Einstein's Last Question

Milo Wolff, Mass. Inst. Tech. (retired)
1124 Third Street. Manhattan Beach, CA 90266
milo.wolff@QuantumMatter.com
Geoff Haselhurst,
Nornalup, West Australia
Haselhurst@SpaceAndMotion.com

A. Abstract-Introduction

Einstein was queried about the huge numbers of short-lived heavy particles found using high-energy accelerators. Those physicists were seeking basic matter and wanted to know Einstein's thoughts. Einstein was a careful thinker not given to theatrics and was very serious when he replied, *I would just like to know what an electron is*. Why did he say this? His answer implied that the pedestrian electron, was more important to science than billions of dollars spent on accelerators. Little attention was paid to his remark.

   But Einstein saw the electron as the leading player in the universe, as could any careful scientist because most activity of the Universe is e-m wave energy transfers involving the electron. At the time, neither Einstein nor others understood the wave-mechanisms of the electron. Although the *force* between 'electrons' can be calculated using rules of Physics I, the rules did not always match Nature. The electron did not appear to be a discrete particle. Something was wrong and Einstein knew it.

   Answering Einstein. This article shows that the electron is indeed the leading player in the universe, deeply involved with the laws of nature. The method is to simply follow a suggestion by Clifford and Schroedinger to reject the discrete material electron and replace it with a wave-structured electron. The math is easy because scalar waves in *space* are the only choice; Only a space wave medium and two principles are needed. Amazingly, it is found that the wave structure has all the experimental properties of the electron and is the origin of all the natural laws fulfilling Einstein's intuition.

The value of philosophy. Einstein was greatly concerned about the electron because he felt that the answer to his question might have a world-wide impact on industry, medicine, our lives, and human affairs, as well as science and the universe. His reason was due to his philosophical understanding of the roots of modern industrial society. In his mind the electron appeared to be a intimation of Nature itself revealing the origins of the natural laws that are the basis of the industry and technology of the modern world. Thus *knowing the electron* would open an enormous window on the world of human affairs. This article will reveal that his intuition was right, as well as that of many pioneer scientists of the electron who have yet to be printed in the textbooks of today. As often happens in basic science you, the reader, will find that many of the treasured concepts that you learned and believed to be true, are not true. You must like an ancient philosopher, carefully re-evaluate the evidence for the truth of Nature.

B. The Problem of the Discrete Electron Seen by Einstein

The structure of the electron had always been a puzzle but in hindsight the obstacle was the erroneous belief that it is a discrete material particle. Einstein had already deduced this was impossible since Nature's forces and properties do not match the discrete particle. Einstein realized that matter is inseparable from the space it occupies. In retrospect only a simple correction was needed: replace the material point electron with a spherical quantum-wave electron. Then, its wave structure is easily found as a solution of the scalar wave equation to get a quantum-wave electron based upon only two fundamental principles of Nature. This is a new electron in current main-stream thinking, but fulfills early proposals by William Clifford and Schroedinger. Surprisingly, all the natural laws are found embedded in the wave structure of the electron – as suspected by Einstein, Clifford and Schroedinger. Unfortunately research on this path was not as exciting as the funded military and industrial technologies begun during WWII. *Truth is no match for emotions.*

C. Historical Proposals for a Wave Structure of Matter (WSM)

William Clifford (1845-1879) a brilliant mathematician whose legacy includes modern Clifford Algebras, lectured before the Cambridge Philosophical Society [1] on *The postulates of the Science of Space.* He discussed our ability to deduce the geometry of space at astronomical distances and in space too small (i.e. particles) to be observed, stating: *I hold:*

1) *That small portions of space are in fact analogous to little hills on a surface which is on the average flat, namely that the ordinary laws of geometry are not valid in them.*
2) *That this property of being curved or distorted is continually being passed on from one portion of space to another after the manner of a wave.*
3) *That this variation of the curvature of space is what really happens in that phenomenon which we call the motion of matter, whether ponderable or ethereal.*
4) *That in this physical world nothing else takes place but this variation subject to the law of continuity.*

Note that he was bold enough to conclude that the entire physical world (*motion of all matter)* therefore all of science and the Universe, was a result of this property of space. This implied that all matter and motion was contained in ONE entity – space. In hindsight, this paper shows that his analysis of the geometric properties of space, more than a century ago, before quantum waves were discovered, were correct. Clifford's deductions about space were revolutionary at the time because *space* was not yet a concept that many scientists recognized.

When J. J. Thompson discovered the electron in 1904 using cathode-ray tubes that enabled him to calculated the charge to mass ratio, everyone was convinced that electrons were discrete material particles. This discrete particle belief began to be questioned about 1930, because the 'wave functions' of the Schroedinger Equation need not be attached to individual electrons unless you assume that electrons are discrete. But the Equation allows one to assume that discrete material electrons exist, or do not exist. It is up to you to choose an interpretation. The math of quantum mechanics is neutral and takes no position. The wave functions provide exact values of energy transfers but only

hint at how transfer happens. But knowing how was what Einstein wanted. We will see below that it is not possible to know unless you abandon the notion of a discrete particle and instead accept that the electron is a quantum wave structure. Then waves can transfer energy.

In 1937, Irwin Schroedinger, the father of quantum theory, proposed [2] to eliminate point particles by using a quantum wave structure. He wrote: *What we observe as material bodies and forces are nothing but shapes and variations in the structure of space. Particles are just schaumkommen* (appearances*).* That is, quantum waves structures are real and discrete material particles are not. He was adding one element to the work of Clifford – that the structure of the waves of *space* lead to the *appearances* we observe of discrete particles These appearances underlie the rules we create to describe the macro world of present day science but only indirectly do we see the real quantum world of Nature itself. Again, by including all material bodies and forces, he was concurring with Clifford and the ancient philosophers, that the space medium is the one substance of everything.

A partial wave structure was found by Wheeler and Feynman [3] in a 1945 pioneer attempt to find the energy-transfer mechanism of the electron. He sought a *response of the universe* to the acceleration of an electron, by calculating waves traveling inward and outward from the location of the electron center. This is reviewed in Section E below.

In 1950, Einstein [4] thought about the mechanism of the transmission of force from one particle to another and concluded that space must possess a property that extends throughout space to connect particles. In this sense, he agreed with Schroedinger and Clifford. His knowledge of Nature told him that discrete particles cannot exist because their borders would be an abrupt discontinuity. Particles and space must be continuous. Further, assuming the Bohr concept were true, he asserted the notion of a discrete particle being *everywhere at once* is impossible to imagine. He pointed out that the Bohr ideas are never found in Nature. He rejected the point particle and Maxwell's field Equations that had become the bible of electrical engineering, writing: *The combination of the idea of a continuous field with that of material points discontinuous in space appears inconsistent. Hence the material particle has no place as a fundamental concept in a field theory. Thus even apart from the fact that gravitation is not included, Maxwell's electrodynamics cannot be considered a complete theory.*

Research of Wave Structure. After 1945, particle physicists chose to work on post WWII weapons. Research on wave structure stopped until 1985 when Milo Wolff using a scalar wave equation with spherical quantum wave solutions, found the Wave Structure of Matter described here. It successfully predicted the natural laws and the properties of the electron, except its spin. Below this article derives a physical origin of spin that accords with quantum theory, the Dirac Equation, and adds new results.

The **new electron in Quantum-electrodynamics**. Akira Tonomura of the Hitachi Corp published in 1998, "The Quantum World unveiled by Electron Waves" (World Scientific Press) a beautifully illustrated book describing quantization of flux in closed current

loops of real electron waves at low temperature. Quantization occurs because the circulating electron calculate the electro-magnetics of transistor circuits, MIT awarded him a $500,000 prize.

Ancient Greek philosophers, Aristotle, Parmenides, etc, and recent mathematicians such as Leibnitz, Descartes, Spinoza, and Kant asserted, using the logic of philosophy, that all matter and motion, (the entire universe) was derived from ONE substance. We will see below that ordinary space fulfills this role as the wave medium of the Universe.

Eric Storri a science historian at Bradley University carefully studied [5] the accuracy of the periodic table of the elements, a foundation stone of chemistry. He find the rules of counting electrons in orbits do not always work. He questioned the assumption that electrons exist inside the wave functions, writing, *According to quantum mechanics the very notion of individual electrons in stationary states was shown to be invalid.* He concluded, like Einstein, that a full understanding of the Atomic Table requires a better knowledge of the electron.

These leading scientists above had concluded that the logical structure of matter is quantum waves in space. Recent this has been mathematically worked out by Wolff [6,7], and Mead [8] and are summarized in section H below.

D. Understanding Energy Exchange

We cannot measure anything in Nature without an energy exchange that tells us something has happened. Experience tells us that communication or acquisition of knowledge of any kind occurs only with an *energy transfer.* Storage of information, whether in a computer disk or in our brain, always requires an energy transfer. Energy is required to move a needle, to magnetize a tape, to stimulate a neuron. There are no exceptions. This rule of nature is embedded in biology and our instruments. Thus, finding the energy transfer mechanism between particles is part and parcel of understanding the electron and the natural laws. Thus we must probe energy deeply. We cannot accept any statement about the measurement of a natural event unless we verify the energy exchange that allowed it. This is the test that distinguishes true from false. Skepticism is good for science.

To understand the mechanism of energy exchange, we first need to understand it. Most people assume that they understand energy exchange because they buy and use it every day; Accordingly no further thought is needed. This is a logical trap because our human scale experiences are not a guide for the real energy exchanges that take place on the quantum level of electron and atoms.

The mechanism of energy transfer had often been sought using Maxwell's Equations (ME) and electromagnetic waves but the method has problems: The electron has spherical symmetry but MEs have no wave solutions in spherical coordinates. Another problem was the infinite fields (singularities) at the center of the discrete point electron. Singularity avoidance was attempted using mathematical "renormalization" wherein

infinity was subtracted from infinity to obtain the desired result. In 1937, Paul Dirac commented [9]: *This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it turns out to be small - not neglecting it just because it is infinitely great and you do not want it.*

Feynman commented on the renormalization problem: *But no matter how clever the word, it is what I call a dippy process! Having to resort to such hocus pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self consistent. I suspect that renormalization is not mathematically legitimate.*

E. Wheeler and Feynman's Calculation to Find Energy Transfer

In 1945 Wheeler and Feynman (W&F) sought [3] the mechanism of energy transfer by calculating electro-magnetic radiation from an accelerated electron. Their electron generated outward and inward spherical waves and evoked a *response of the universe* from absorber charges. W&F calculated the electron mainly to find a fundamental understanding of the universe so they looked at many ideas. They discussed this with Einstein who suggested a proposal by Tetrode [10] that light was two-way communication exchange between source and receiver utilizing in- and out-waves. Tetrode wrote, *An atom that emits light from a star one hundred light years away, knew then, one hundred years ago, that it would enter my eye today, before I was even born.* They considered this proposal realizing it was controversial because in-waves appear to violate the causality principle: *Actions should not appear before their causes.* W&F wished to use the in-waves but avoid violation. Their mathematical goal was to verify a formula for radiation force found by Dirac using in/out scalar quantum waves.

Their accelerated electron generated both in- and out-waves. The out-waves then stimulated absorber charges elsewhere in the universe whose waves returned to the initial charge, a *response of the Universe*. Upon arrival, those waves became in-waves of the initial charge. Remarkably (but as they intended) causality was not violated because they cancelled in-waves from the absorbers upon arrival at the initial charge by opposite in-waves from the charge! Force on the electron was assumed to be the product of charge times half the difference of total in- and out-wave amplitudes. Dirac's formula was verified, independent of absorber properties provided that absorption was complete.

W&F described the wave behavior: *Absorber charges at a large distance produce spherical waves headed towards the source. At the moment the source is accelerated these waves just touch the source. Thus all the waves from the absorber charges form an array of approximately plane waves marching towards the source. The Huygens envelope of these plane waves is a spherical in-going wave. The sphere collapses on the source, and then pours out again as a divergent outward wave.*

This description above of in-and out-waves is almost identical to the quantum waves of the electron that can be obtained rigorously using a scalar wave equation in Section H below. In hindsight, the partial success of W&F's method was due to changing the *vector* e-m waves to *scalar* waves, during their calculation so that in effect they were calculating

scalar quantum waves, even though they assumed the final sum of waves had vector properties. This was not proper math, but nevertheless pointed to quantum waves as the real structure of the electron. They were also forced to assume an illogical behavior of the absorber – the absorber out-waves began before the initial acceleration - in order to arrive at the electron at the moment of acceleration. This switching from vector e-m waves to scalar quantum waves was needed in order to reach their goal.

F. Philosophical Importance

W&F's work goes beyond explaining radiation forces because energy transfer and the motion of matter are important fundamental processes of nature. Further their concept, that the absorbers in the whole universe contributes to each electron, implies an inter-connection, i.e., *Every charged particle is part of the universe and the universe is part of each charged particle.* This implies that each of us, including you and me, are connected together as part of the observable universe! This fundamental but revolutionary concept is still not recognized by mainstream physics. It caused much speculation and others, such as Hoyle & Narlikar [11], and Cramer [12] used W&F's work to examine the universe.

G. The Answer to Einstein's Question

Einstein wished to resolve the disparity between the experimental properties of the electron and the common discrete electron model. He also wanted to know why it appears that "God plays dice" according to the uncertainty interpretation of quantum mechanics, that he did not believe.

Wolff [6,7], Mead [8], and Haselhurst [13] explored the Scalar Wave Equation and found that its solutions form a quantum-wave structure, possessing all the electron's experimental properties, eliminating the paradoxes of quantum mechanics and cosmology. This wave structure completely replaces the material particle. This is what Einstein wanted to know. Finding that the discrete particle electron does not exist, removes the Bohr interpretation of the wave functions and assures us that God does not play dice as well as removing the infamous wave-particle paradoxes. The mathematical approach below describes the electron, its origin and role in the universe.

H. Solutions of the Scalar Wave Equation

Waves without Mathematics. You need not be a mathematician to understand the wave structure of the Universe, so I have written the description below in ordinary prose. At the same time, I have also written the related equations. Why both? So you can ask your mathematician friends to verify that indeed both descriptions agree. You can read either or both as you like.

Principle I – The scalar wave equation in Space. The universe abounds with things that oscillate, such as; the ocean surface, a violin string, a drum head, a child on a swing, and the structure of electrons and atomic matter. All have a property in common: Energy of motion is exchanging back and forth with energy of position. It is precisely this

energy exchanging property that is the heart of a wave equation. There is always a wave medium involved such as: water, a string, a membrane, a rope, and, for micro-atomic matter, basic to all oscillators, the medium is *space*. Mathematicians use the equation to calculate position and speed of the moving thing but you can understand it just knowing about the energy exchange.

To understand the electron we need to find and solve a wave equation in space. Since the universe is three-dimensional, the logical choice is the well-known scalar 3D wave equation. It is not fruitful to consider the vector wave equation – so familiar in electromagnetic wave guides – because it has no solutions in 3-D space. Thus this step was easy – only one choice.

I won't write the scalar wave equation because your math friend already knows it. Sufficient to say there are only two possible spherical wave solutions. Again an easy step:

$$\text{The outward wave} = \text{Ø}out = (1/r)\ \text{Øo}\ exp(iwt - kr) \qquad\qquad (1a)$$
$$\text{The inward wave} = \text{Øin} = (1/r)\ \text{Øo}\ exp(iwt + kr) \qquad\qquad (1b)$$

Where **Øo** is a scalar wave amplitude, frequency $w = 2\pi mc^2/h$, k= wave number. The physical dimension is the radius r of the spherical waves, from a wave center.

You can picture the waves as continually expanding and converging bubbles of energy as drawn in figure 1. From our human scale perspective we imagine the location of the 'particles' as the wave centers. But better yet - a trip to your computer will show you moving animated waves of the electron – the four best web sites are:
  1. www.QuantumMatter.com/see - It shows the electron - made by Winston Wolff in Berkeley, California. 2. daugerresearch.com/orbitals/index.html It shows the H atom - by Dean Dauger at UCLA, Los Angeles. 3. www.SpaceAndMotion.com/Physics providing philosophy by Geoff Haselhurst in Nornalup, Australia.
  4. www.geocities.com/glafreniere00/matter.htm by Gabriele Freniere in Canada.

These animations show you how the two oppositely moving waves form a resonance in space around a center. You can exchange ideas at a Yahoo discussion group: http://groups.yahoo.com/group/Wave-Structure-Matter/

Waves of the electron-positron. These two waves can be combined in only two forms which are the structures of the electron-positron. These are combinations of the in- and out- spherical waves:

$$\text{electron} = \text{Øin} - \text{Øout} + \text{CW spin} \qquad\qquad (2a)$$
$$\text{positron} = \text{Øout} - \text{Øin} + \text{CCW spin} \qquad\qquad (2b)$$

The in-waves reverse direction at the center to become out-waves. This reversal is expressed mathematically by CW and CCW rotation (spin) operators on the waves [14]. The operators cause either '3D clockwise' or '3D counter-clockwise' allowed motions that do not tangle up the coordinates of space. The inward wave rotates twice in a 3D

fashion, that converts it to an outward wave as is Figure 1. The rotation fulfills a geometric requirement of wave continuity and produces the formerly mysterious quantum spin of value h/4π. Both the amplitude of the waves and the direction of spin are opposite to each other in the electron and positron. This is the reason that electron-positron superposition experimentally produces annihilation. Notice how simple Nature makes the electron by choosing the simplest and only means of oscillating in free space!
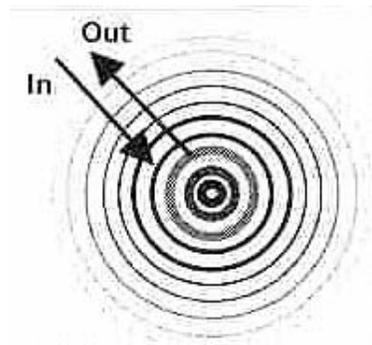

Figure 1. The spherical waves of the electron or positron. Each is a pair of waves, one converging, one diverging, that form a continuous resonant structure in space. The wave amplitudes of the electron are exactly opposite to those of the positron. Rotations of 720° at the center that transform in-waves to out-waves, are also opposite. The resulting spin = ± h/4π. Thus, superposition of an electron and a positron causes annihilation since Eqn. 2a = - Eqn. 2b.

Look above in Section E above, where W&F approximately described the behavior of the actual waves of the electron or positron, even though the waves were not known at that time. Their description of the in-waves as a Huygens superposition of out-waves from other particles (absorbers) in the universe, shown in Figure 2, accords with other calculations. Missing from the W&F description was the 720° rotation of the in-wave that changes it to an out-wave. This basis of electron spin was not known before the work of Wolff [6] and Batty-Pratt [14].
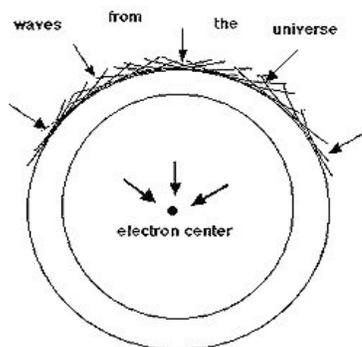

Figure 2. Formation of the in-wave. The spherical out-waves of an initial electron encounter other electron wave-centers. At each encounter, a signature of the initial electron is transferred to the out-waves of the other electrons. The out-waves generated become a Huygens combination, the in-wave of the initial electron. This intermingled exchange of waves makes each particle like a 3D hologram of all others in the universe, Wolff [7].

The second Principle II of the WSM is used to calculate the density of the quantum wave medium – the space all around us. The role of the medium was foreseen in 1883 by Ernst Mach [15] who noticed that the inertia of a body depended on the presence of the visible stars. His deduction of the familiar law F=ma, arose from two different methods of measuring rotation. First, without looking at the sky one can measure the centrifugal force on a rotating mass m and use the inertia law F = ma to find circumferential speed and position, as in a gyroscope. The second method is to compare the object's angular position with the fixed (distant) stars. Both methods give exactly the same result. He asserted: *"Every local inertial frame is determined by the composite*

matter of the fixed stars (the universe)" and jokingly, *"When the subway jerks, it is the fixed stars that throw you down."*

At first, Mach's Principle was criticized because it appeared to predict instantaneous *action-at-a-distance* across empty space. How can information travel from here to the stars and back again in an instant? It cannot. The answer is that the inertial energy exchange mechanism, formerly unknown, is the interaction of waves from accelerated matter with the universal space medium around it. Space is not empty because it is a quantum wave medium created by waves from every particle in the universe. Inertia, charge, and other forces are seen by us as effects of the wave interaction with the surrounding space medium. There is no need to travel across the universe.

There is only one way to rationalize Mach's principle of inertia and our experience: That is, the matter of the universe creates the wave medium in all space of the Universe. Thus the inertia of an accelerated object is an energy exchange to the waves in the space around it. We observe space as coincident with the framework of the fixed stars. The laser gyro used in commercial aircraft is an important application of Principle II. You can experience rotational inertia yourself by spinning on a piano stool.

How is Principle II obtained mathematically? Wolff [6] extended Mach's Principle by calculating the density of the wave medium as the sum of the squares of the waves from every particle in the universe, each diminished by the inverse square of the distance. Knowing the density you can calculate the velocity c of the waves, their amplitude and the motion of the wave centers. The velocity c is almost constant everywhere because there are so many (10^{80}) particles contributing waves. Nevertheless, c varies somewhat near large masses like the Sun.

It is important to realize that inertia is an interaction between an accelerated object and its surrounding space. You should not try to imagine that the object is interacting with the distant stars. Instead the density of the surrounding space is already created by the waves from the distant stars. This agrees with laboratory experience using gyroscopes, accelerometers, and the laser gyros that navigate aircraft. Before knowledge of the space medium, inertia was a paradox stated by Newton as: *action-at-a-distance*.

If you think Principle II over carefully, you will see a strange feedback loop in Nature, as follows: *The matter of the universe combines to tell the space medium what it is and in turn the medium tells all matter how to behave.* In other words: The matter of the universe determines the particles and the particles determine the matter.

The reader may be inclined to disbelieve this strange result. But there are several confirmations, one of which is Einstein's General Relativity (GTR) which contains the same feedback loop: Reduced to basics GTR calculates the density of space-time at each point in space using the density of matter and energy everywhere in the universe. A varying density is referred to as *curvature of space*. This space density is then used to determine the paths of moving matter and of light which follows the curvature. Archibald Wheeler expressed this: *All the matter of the universe tells space what it is and in turn*

space tells matter how it must move. The feed back loop is the same. This is not surprising because we have already found that *all* physical laws are a result of the WSM and its space medium. If GTR were not included in the WSM this would be unexpected indeed. Nevertheless, this feedback in Nature is puzzling and perhaps the reader can assess its further meaning.

Equation of the Cosmos. A simple calculation [16] using Principle II also yields an eye-opening relationship between the effective radius **r** of the electron waves, the radius **R** of the Hubble universe and the number **N** of particles in the universe, termed the *Equation of the Cosmos*:

$$\mathbf{r^2 = R^2/\sqrt{[3N]}}$$

This is remarkable! The smallest things of the universe, r, depend only on the largest, R and N. This equation also expressed the connectivity of matter – each particle depends upon all others in the universe. The computed value of **r** corresponds with the classical electron radius, approximately 10^{-15} m. This is expected. It is the logical common thread between Mach's Principle, General Relativity, and the ancient philosopher's concept of ONE substance, which are brought together as consequences of the Wave Structure of matter.

Why can't we feel 'space'? Feeling requires a sensor of an energy exchange. We don't easily sense the space medium because our survival as an animal species depends mostly on our ability to fight with other animals seeking food, and to compete for mates that produce children. Observing the medium would not help our survival so Nature has not equipped us to sense it. In our self-focused human perspective few of us are even aware of the wave medium in which we exist. For survival, it doesn't matter what space is, or whether we can observe it - it exists nevertheless. As Sir Oliver Lodge quipped: *A fish cannot comprehend the existence of water. He is too deeply immersed in it.*

I. Origin of the Natural Laws

The wave structure of the electron Eqns. (2a & 2b) contains the experimentally observed natural laws. The mathematics are derived by Wolff [6,16] and summarized as follows:
 a) **Doppler.** The most surprising consequence of the WSM is found from the Doppler effect between two relatively moving wave centers. Say, one is an observer electron and the other is a source (another electron). Using Doppler math, you will find the **relativistic mass increase**, the Compton and deBroglie wavelengths, and consequently the **Schroedinger Equation.** At first it seems astonishing that all these occur together but upon reflection it is logical since each of them depends on relative velocity. They are calculated by writing two waves, like Eqns. 2a or 2b, for the two relatively moving electrons. The Doppler effect is then inserted into both the inward and outward waves. Then you find that in each term of the resulting total Doppler shifted wave that contains mass or frequency, there is a relativistic mass-increase factor. And the Doppler wavelength becomes the deBroglie wavelength, and, the phase velocity contains the Compton wavelength. Before the WSM there was no theoretical explanation of either

QM or SRT or their common origin. Now the reason is immediately clear from the wave algebra: Both the in- and the out-waves have symmetrical roles in the Doppler. This means there is no dependence on the direction of the relative velocity, as is experimentally observed.
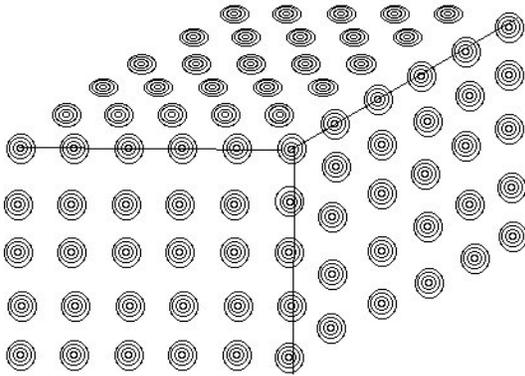
Structure of a crystal

Figure 3. Apparent location of charges. The spherical wave structures of atoms and the electrons arrange themselves in a configuration of minimum amplitude or minimum energy. For example, in this crystal, the waves of adjacent electrons overlap with opposing phases resulting in equal spacing of the wave centers. This is caused by Principle II. Most of the wave amplitude of an atom and its electrons are concentrated around a center point where energy exchange occurs. This produces the *appearance* of a particle that we emotionally expect, as predicted by Schroedinger.

b) **Annihilation** of electron and positron waves occurs when super-imposed. This is immediately obvious because Eqn. 2a = - Eqn.2b.

c) **Spin** of h/4π occurs due to 3D rotation of the in-wave at the center to become an out-wave. This rotation is described by the SU2 group theory of Battey-Pratt [14]. The two opposite rotations produce matter and anti-matter that make up the binary universe in which we live. This is especially interesting because group-math theorists have shown that this type of rotation is a property of 3D space only, not 4D, or 10D or 11D etc. Thus matter and anti-matter can occur only in a 3D world.

d) **Energy Conservation** occurs because only identical wave states can resonate with each other, producing equal and opposite frequency (energy) shifts.

e) Electric force interactions appear to occur (as proposed by Schroedinger) at the high-density centers. The wave centers look like point charges, as in Figure 3.

f) **Gravity** is a property of the behavior of wave centers [13]. It occurs because the in-wave, on arrival at the center, establishes the position and motion of a particle. Then matter nearby can modify the density of the surrounding medium, according to Principle II. Finally, the changed medium density causes the in-wave to speed up going towards the nearby matter. We observe this speed-up as gravity force. Other forces are also produced by a similar change of medium density.

g) The **CPT** (**c**harge, **p**arity and **t**ime) **transformation** properties of an electron have been observed in experimental QM for many years but the reasons have not been known. CPT means that if you switch a particle to its opposite property in the order **C** >**P** >**T** you will arrive back to the initial particle. Now you can easily show with a little algebra that Eqns. 2a and 2b contain this property.

h) **Inertia** - The acceleration of matter changes its Doppler frequency relative to the surrounding wave medium. Restoring frequency equilibrium produces energy exchanges with the medium that appears as a local force F=ma that has been known experimentally since Galileo and Newton, but the reason has not been

known. The total energy exchange will follow the relativistic rule from a) above, that at small velocity becomes the familiar energy rule $E=1/2mv^2$.

J. The New Electrodynamics

Prof. Carver Mead, an engineer at Cal Tech investigated the e-m consequences of the WSM in his 2000 book "Collective Electrodynamics" [8]. This book is very popular in Silicon Valley because it shows correct ways to solve the electromagnetics of transistor circuits. He recognized that the electron is not a point particle but a wave structure. Thus the approximations of Maxwell's Equation do not work when dimensions approach the quantum region, especially magnetism. Mead made use of the electron wave structure observed at low temperatures [17] to derive a vector potential in place of the erroneous magnetic terms of Maxwell Equations – an error foreseen by Einstein. His work begins an important future for wave-based electromagnetism.

K. Conclusions

The proposals of Clifford and Schroedinger were correct that an electron is a continuous wave structure in space not a material particle, and our observation of point particles and electromagnetic waves are merely appearances (s*chaumkommen*). The Schroedinger wave functions must be interpreted as the electron itself, not as probability numbers, as seen at the Dean Dauger (UCLA) animation site above. Many classic paradoxes, including, 'renormalization', wave-particle duality, and Copenhagen uncertainty, no longer occur because they were caused by the notion of a material particle that does not exist. There is no causality violation because the in-waves are real and do not run backwards in time.

Unity of the Universe. The wave medium - the space around us - is the ONE source of matter and the natural laws. Since the waves of each particle are inter-mingled with the waves of other matter and all contribute to the density of the medium, it follows that every charged particle is part of the universe and the universe is part of each charged particle.

Principle II (extended Mach principle) states that the stars and galaxies of the universe are essential to the laws of Nature and to the existence of the Earth and ourselves. This important fact is not presently familiar to the physics community. For example, the present Standard Model of the universe contain no recognition of Mach's Principle, or our inter-connection with the universe.

Why has the science community not sought the WSM? There is a dark side to the development of science. It is tempting to imagine scientists as noble pioneers, questing for the greater good of humanity, and transfixed by the wonderful mysteries of the world. However the day to day history of nearly every radical discovery tells an entirely different story portraying a community that will eat its own in the name of progress and where each member usually votes his pocketbook. Scientists are no different than you or I. All the deadly sins of man and womankind are also found in the hearts of scientists.

Knowing this helps understand why the science community has not sought the Wave Structure of Matter. It will take a long time to dispel treasured scientific illusions even though following the path of the discrete particle leads science down a dead end street. Figure 4.
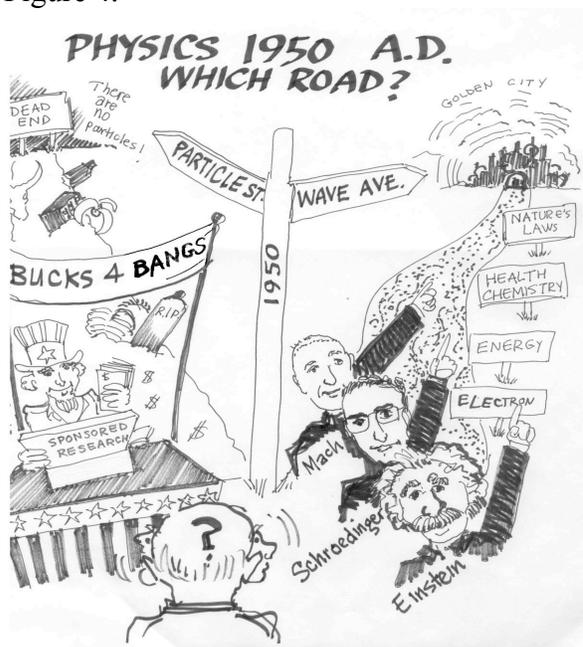

Figure 4. The illusive lure of the discrete particle. Although the twentieth century pioneers of physics urged their peers to consider waves as the fundamental structure of matter, the temptations of government led science down a dead end street searching for discrete particles. The government wanted to buy weapons of high-energy and the physics community tried to oblige. As Prof Carver Meade wrote: *The last 70 years of the 20th century will be seen in history as the dark ages of science.*

L. The Future

There will be new valuable applications of the WSM in technologies concerned with the behavior of matter at small molecular dimensions: especially the quantum world at low temperature, the design of new alloys and catalysts, more efficient power transmission, understanding the mechanisms of bio-physics, building molecular computers and memories.

References:
1. Wm. Clifford,(1876) "On the Space Theory of Matter" in *The World of Mathematics*, p568, Simon and Schuster, NY (1956).
2. E. Schroedinger. In *Schroedinger- Life and Thought*, Cambridge U. Press, p327 (1989).
3. J. A. Wheeler, and R. Feynman, Rev. Mod. Phys. **17**, 157 (1945).
4. A. Einstein, *Relativity*, Crown Books (1950).
5. E. R. Storri, American Scientist **85**, Nov-Dec, pp 546-553 (1997).
6. M. Wolff, Physics Essays **6**, No 2, 181-203 (1993).
7. M. Wolff, *Gravitation and Cosmology* in *From the Hubble Radius to the Planck Scale*, R. L. Amoroso et al (Eds.), pp 517-524, Kluwer Acad. Publ. (2002).
8. C. Mead, *Collective Electrodynamics*, MIT Press (2000).
9. P.A.M. Dirac, Proc. Roy. Soc. London **A117**, 610 (1929).
10. H. Tetrode, Zeits. F. Physik **10**, 312 ((1922)
11. F. Hoyle and J. Narlikar, Rev. Mod. Phys. **67**, No. 1, 113 (1995).
12. J. Cramer, Rev. Mod. Phys. **58**, 647 (1986).

13. G. Haselhurst, (to be published in) *What is the Electron*, Apeiron Press (2004).
14. E. Batty-Pratt and T. Racey, Int. J. Theor. Phys. **19**, 437 (1980).
15. E. Mach, (1883 German). English: *The Science of Mechanics*, Open Court (1960).
16. Wolff, M. *Exploring the Physics of the Unknown Universe, Technotran Press,* (1990).
17. B.S. Deaver and W.M. Fairbank, Phys. Rev. Ltrs. **7**, 42 (1961)