinear phase conjugate optics.

16.

I suspect that the pinning action is due to the hidden pump waves, the novel oscillating quantum well, and the negative resistance effect previously mentioned. The two sets of hidden pump waves will

generate a hidden multiwave interferometry of the Whittaker multiwave pairs. Such "scalar potential" interferometry (i.e., the hidden interferometry of the multiwaves comprising the interfering scalar potentials) was shown by Whittaker in 1904 to create all the normal EM fields anyway.

So two **E**-fields (potential gradients) are created, with two sets of pumps for the defects and nonlinearities. Attempted stress-relieving departure of the pinned electrons results in an EM "signal input" into the pumped defect mirror [four wave mixing theory]. In turn, the pumped phase conjugate mirror emits an amplified phase conjugate replica, which sharply reverses the attempt of the individual electron to leave the pinned area. Consequently the electron is forced back toward the pinning site (PCM), with negative feedback then stopping it. The end result is that the amplified negative feedback from the pumped PCM defect/nonlinearity holds the electron fast. This creates a pinning and compressing effect with an amplifying *dynamic* quantum well, at each defect or nonlinearity in the lattice where the electrons are pinned. In other words, the quantum well continually adjusts itself to counter any move the electron attempts to make. This pins the electron and blocks it in place.

Another way of expressing this *dynamic quantum well effect* is to say that it continually *compresses* the pinned electron clusters at the pinning sites, since it produces a stronger recovering force upon the electron attempting to deviate, than was that electron's deviation force.

17.

The Poynting energy density flow is given by  $\mathbf{S} = \mathbf{E} \times \mathbf{H}$  in the general case. There are other comparable formulas to compute the **S**-flow from electric dipoles and from magnetic dipoles. Rigorously, the **S**-flow is expressed as an *energy density* flow, in terms of joules per m<sup>2</sup>sec, or joules per collecting coulomb, etc. In whatever fashion it is expressed, this energy density flow must be multiplied by the appropriate numbers for the right side of the "per" statement. But it is quite awkward to continually write or say the mouth-filling phrase *Poynting energy density flow*. Consequently texts refer to it loosely by a variety of terms such as *energy flow*, *energy density flow*, *Poynting energy flow*, *Poynting flow*, *S*, *S*-flow, *Poynting current*, *energy current*, *energy density current*, etc. In this paper all such terms refer to the Poynting energy density flow.

18.

Cluster theory can perhaps be applied to more adequately explain the long range ordering and spin density waves that seem to occur in the transistor, or at least to augment the rough, proposed explanation given here.

19.

In other words, optical switching and long range ordering now apply.

20.

In the Whittaker decomposition of the scalar potential, a harmonic series of biwave pairs results. The frequency is unlimited, consisting of all the harmonics from any fundamental from which one starts.

21.

Heating represents the scattering of photons (energy). Of course it is only the *conglomerate hierarchy* of the photons that has been "disordered"; *each photon itself remains perfectly ordered*. Hence macroscopic "entropy" is composed of, and overlaid upon, an underlying perfect order. Since only the patterning of energy can be created or destroyed, while the underlying order (energy) always remains constant, then energy cannot be created or destroyed (the fundamental conservation of energy theorem). When we perform work, the energy that is scattered or changed in form is *still there*, every bit of it. As does nature, we can utilize the same energy, over and over. By multipass retroreflection in scattering processes (as in the well-known but previously not understood anti-Stokes emission), one can readily "recover" and utilize the hierarchical ordering of the scattered photons -- or much of it -- and "reuse" (i.e., rescatter) the photons again. This recovery and reuse process can be iterated. From a single joule of energy, we can "collect" and obtain a million joules of work -- rigorously in accord with the master conservation of energy law. *There is no "conservation of work" law in nature!*

The present *energy-work theorem* is a highly specialized case for "single pass" energy collection and single dissipation implicitly assumed. Nature itself *multipasses*, *multicollects*, and *iterates* the dissipation of the same energy flow, over and over, ubiquitously. In spite of all the work that has been accomplished in and on the matter of the universe, precisely all the energy that was present in the primordial universe just after the big bang is:

- (i) still present and
- (ii) still repeatedly doing work!

Every joule of it has already done countless "millions of joules" of work! Note that retroreflection (as in phase conjugate reflection) is a *negentropic* and engineerable process. At any rate, the multipass, multi-retroreflection, multicollection process is a fundamental change to the work-energy theorem of physics. As presently stated, that theorem implicitly assumes single-pass, single collection of energy, with consequent loss, scattering, or transport of the collected energy. Further, electrodynamic collection of energy is nominally a process of only about  $10^{13}$  efficiency. Thus almost all the flowing Poynting energy is still there in the **S**-flow after a single-pass collection. Millions or even billions of iterative additional energy collections are possible in the same volumetric area from the same **S**-flow, merely by retroreflecting it iteratively. When the energy density in that volume is thus increased by *multipass multicollection*, this also increases the Poynting flow itself, since the local  $\phi$  (energy density) increases by the extra collection of energy in the same volume.

We are preparing a technical paper detailing this major change to the present work-energy theorem,

and its major ramifications for overunity processes. Both the Patterson Power Cell® and the Lawandy patents (lasing without population inversion, via negative absorption in -- translation: *excess emission from* -- the medium) are already independently validated and patented overunity processes using iterative retroreflection for iterative multicollection in the same volume, from the input Poynting  $\mathbf{S}$ -flow.

If there is no scattering of the Poynting flow, there is no divergence and no heating. This of course has always been the *first part* of the solution to room temperature superconductivity; i.e., it is a *necessary* but not *sufficient* condition for room temperature superconductivity. In this respect, the bridging concept is important. By *bridging* we mean the external introduction of Poynting flow  $\mathbf{S}$ , of emf, of  $d\mathbf{E}/dt$ , and of  $d\phi/dt$  onto and into a  $dq/dt$  closed loop -- *without* externally introducing any  $dq/dt$  in the process. We call the component which connects the external  $\mathbf{S}$ -source with the  $dq/dt$  closed loop the *bridge*. From the processes just being described in Fogal's semiconductor, one remaining condition for achieving room temperature superconductivity is that the Poynting flow furnished from the process described so far, must again be introduced into the external current loop, without introducing current  $dq/dt$  from outside that loop. In that fashion the electrons in the load loop can be energized and powered normally by the introduced emf alone.

However, it can be shown that the external loop electrons in the return line will not power back against the back emf, *if no other function is accomplished*. In other words, in the receiving (load) loop, the "source" component acting as the emf source must provide an additional function that makes the current flow backwards, *against* the back emf in that region. So a second remaining condition for room temperature superconductivity is that, in this "activated" or "energized" load loop, the back emf across the load-loop side of the bridge must exist in a *partially time-reversed region* -- which simply means phase conjugate reflection of at least some of the photons comprising the back EMF so that partial "time reversal" is achieved. That means that a fraction of the "back EMF" -- as seen by the external observer in his "forward time" -- actually is a *forward* emf, as far as the return conduction electrons are concerned, because of the partial time reversal. Expressed another way, the current flows with the inducing emf in a time-forward region, and against the emf in a time-reversed region.

With the addition of the time-reversing function on the load side of the bridge, the  $dq/dt$  isolated load loop will be fully powered-up by the external introduction of the  $\mathbf{S}$ -flow across the bridge, and current  $dq/dt$  will circulate normally in the load. This provides not only room temperature superconductivity, but also overunity coefficient of performance of the load loop, since it is:

- (i) a closed system with respect to  $dq/dt$  flow, but
- (ii) an open system with respect to input of excess energy from its external environment, and radiation of that excess energy from loads.

Energetically being an open system not in equilibrium, *nonequilibrium* thermodynamics applies and overunity COP is permissible, as is well-known for such systems.

Presently the only device I know of, that will reliably perform the bridging function, is the Fogal semiconductor. We have several other candidates, but so far none has yet proven out. My colleagues

and I have filed several patent applications on the process for use of the bridging concept for room temperature superconductivity and overunity COP, and for the use of the Fogal semiconductor in the requisite Poynting flow bridging. Fogal retains full patent rights on his semiconductor; our use of it in our own patent pending processes represents a licensed application.

22.

Of course here one needs to clarify the use of *charge coupled*. As I understand his use of the term, Bill is referring to a charge coupling of a quantum mechanical nature rather than of the normal "translation of charge carriers" sense. Electrons actually do not "move down the wire" as little balls, as we tend to think of the current classically. A blocked or pinned electron is not totally and physically "located at a point" as in the classical notion. Instead, it is probabilistically located; i.e., there is a certain probability at each point in a distributed spatial cloud, that it will be found there at that point. By the *time-fraction* interpretation of probability, one can say that the blocked electron already "spends a portion of its time" at each point in the cloud region, where that fraction of time it is "located" at one point is given by its probability of being there. Another way of saying this is that the electron considered as a wave function overlaps an entire region of space, and only appears at a point in space as a particle when physical intervention ("observation" or "measurement" or "detection") occurs by collapse of the wave function. So it's as if the electrons "feel every possible path and point ahead" in the cloud, and are free to simply "appear" at points ahead in the cloud without "physical travel through the intervening space" as in the classical sense.

I believe this is what Bill means by "charge coupled device." Bluntly, the blocked electrons are no longer localized as simple particles, because of the blocking of their particle nature yet passage of their wave aspects. Bill considers this also as their wavefunctions overlapping and blending, and their "states" thus melding into a conglomerate." Given that this "grouping" of wavefunctions and nonlocalization of the electrons actually occur, then the classical picture of charge transport fails completely. Charge transport is now by an entirely different mechanism, seemingly a "tunneling" in one sense, but not really tunneling in the accepted sense. It would appear that, if we call it "tunneling" anyway, the tunneling is also oscillating! At any rate, let us just consider that the charges flow into the blocking region and mechanism classically, then exit at a given but separated point further along in the circuit and flow from that exit point classically.

In the nonclassical region, the notion of "flow through space" does not apply, at least in 3-space. I personally believe that the mechanism herein is essentially equivalent to the "open path" concept uncovered by Gabriel Kron, who applied full general relativity to electrical circuits, networks, and machines. Circa 1962, Kron -- perhaps the greatest electrical scientist in U.S. history -- wrote these words (accent added):

*"...the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in which currents could be made to flow in branches that lie between any set of two nodes. (Previously -- following Maxwell -- engineers tied all of their open-paths to a single datum-point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which created 'lamellar' currents..." "A network with the simultaneous presence of both closed and open paths was the answer to the*

*author's years-long search."*

I believe that Kron's "open paths" may correspond to, or be related to, my own concept of bridging the  $\mathbf{S}$ -flow between  $dq/dt$  isolated closed loops. To show the complexity of what is actually ongoing in electrical circuits, we further quote from Gabriel Kron:

**Gabriel Kron, "Invisible dual (n– 1)-networks induced by electric 1-networks"**  
IEEE Transactions on Circuit Theory, CT-12(4), Dec. 1965, p. 464-470:

*"Since Kirchhoff's current-law prohibits the use of 'nodes,' and Kirchhoff's voltage-law prohibits the use of the 'planes over the meshes,' the topological theory of electric networks must be based upon the utilization of 'branches' only (1-network) and their surroundings. A large number of visible and invisible multidimensional p-networks surrounding the branches can be introduced, that collectively form neither a graph nor a polyhedron, but a non-Riemannian space. All the parameters of Maxwell's field equations ... of each p-network form the building-blocks of an asymmetric 'affine connection' .... It defines the 'covariant' space-derivatives, that replace in networks the familiar gradient, divergence, and curl concepts of fields."*

Quoting again from the same reference, p. 464:

*"A conventional electric network differs from transportation, communication, and all other types of nonelectric networks dealt with by electrical engineers, in that an electric network is surrounded in all directions to infinity by an invisible dynamic electromagnetic field of its own creation. In order to describe such an intricate n-dimensional continuous field in a discrete manner, several sets of visible and invisible abstract reference-frames must be introduced, that can be utilized to form a still larger variety of multidimensional physical p-networks. These interlinked p-networks propagate all the electromagnetic parameters (not merely  $i$  and  $e$ ) whose presence is defined by the field equations of Maxwell. However, the latter have to be expressed in their tensorial (relativistic) form in order to organize properly the topological structure of conventional electrical networks."*

The point is, when one blocks  $dq/dt$  and "slips" the  $\mathbf{S}$ -flow on past, one directly alters the entire multidimensional topology of the involved circuitry. Something very akin to higher dimensional "translation" of charges *can* occur, and something similar to this is what Bill is referring to by *charge coupling* and by *charge compression*.

23.

It is the Poynting flow  $\mathbf{S}$  from a dipole that creates the potential  $\phi$  and the therefore the  $-\nabla\phi$  that constitutes the  $\mathbf{E}$ -field in space, surrounding the charges at the ends of the dipole. That is, from particle physics, as is well-known the dipole is a broken symmetry in the virtual photon flux exchange between the vacuum and the charges comprising the ends of the dipole (in fact it is *two*

broken symmetries, one for each end). The asymmetry is a "gating" effect, which means that some of the vacuum exchange energy is extracted and gated out of the dipole (that is what asymmetry means!)

Further, as is well-known in particle physics, when symmetry is broken, something virtual has become observable. So all the observables for which the dipole charges are "sources" -- i.e., the **E**-field, the scalar potential, the **S**-flow, etc. -- are created directly from the vacuum flux exchange by the asymmetry of the dipole. That's why a "static" charge is a *source* of  $\phi$  and a *source* of **E**! More accurately, its asymmetry in the dynamic vacuum flux is the source of those entities. The vacuum exchange is *anything but* static! Since one end of the dipole is time-reversed with respect to the other end, it follows that a bidirectional gating occurs -- in short, it follows that one gets *bidirectional field flows*, as typified by Stoney/Whittaker biwave decomposition of the scalar potential across the dipole.

24.

Actually there has been an ongoing, polite debate for many decades about the "energy flow" in circuits; e.g., in American Journal of Physics. Many engineers are thoroughly confused by the universal misuse of the term "power" in electrical engineering. They speak of a "power source" -- even in the textbooks and the literature -- when the source is an *energy density flow* source. E.g., the source hardly furnishes a single extra conduction electron to the external circuit; instead, the Drude gas conduction electrons in the circuit are contributed by the atoms in the conductors, materials, etc.

Engineers speak of "drawing power" from the source, which is equivalent to saying "drawing the scattering of energy" from the source, which is a non sequitur. It is also equivalent of saying (simple case) "drawing VI" from the source, which again is a non sequitur because the source does not furnish the electrons, and hence cannot furnish the I. It *causes* the I to occur in the conduction electron gas, by activating the conduction electrons in a violent longitudinal bath of Poynting energy flow **S**. This Poynting flow carries the E-field, and therefore the  $E = -\nabla\phi$ . In short, the Poynting flow *furnishes* the emf of the circuit. But it does not *furnish* the I.

One draws the Poynting *energy density flow* from the source -- *not* the scattering of the energy; the energy scattering occurs in the loads and losses. Many engineers believe that the Slepian vector  $\mathbf{j}\phi$  prescribes the energy density flow of the circuit; it does not do so at all. Instead,  $\mathbf{j}\phi$  in a current loop is part of the *energy density dissipation rate* in that current loop. E.g., for proposal of  $\mathbf{j}\phi$  as the Poynting vector, see:

**C.J. Carpenter, "Electromagnetic energy and power in terms of charges and potentials instead of fields"**

IEE Proceedings A (Physical Science, Measurement and Instrumentation, Management and Education), (UK), 136A(2), Mar. 1989, p. 55-65.

For a refutation of the Slepian vector approach advocated by Carpenter, including citing of experimental refutation, see:

**J.A. Ferreira, "Application of the Poynting vector for power conditioning and**

**conversion"**

IEEE Transactions on Education, Vol. 31, No. 4, Nov. 1988, p. 257-264.

The energy flow is  $\mathbf{S} = \mathbf{E} \times \mathbf{H}$ , and only a tiny, tiny fraction of that energy flow is "intercepted" (collected) by the electrons in the circuit and then dissipated in the loads and losses. It can be shown that, in a nominal single-pass circuit, only about  $10^{-13}$  of the available Poynting flow  $\mathbf{S}$  is intercepted and "collected" and dissipated by the conduction electrons in the circuit. Of that minuscule collected fraction, half is expended in the source dipole to scatter the charges comprising the dipole, thereby gradually "killing" the dipole and consequently its broken symmetry "gate" that is extracting and furnishing the Poynting energy flow.

Most university electromagnetics texts give very short shift to Poynting energy flow in circuits, usually showing only one or two very simple circuit examples, then moving on from that "bottomless pit" with a great sigh of relief. E.g., J.D. Jackson's epochal Classical Electrodynamics, 2nd edition, Wiley, 1975, does not even *cover* Poynting flow in circuits. But see:

***J.D. Jackson, "Surface charges on circuit wires and resistors play three roles"***  
American Journal of Physics, 64(7), July 1996, p. 855-870

...for an excellent example of Poynting flow and effects in a simple circuit. Jackson strongly accents the fact that the surface charge densities must vary in the conductors. But as with other texts, the concept does not appear of bridging the Poynting flow from a blocked charge area, and introducing it upon a  $dq/dt$  closed current loop containing the load.

25.

Here Bill gives me too much credit! I cannot personally handle the Kron-type approach -- which involves full general relativity and lots of other things -- necessary to adequately do this. What I have done is to advance a rigorous definition for electric charge, which has not previously been done in physics. E.g., quoting M.P. Silverman:

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

*"And yet, curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."*

To define a charge, the definition must capture (1) the mass of the charge, and (2) the violent flux exchange between the charge and the surrounding QM vacuum, at least to the point of including the broken symmetry in that flux and hence the gated Poynting  $\mathbf{S}$ -flow, with its concomitant  $\phi$  and  $\mathbf{E}$ . To first order,  $q \equiv \phi_q m_q$ , where  $\phi_q$  is the self-potential exhibited by the charge  $q$  and interpreted as the

set of virtual EM interactions between  $m_q$  and the entire surrounding vacuum, and  $m_q$  is the mass associated with  $q$ . The importance of this definition is that charge  $q$  is not a *unitary* quantity at all! Instead, it is a *system* comprised of a massless charge (potential)  $\phi_q$ , and a mass  $m_q$ . Charge itself is massless and is the  $\phi_q$  portion. [A separate and fundamental definition for mass has also previously been given; see:

***T.E. Bearden, "Quiton/Perceptron Physics"***

National Technical Information System, Report AD-763210, 1973.]

With  $q \equiv \phi_q m_q$ , one may then apply Stoney/Whittaker decomposition to express  $\phi_q$  as a harmonic set of hidden bidirectional wave pairs, extending from the location of  $q$  out to infinity in all directions. This further provides internal hidden EM variables inside  $\phi_q$ . By separately forming such wavepairs in a desired sequence, and assembling them, one can create a massless charge (scalar potential) with a desired, deterministic set of "hidden wave" structuring. Placing charges  $q$  in this potential will result in a gradual exchange of internal patterning (*dimensioning*) via a mutual diffusion process. When the now-*dimensioned* charges are then removed and sent elsewhere, they carry their dimensioned self-potentials  $\phi_q$  with them, holding it for a while as it gradually dissipates by diffusion mixing with other potentials it comes in contact with. Charges  $q$  with such deterministic components of structuring inside their  $\phi_q$  components are said to be *dimensioned*. A dimensioned charge  $q$  can behave quite differently in -- for example -- chemical interactions in the body than does a nondimensioned "identical" charge  $q$ . An entirely new area of electrodynamics is opened up, one which allows the direct engineering of Bohm's hidden variable theory, including instantaneous action at a distance, and including deliberate structuring and usage of Bohm's quantum potential. The implications for physics, electronics, medicine, and power systems are profound.

26.

The Poynting flow from the source dipole flows primarily along the outside of the conductors in the external circuit, so that the conductors act essentially as "guides." E.g., a very nice statement to this effect is given by Mark A. Heald:

***Mark A. Heald, "Electric fields and charges in elementary circuits"***

American Journal of Physics, 52(6), June 1984, p. 522-526. Quoting:

*"The charges on the surface of the wire provide two types of electric field. The charges provide the field inside the wire that drives the conduction current according to Ohm's law. Simultaneously the charges provide a field outside the wire that creates a Poynting flux. By means of this latter field, the charges enable the wire to be a guide (in the sense of a railroad track) for electromagnetic energy flowing in the space around the wire. Intuitively one might prefer the notion that electromagnetic energy is transported by the current, inside the wires. It takes some effort to convince oneself (and one's students) that this is not the case and that in fact the energy flows in the space outside the wire."*

Our only comment on Heald's statement is that electrodynamicists do not utilize the concept of the *electron as a system in a violent energy exchange with the vacuum*, and do not include the asymmetry of the charges with the vacuum VPF, the formation of the virtual dipoles, and the emission of the charge systems' individual Poynting energy density flows  $\mathbf{S} = \mathbf{E} \times \mathbf{H}$  as the collective *cause* that produces the circuit's  $\mathbf{S}$ -flow,  $\mathbf{E}$ -fields, etc.

27.

Here I interpret Bill as stating the mutual crowding of additional like charges on each side of a double layer, as constituting the increase of charge density in the double layer area. This contrasts to "normal" capacitive double layer where the signs of the charges on each side differ. In the Fogal case, what would normally be the "flow-out" of charge from one side of the double layer is reversed due to the unexpected phase conjugation effect of the tantalum, and the blocking of the bleed-off by the parallel resistor.

If we consider the constituent bidirectional waves comprising the potential formed by this charge compression effect, the hidden biwaves form optical pumps for the tantalum material, which is acting as a pumped phase conjugate mirror. In turn, this acts as a sort of amplified negative feedback to reverse the bleed-off usually performed by such a parallel resistor. If this amplified phase conjugation effect is added, then high charge densities of like sign are developed on both sides of the double layer. I interpret this "crowding together" in tightening clusters, of the like charges on both sides of a very sharp boundary (the double layer), as Bill's "compression of charges."

The result is that what would otherwise be a single double layer now has *another* double layer immediately surrounding it, with the inner double layer increasing its charge density much greater than that found in a normal double layer, because of the thwarting of outflow bleed-off and stress relieving. A very steep electrostatic gradient -- and consequently a large blocking  $\mathbf{E}$ -field -- results from the triple layer action. This "triplet layer" effect would seem to provide a mechanism for *significantly amplifying the effect of a normal double layer*. If valid, then Bill has incorporated a "new" kind of overpotential effect.

If so, two effects should thus become apparent:

- (i) even a very small voltage (e.g., microvolts) across the new, amplified "outer" double layer can produce an *unexpectedly large* charge barrier  $\mathbf{E}$ -field, since the separation distance across which it exists is compressed smaller than the original separation distance, and
- (ii) the Poynting flow  $\mathbf{S}$  from the amplified double layer is also amplified as a function of the square of this increased  $\mathbf{E}$ -field, compared to the  $\mathbf{S}$ -flow from a *normal* double layer without charge compression.

At least something very similar to the preceding is happening in the transistor, which can perhaps explain

- (i) its extreme sensitivity,
- (ii) its extreme reduction of noise in the processed and passed Poynting flow signal, and
- (iii) its dramatically increased frequency range and response.

Obviously a great deal of very exacting, specialized laboratory testing must be accomplished on the semiconductor in order to fully develop and substantiate the unusual mechanisms occurring, and the full parameters of the device.

28.

This unusual and anomalous "lack of heating" functioning is apparently due to the "time reversal" region still being established in the "bridging" function region of the transistor. Heating by passage of current is due to scattering (divergence) of the photons in the energy flow, usually following electron collisions with the lattice vibrations. With time reversal present in what would otherwise be the normal scattering region, the scattering (divergence) has become reversed (i.e., has become *convergence*) for much of the photon scattering and the current flow. This would seem to be a special, new kind of "electrostatic cooling," or a direct "noise reduction" effect, so to speak.

Just exactly how one models it and thinks of it is still very much to be determined after much more extensive and precise laboratory testing. In my above comments I have only presented what I regard as some probable mechanisms that would explain the novel phenomena encountered. In other words, at best we presently have only a rather "ad hoc" model, and much more work obviously needs to be accomplished before one regards the conceptual model as "solid." However, our comments on the functioning of the transistor and the use of the "inner Stoney/Whittaker" hidden variable electrostatics should serve to highlight some of the hundred-year-old flaws in the conventional EM theory. At least some of these major flaws and omissions in classical and quantal electrostatics must be corrected, if the performance of the Fogal Charged Barrier semiconductor is to be properly deciphered and modeled.

29.

First, by Stoney *ibid.* and Whittaker 1903 *ibid.*, every scalar potential is comprised of hidden pairs of bidirectional EM waves, with the pairs in phase-locked harmonic series. Now see:

***E.T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions"***

Proceedings of the London Mathematical Society, Series 2, Vol. 1, 1904, p. 367-372.

Here Whittaker shows that any EM wave or field pattern can be expressed as two scalar potentials (rather than the conventional scalar potential and vector potential). By Whittaker 1903, each of those two scalar potentials is further comprised of biwaves in harmonic series. So rigorously, even an "ordinary EM wave" is comprised of hidden biwaves.

For every wave accounted for by classical EM theory, there is also an antiwave (time-reversed replica wave) accompanying it, as we discussed in preceding notes above. Both Faraday and Maxwell erred in deleting this antiwave, followed by Heaviside, Hertz, and Gibbs also in their dramatic topological reduction of Maxwell's theory to the present "Maxwell's equations" which are due to Oliver Heaviside.

One may visualize the missing wave this way: When a Drude electron gas in a wire antenna is stimulated, the EM coupling of the electrons to the atomic nuclei is also stimulated. The nuclei are stimulated with equal energy; but the positively charged nuclei are time-reversed, and their amplitude of oscillation is highly damped due to their much greater mass density. However, equal energy vibrations occur in the nuclei. Consequently, the wire antenna actually "slaps" the vacuum flux medium (i.e., the virtual photon flux of the vacuum) with an injection of two simultaneous disturbances: one from the electron gas "slap" and one from the nuclei "slap." By "slap" we refer to the quantum field theoretic injection of virtual photons. Both slaps inject equal photon densities; the electron gas injects photons and the nuclei inject antiphotons (time-reversed photons). In the vacuum both perturbations have the same damping factor, so the perturbed medium excursions due to the equal photon injections are equal and opposite.

Consequently, what actually occurs in the dually disturbed "virtual gas" medium is a wave of "compression and rarefaction" of the virtual gas. What we mean by "compression" is an increase in local virtual photon flux of vacuum, and by "rarefaction" we mean a decrease in the local virtual photon flux of vacuum. We hold to the proven particle physics that no symmetry of our mass systems can exist anyway unless the vacuum interaction is included; classical EM theory is very much in error in neglecting the vacuum medium. Note that the "wave of rarefaction and compression" is properly modeled as a longitudinal wave, not a transverse wave at all.

We point out that a "string wave" stays on the string; it does not go into the medium it perturbs when the string "slaps" that medium, and it is not the "wave that is in the medium" at all -- *unless one postulates that the medium itself is composed of taut strings!* Instead, the slapped medium vibrates with its own degrees of freedom, not with the more restricted degrees of freedom of the perturbing constrained string. Again, both quantal and classical EM theory are in serious error in following the Faraday/Maxwell assumption of the transverse string wave.

We also point out that, due to the separation of the ends of the dynamic dipoles that comprise an atom, there is a very tiny phase lag between the disturbance of the Drude gas in the antenna and the accompanying disturbance of the "nuclei". When the biwave vacuum disturbance impinges upon another wire antenna at a distance, the material in the wire has the same phase lag between its nuclei interaction and its electron disturbance. Essentially what happens is that the time-forward wave of the impinging biwave reacts with the electron gas in the receiving antenna, and the time-reversed wave of the impinging biwave reacts with the nuclei. In the nuclei, the disturbance is just the well-known Newtonian third law recoil -- which until now has not had any EM cause associated with it. Now we have presented the actual EM generatrix for Newton's third law.

Let us examine the reaction of the receiving antenna, to this longitudinal wave disturbance that impinges upon it. A longitudinal force perturbation is created upon the electrons comprising the Drude gas. However, the electrons are severely restrained longitudinally, though not nearly so restrained laterally. Further, the electrons are spinning (classically viewed). Since they are restrained longitudinally, they constitute little gyroscopes. Consequently, when longitudinally disturbed, they precess laterally. All our instruments are "electron wiggle detectors" and detect the gyroelectrons' precession and lateral movement. In the electron gas, the *detected* wave is indeed a transverse wave -- but that is not at all the perturbing EM wave from the vacuum; instead, it is the *gyro precession wave* of the electron gas. The detected transverse wave in the Drude gyro-electrons actually proves that the incoming vacuum disturbance is longitudinal! Else we must discard the spin of the electron, the longitudinal constraint of the electrons, and gyro precession theory.

In the early days when EM theory was formed, the surrounding vacuum ether was considered to be a thin material fluid, as indeed was electric fluid. The concept of energy flow through space was not yet born, since it was only created by Heaviside and Poynting well after Maxwell's death. Consequently, the early electricians regarded the electrical transverse waves detected by their instruments as being simply an interception of the penetrating transverse waves from the ether. In other words, they confused the electron precession waves with ether waves, since

- (i) the electron had not yet been discovered, and
- (ii) both the vacuum and electricity were regarded as thin material fluids.

Maxwell included the material ether (and Faraday's physical strings comprising it!) in his electrodynamics, and it was perpetuated in the subsequent topological reduction to a subset theory, by Heaviside, Hertz, and Gibbs.

So the myth of the "transverse EM wave in the vacuum" continued, and is still present in all our textbooks today -- and the assumption of the material ether is still erroneously contained in CEM, in the notion that *force* fields exist in the vacuum. There are no force fields in the nonmaterial vacuum. Mass is a *component* of force, by  $F \equiv d/dt(mv)$ .

Electrodynamics actually assumes that at each and every point in the vacuum, there exists a unit north pole, a unit positive electric charge, and a unit mass -- an assumption that foundations scientists are well aware of. E.g., see:

***Robert Bruce Lindsay and Henry Margenau, "Foundations of Physics"***  
Dover Publications, New York, p. p. 283,

...which emphasizes that a "field of force" at any point is actually defined only for the case when a unit mass is present at that point.

It follows from the antiwave generation of Newtonian recoil in the nuclei of the receiving antenna, that were we to redirect the antiwave before it struck the nuclei, then the atomic nuclei would not recoil and the antenna would exhibit an "apparent violation" of Newton's third law. This has already been widely done, in phase conjugate mirror reflectors. Here the incoming waves undergo multiwave interaction due to the nonlinearity of the situation. The antiwaves from the incoming signal wave are

interacted outside the nucleus, and redirected back along the path of the signal wave (via the distortion correction theorem). But that means that Newton's third law reaction mechanism did not occur, since the antiwaves did not interact with the nuclei to generate the reaction. One would therefore predict that a phase conjugate mirror, no matter how strongly pumped, will not recoil when it emits a powerful phase conjugate replica wave. And that is true, as has long been proven in PPCM theory of nonlinear optics, although there it is "explained" (actually *described*) quantum mechanically.

We can in fact also utilize this process for "absenting a force-creation mechanism" effect to produce antigravity directly in a suitable material on the bench, but that is outside the scope of the present commentary. For an actual experiment that did this successfully, see:

***Floyd Sweet and T. E. Bearden. (1991) "Utilizing Scalar Electromagnetics to Tap Vacuum Energy"***

Proceedings of the 26th Intersociety Energy Conversion Engineering Conference (IECEC '91), Boston, Massachusetts, 1991, p. 370-375.

31.

The wavelength of the switching frequency to separate the hidden wave pairs is on the order of the length of the dynamic dipoles constituting an atom, where the negative end of the dipole is one of the electrons in the electron shells, and the positive end of the dipole is one of the protons in the nucleus. This is largely beyond the ability of "charge pushing" switching; instead, optical switching is required. Since the Fogal semiconductor process in terms of field energy and Poynting energy density flow, it can in fact observe such optical switching times -- sharply differentiating it from orthodox transistors. In theory, an extremely well-made Fogal semiconductor should be able to switch and *amplify* at frequencies from the infrasonic range to the optical range, and perhaps eventually even into the x-ray and  $\gamma$ -ray range, in the same device.

32.

Indeed, the recording medium *does* record all the more subtle information being referred to, but not in a form prescribed by conventional theory. Instead, it is recorded "in" the hidden variable Stoney/Whittaker biwave structuring of the scalar potentials comprising the various lattice vibrations, atomic vibrations, nucleus vibrations, etc. in the medium material itself (a la Whittaker 1904 and Whittaker 1903). Present semiconductors will not detect this dimensioned signal information at all, while the Fogal semiconductor will react to and detect at least some of it. There are literally thousands of waiting applications of this new "internal electromagnetics" technology. Just as one example, with the proper pinna information detectors, a radar should be able to track a target right through the heaviest of ECM with impunity, with its return signal completely overwhelmed even by 40 to 100 dB down in the jamming noise. Further, all the internal field information of the tracked target is there in the signal, waiting to be detected and processed, as the technology is further developed. The information about what is inside the detected target, under the surface of the ground, or beneath the surface of the ocean is all there in return reflections of signals from the surface, without signal

penetration. It just needs detection of the "internal hidden variable EM" in order to be utilized.

33.

Refer again to Whittaker, 1903, *ibid*. The scalar potential ("voltage") is actually comprised of hidden wavepairs of bidirectional waves. The test was an attempt to insert signal intelligence (i.e., signal modulations) upon one or more of these "hidden wavepairs" comprising the DC potential. In the mid-to-latter 1980s, Ziolkowski independently rediscovered the Stoney/Whittaker infolded biwave pairs comprising the scalar potential, and also added the *product* set of internal waves in addition to Whittaker's *sum* set. E.g., see:

***Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations"***

*Journal of Mathematical Physics*, 26(4), April 1985, p. 861-863.

See also:

***Ioannis M. Besieris, Amr M. Shaarawi, and Richard W. Ziolkowski, "A bidirectional traveling plane wave representation of exact solutions of the scalar wave equation"***

*Journal of Mathematical Physics*, 30(6), June 1989, p. 1254-1269.

Ziolkowski in my opinion laid the groundwork for superluminal communication -- for communication with the stars. Further, if there *are* advanced civilizations "out there" in other star systems, then they are almost certainly communicating superluminally, not by the puerile electromagnetics we presently use.

The infolding experiment at Huntsville was the beginning of our experimentation intended to eventually achieve superluminal transmission capability, along the following lines:

- (i) "Tunneling" of a signal can in a sense be conceived of as the passage of a signal without the passage of a normal potential gradient (force field). In other words, ordinary force-field communications signals involve gradients of the electrostatic and magnetostatic scalar potentials. Tunneling may be the passage without those gradients, and therefore appear to be "force free" propagation.
- (ii) In turn, one way to conceive the signal "passing" without a gradient (i.e., to conceive a "force-free" signal) is to consider it having "burrowed inside" the scalar potential, so that it no longer requires a "bulk gradient" change in the entire potential.
- (iii) Since a (normal transverse wave) gradient involves a transverse change, we might consider that this "burrowing" or "infolding" means that the field has simply "lost its transverse component," while *retaining* its longitudinal component. In other words, infolding differs from total absence of the field, in that it is only the absence of the field's transverse component, while the longitudinal component remains.
- (iv) Interestingly, if one decomposes the electric field into both longitudinal and transverse field components, the longitudinal component is propagated instantaneously. However, if the

*transverse* component is also present, it can be shown that it contains a term which *exactly cancels* the instantaneous longitudinal electric field; e.g., see:

***Rod Donnelly and Richard Ziolkowski, "Electromagnetic field generated by a moving point charge: A fields-only approach"***

American Journal of Physics, 62(10), Oct. 1994, p. 916-922.

Thus the (in standard theory) transverse waves we normally produce, simply "blank out" an associated instantaneous communication by their longitudinal components. On the other hand, if we *ifold* the signal, so that a "surface gradient" is not present, then we remove the offending transverse component. At least conceptually, then, we have removed the term which canceled the instantaneous longitudinal component. In that case, the "infolded" signal is free to travel instantaneously -- or certainly much faster than the speed of light. Certain anomalies in previous communications testing of a Fogal device, made by one of the leading communications companies, did reveal what appear to be "absences of appropriate system delay" through satellite links, link amplifiers, etc.

So in our search for superluminal communications, our testing had started at the beginning: Simply see if the Fogal device can *ifold* signals, inside a DC potential, so we can rid ourselves of that offending "transverse field component" and free the longitudinal component. If one believes the exact mathematics of Stoney, Whittaker, and Ziolkowski, and if one also believes quantum mechanics (which has always included instantaneous action at a distance), then *superluminal communication is possible*. And we think the place to start on it, is to begin tests on infolding signals in DC potentials.

Finally, we point out that "infolding" may be modeled in  $n$  dimensions, where  $n > 4$ , as moving the signal out of 3-space into hyperspace. In that case it is free to move superluminally, since a single orthogonal rotation in hyperspace, away from the velocity vector, is what the speed  $c$  is. Two consecutive "departing" orthorotations would give (to the normal 3-space observer) a communications speed  $c^2$ . Three would give  $c^3$ , etc. If one insists on 4-d Minkowski space modeling, then infolding is moving the signal into "subspace," where it can move superluminally anyhow.

34.

This is explainable by the fact that the reflected field from a dielectric material is not generated just at its surface, but comes from everywhere in the interior of it. For a discussion, see:

***G.C. Reali, "Reflection from dielectric materials"***

American Journal of Physics, 50(12), Dec. 1982, p. 1133-1136.

Rigorously this means that the reflections from the entire volume of surveilled space in the camera image, contain not only surface information from all the reflecting objects, but also voluminous internal information from each and every one of them. This "hidden variable" information in the primary image -- i.e., the internal (infolded) pinna information content of the "gross potential gradient fields" -- can be detected and processed by the Fogal semiconductor. Therefore one should not be surprised that the *infolded content* of a fixed "field of view" image from a video camera can also be

scanned "in focus" in both its seemingly blurred foreground and its seemingly blurred background. *The internal information is not blurred!*

Another way of looking at it is to consider a zero vector resultant that is comprised of nonzero finite vectors. The "gross" examination of that system -- by a detector that only uses gross translation of electrons -- will see nothing at all because its electrons are not translated. On the other hand, an examination of that system by a detector that "sees beneath the zero-vector-summation surface" to the "infolded" real vectors beneath it, will see a pattern of real hidden vectors and real, hidden dynamics. By using only bulk gradients in scalar potentials and ignoring the Stoney/Whittaker decomposition of the potential into its infolded hidden dynamics, orthodox EM models have unwittingly discarded consideration of the infolded real vector components of zero-vector-summation systems. Such zero-vector systems are still very much real entities, containing real energy, hidden dynamics, and hidden information! In the simplest example, these "trapped" energies constitute nested structuring of curvatures of local spacetime. Thus they are little vacuum engines which can act upon subcomponents of physical systems, and upon the hidden EM dynamics of those components, in other than a "gross particle translation" manner.

35.

E.g., see:

***Michael Stocker, "Trying to 'pinna' down the localization of sound sources"***  
Electronic Engineering Times, Feb. 3, 1997, p. 44.

For information on the pinna transform, see:

***Gardner and Gardner***  
Journal of the American Acoustics Society (JASA), 53(2), 1973;

***Wright, Hebrank, and Wilson***  
JASA, 56(3), 1974; C. Puddie Rodgers, JASA, 29(4), 1981.

36.

It is stressed that the backtracking of the emitted wave from the PCMs is convergent and like a "laser beam" rather than a broad wave front. So this is not a "broad wavefront" type of repelling force effect, but instead is a set of pinpoint repulsion-force-generating beams. The energy is far more concentrated at its "targeted pinpoints" than is the same energy in a broad-front force field. Further, the pinpoint effect is iterated for all approaching atoms and molecules; these are "self-tracked" in pinpoint fashion. In nonlinear optics, such an effect is known as *self-targeting*. In this fashion the "repulsion beam" can actually be "locked-on" to the repelled object, delivering all its energy to that object to repel it. At least in theory, eventually it should be possible to use this effect on an aircraft skin -- for example -- to repel incoming bullets or projectiles.

It also appears possible to adapt this PPCM effect to produce *attraction* forces upon the targeted objects rather than repulsion, but that is beyond the scope of these comments.

In theory it is also possible to develop an electromagnetic antigravity propulsion system, and a concept along that line was developed some years ago and -- at least once -- successfully tested, smoothly and controllably reducing the weight of an object on the bench by 90%. For the results of the test, see:

***Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy"***

Proceedings of the 26th Intersociety Energy Conversion Engineering Conference (IECEC '91), Boston, Massachusetts, 1991, p. 370-375.

Further discussion of this effect is proprietary and beyond the present scope.

37.

***G. Holton, "Thematic Origins of Scientific Thought"***

Harvard University Press, Cambridge, MA, 1973.

38.

***Arthur C. Clarke, in "Space Drive: A Fantasy That Could Become Reality"***

Nov./Dec. 1994, p. 38.