Matter Waves and Buddhist Thought - *Explaining Tetrode and the EPR Effect*

Introduction.

The advent of the quantum theory in the years 1920-1930 brought with it the possibility of understanding the origin of consciousness. During the last decade, research on the mysterious Einstein-Podolsky-Rosen (EPR) effect and "tangled quantum states" has created an added appeal that there may be a connection between consciousness and 'tangled state' quantum phenomena. This could be true. There is a phrase often spoken in hindsight after a new scientific advance, "Nature did it first!" This fact of nature suggests that the human brain during evolution, could have made use of this unique and mysterious means of communication. Now, physics research of the last five years has gone a step further and delineated the origin of quantum waves and the EPR effect (Wolff,1990-1998). They are no longer mysterious but a consequence of the matter wave structure of charged particles, particularly the electron-positron. This reality of communication in Nature, which we cannot directly sense, has implications for religious and philosophical thought....

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... Buddhist thought is tremendously rich in the arena of human consciousness and its connectedness with nature. Notions of the interconnectedness of all phenomenon occur in many spiritual contexts. For example, there is thedoctrine that all living creatures in the world have an inner or psychological being. This is is based on the idea that there is one fundamental, universal substance of life. Spinoza also taught that spiritual phenomena are attributes ofone underlying substance.

Scientific evidence of the origin of consciousness or the substance of life is difficult to isolate. Thus these ideas areregarded as speculative. Nevertheless, speculation is often productive, and a powerful motive force for scientificinquiry as well as a guide in religious life. However scientific results only happen when you are clever enough tocreate models and/or hypotheses based on one or more implications of your speculation which are capable of beingtested. Caution is needed before drawing conclusions. You shouldn't write checks with your speculations, that youcan't cover with your science!

There are other reasons for focusing on matter waves. The funded Human Genome Project ambitiously proposes to completely unravel four billion genes of human chromosomes which determine the structure of our bodies. Thisstructure is the hardware of our body computer. Where is the software? We are born with many built-inemotions and survival mechanisms which are 'software programs'. L ike consciousness, they occupy our mind but have no identified physical location. Since our unconscious brain and its peripherals are the 'cpu' of our bodycomputer, then matter waves could be their internal communications mechanism. These waves are not limited in their range, soit becomes conceiveable that external mind-to-mind and mind-to-matter communication can also occur. Survivalis the primary goal of each organism thus internal communication would be the predominant role waves while external communication would be rare. This may explain the greater effectiveness of meditation.

Although many mathematicians and scientists, including Schroedinger, deBroglie, and Einstein, have advocated a wave structure of matter, one of the more interesting was Hans Tetrode who made a prediction that upstages the EPR effect. I will tell his story and in the process describe the new Matter Wave Structure of Particles. Then it is up to the professional neuro-psychologists to make further connections with consciousness.

TETRODE'S WORLD

This article is a visit with a German astronomer, Hans Tetrode, who was an astronomer colleague of Albert Einstein 80 years ago. Then and now, he was a pioneer in exploring the nature of the universe. Tetrode had a far-reaching concept of how light is transmitted from a distant star to our eye. He thought a great deal about the properties of the energy transfer carried by light and came to a surprising conclusion. Tetrode wrote in the Zietshrift fur phyzik, 10, 317 (1922), "When I see light from a star 100 light years away, not only do I know that the light was emitted 100 years ago but also a group of atoms in the star knew that the light would enter my eye 100 years later, before I even existed!" Privately, Einstein agreed with his friend but had no explanation for his bizarre conclusion.

Below we will examine his idea in the light of modern matter waves and the structure of the electron.Who knows what a 'photon' is? For Hans Tetrode, the word had just been invented. Today, along with electron, this word is one of the most familiar in physics. Yet, until very recently (Wolff, 1995) no one knew what these two things were. They are closely related because an electron and an anti-electron will annihilate when they come together producing two photons with the same total energy as the original two electrons. Also, in the 'photo-electric effect' when a photon appears to strike a metal surface it removes an electron whose total energy, kinetic + potential, equals the energy of the photon. Let's look at the modern electron to understand them.

We will see that both the electron and the photon are consequences of the micro physics of the quantum world. In that arena, things can be puzzling because we cannot observe the quantum world using our limited five senses. Instead we must imagine particles as they really are: structures of matter waves (like quantum waves) in their wave medium, the quantum ether. They are part of the new physics of the Wave Structure of Matter. Strangely, Tetrode seemed to know some properties of the matter wave structures before they were discovered!

The photon was more puzzling than the electron because its behavior does not fit into the ordinary laws of electricity and magnetism. Some cautious thinkers were not sure that the photon existed at all. This puzzle

about the nature of light had existed for four centuries. In Newton's time, two favorite concepts of light were: 1) a stream of particles, and 2) a wave phenomenon. To his credit, Newton didn't stop at theorizing but measured the properties of light using a prism to separate the apparent wavelengths. He was the first person to observe the color spectrum of light. He asserted that light was a wave phenomenon and his opinion was adopted for the next three hundred years. Then in the 1920s another puzzle surfaced when experimental evidence of the vast quantum universe appeared. This evidence brought forth new advocates of the old particle concept of light.

Energy Exchange

Note that Tetrode is talking about a process of energy exchange. We need to examine energy exchanges carefully. Our experimental e vidence tells us that a molecule in the star loses a bit of energy (a molecular quantum state shifts downward) and later your eye gains it (a molecule in your eye shifts a quantum state upward). All energy exchanges are a process like that. All observations involve that process. In order to understand the process, you have to analyze the Mechanism of Energy Exchange between particles. But old conventional physics could not understand and analyze because it contained no mechanism for energy exchange. The new mechanism of wave structured matter was the first ever put forward. You may be reading it for the first time here!

Looking back in history, we can soberly notice the strange lack of curiosity about energy exchange on the part of scientists. This was just as bizarre as the photon itself. In hindsight this was amazing! All the experimental observations of scientists, all the data in the huge memories of our computers today, are the result of energy exchanges. But few persons have asked, "How does energy exchange work?" Not having a foundation to build upon, the old force laws simply assumed, 'Energy exchanges happen - like acts of God.' Scientists maintained a religious trust in the 'natural laws' and set aside their human curiosity. Having done this, there was no way to think about exchange because the force laws of old physics were static - static because the point particles in the old laws were static. No waves moved between them. Particles had no means of communication. No information was exchanged between them. It was impossible to understand how the laws operated.

Trying to explain the energy transfer puzzle, the photon concept was invented in which a 'bundle' of electromagnetic energy moved from place to place. Unfortunately, the photon concept is in total conflict with the natural laws of electricity and magnetism. And affirming that conflict, no traveling 'bundles' have ever been observed. Photon bundles appear bizarre because they are illogical.

The Wave Structure of Matter

Tetrode's thoughts were just as puzzling as the electron and the photon! But recently, using the new physics of the wave structure of matter, it appears that Tetrode had come closer to the mark than anyone of his time. How is his idea to be interpreted using the new wave structure of matter? To do this, carefully examine the observations and the scientific process involved in the transmission of light. We have to deduce and construct a logical foundation. We must not draw false conclusions by using erroneous assumptions.

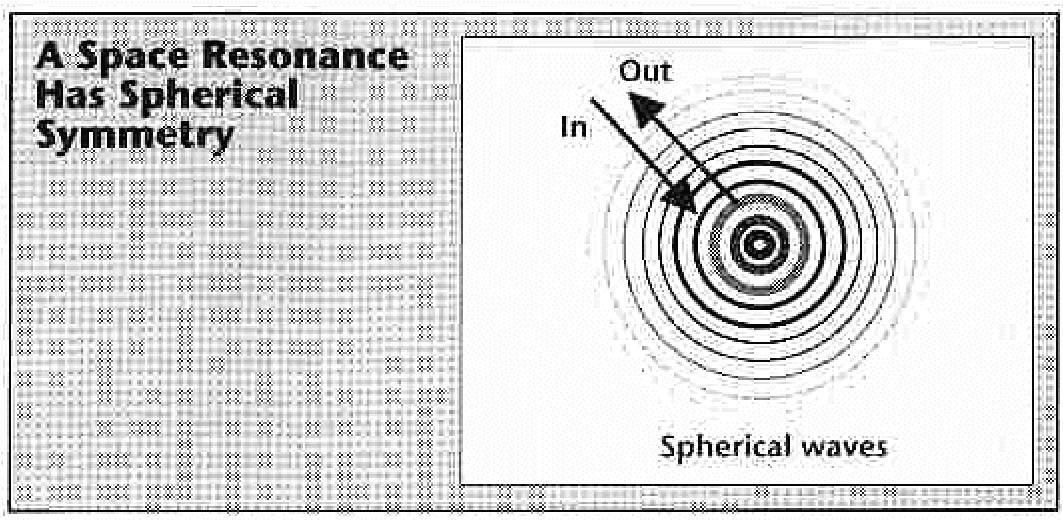

Figure 1. Quantum waves of an electron

Recent work on the wave structure of matter has shown that particles are not static. Instead they are dynamic wave structures. An electron is simply composed of two spherical matter waves (like quantum waves). These inward and outward waves are shown in Figure 1. One wave moves inward and one wave moves outward. One proof that this simple structure is correct is that the behavior of two such particles quantitatively predicts the natural laws. Only three mathematical assumptions are necessary to derive the natural laws . It is immediately clear that the inward and outward waves can provide the communication needed to exchange energy in accordance with the energy conservation law.

The Three Principles of Wave Structure of Matter

These three principles or basic assumptions are all that is needed to: 1) deduce the structure of particles, 2) find the origin of the natural laws, 3) solve many paradoxes, and 4) learn relationships that connect the universe and the charged particles. These principles describe properties of scalar waves and their ether-like wave medium that pervades all of space. They are:

Principle I - The Wave Equation: *A space ether medium exists which can propagate scalar waves everywhere in space according to the scalar wave equation*

$$\nabla^2 A - 1/c^2 \; \partial^2 A / \partial t^2 = 0$$

The governing equation of matter waves traveling in space at velocity c.

This equation is similar to other oscillatory equations in nature. It provides the law of formation and

structure of all the particles. The scalar wave amplitude **A**has only a single (scalar) value at each point in space, thus it is the same type as quantum waves. It is is not a vector amplitude like a radio wave. Two solutions of the equation in spherical coordinates are an in-going and an out-going spherical wave. Combinations of these two waves form the electron-positron and other charged particles, as shown in Figure 1. The mathematical properties of these two combined waves are the origin of the natural laws (Wolff, 1992).

Principle II - The Wave Density Principle: *The propagation property of the space ether can be described as proportional to a 'density' of space. The density of space at a given point is proportional to the sum of the densities of all the waves from all the particles in the universe whichhave arrived at that point. The wave amplitude of any particle located at that point must be included.*

The frequency or mass ($hf = mc^2$) of the waves of an electron is proportional to the space-ether density, and Principle II can be written:

Space density is proportional to:$\mathbf{constant \times SUM[(amp_n/r_n)^2] = mc^2 = hf}$

where $\mathbf{r_n}$ and $\mathbf{amp_n}$are the distance and amplitude of each particle wave center.

In most of space, the total density from all **n**particle waves is almost constant, simply because of the large number (about 10^{80}) of particles in the Universe. Thus the propagation speed c, the electron mass m, and its frequency f are very nearly constant everywhere, as observed. The space density is significantly larger only at the center of each electron, because of the electron's own wave density.

Testing Principle II. The correctness of Principle II can be checked using astrophysical measurements because the the radius **R** of the visible universe and the particle total **N,** mostly hydrogen, are approximately known. If an electron's own waves are to have any significant effect on space density at its center, then that density must be roughly equal to the total density due to all the waves from the other **N** particles in the universe. This rquirement produces a result (Wolff, 1990):
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$$\mathbf{r_e^2 = R^2 / 3N} \qquad (\textbf{Equation of the Cosmos})$$

This remarkable relation, a research goal of several decades standing,provides a numerical connection between the large numbers **R,** and **N** of cosmology and the small number, $\mathbf{r_e}$ = radius of the electron, of micro physics.The reader can verify this himself by inserting the measured values.

Principle III - Minimum Amplitude. Nature is often observed to have 'principles of compulsion.' As examples: 'Ocean water seeks a minimum level,' 'Entropy always increases,' and, 'Mechanical objects move along a path of least action.' These conditions are a result of the behavior of the matter waves of particles demanded by the Minimum Amplitude Principle (MAP):

The total amplitude of particle waves in space at every point always seeks a minimum. As a result, wave centers move or undergo frequency exchanges (energy exchanges) to approach a minimum value of:
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$$\mathbf{SUM\ \{\ [A_1 + A_2 + A_3 + \ldots\ldots + A_n]^2\} = a\ minimum}$$

This important principle is needed to bring about energy transfers and motion of particles. At first the MAP appears simple and perhaps obvious but its applications in particle physics are broad, necessary and often unsuspected. For example, particles of opposite charge move together because total wave amplitude is decreased. Conversely, like charges move apart for the same reason. Another example is

the formerly mysterious Pauli Exclusion Principle which requires 'No two identical particles may occupy the same state.'

The Energy Exchange Mechanism

The energy exchange mechanism is contained in the *Wave Density Principle II.* Briefly, this principle shows that the density of the propagation medium at the center of each particle is large (Wolff, 1990). Thus the propagation properties at the center are non-linear. Non-linearity causes two particles to interact by mixing their wave frequencies. In the technical slang of engineering, the two particles (wave sources) are 'coupled' together. Coupling means the frequency components of their separate waves can be exchanged between the two particles. This energy exchange process has analogies - coupled devices we are familiar with. For example, exchange of vibration between two resonating violin strings, or between two identical pendulums that are joined by a weak coupling spring, or between a radio transmitter and a receiver tuned to each other. (Caution: Matter waves are not the same as e-m waves!) Note that the exchangemechanism provides properties that a particle must have: communication, it mimics 'charge' and 'mass,' and it exists at the center of a particle. Knowing this, the old concepts of particulate 'mass substance' and 'charge substance' are no longer needed or useful.

Our mistake was to ignore other waves in the universe. Let's instead look at the universe with all the particles in it. In this real universe. the waves of particles are traveling everywhere, in and out, to and fro, mixing with each other in an apparently hopeless tangle. However, on closer examination, a consistent behavior pattern emerges from the hopeless tangle. We find that all the particles of the universe are joined together in a unified symmetric harmony where each particle is mutually dependent on the others for its existence. How does this happen?

The Huygens Combination Wave Front

Two hundred years ago Christian Huygens, a Dutch mathematician, found that if a surface which contained spherical wave sources was examined at some distance away the combined spherical wavelets appeared like a flat wave surface, a plane wave front. This plane wave is said to be a 'Huygens combination' of the separate spherical wavelets from the sources. This basic process occurs for the waves of all the particles in the universe and is the mechanism that creates their in-waves. See Figure 3 below. Let us follow the path of the waves from a wave center. We describe the origin of the in-waves by beginning with an initial space resonance (a wave center). Its waves travel outward and encounter other particle centers. Like all particles, they have non-linear centers which mix wave frequencies. When the outward wave of the initial particle encounters them, a signature of the out-wave is transferred to the spherical out-waves of theother particles. This happens at every encounter.As a result, all the other particles in that universe are making contributions to Huygens Combination waves which are *in phase* upon return, at the initial particle. Those contributions become the in-wave of the initial particle.

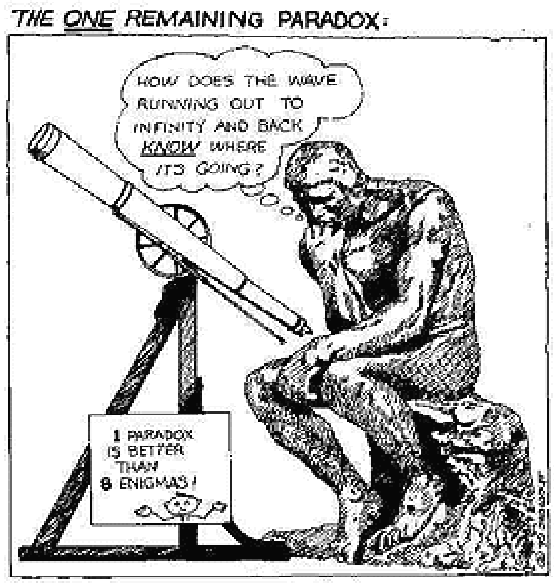

Figure 2. Inter-dependent Harmony of the Universe

It is convenient to envision a particle alone, as we have done, comprised of its IN and OUT waves, separated from other particles in the universe. This simple structure allows us to examine and study the particle, uncluttered by other particles. It provides a mathematical basis to predict the experimental properties of space resonances. It gave us confidence, because only three principles replaced a dozen assumptions of old physics. But this simplest representation does not allow us to understand the origin of the inward waves. We are puzzled like the thinker shown in Figure 2.

The in-wave propagates inward just as the out-wave propagates outward; both are minute components of the immense fabric of waves from the entire universe. Only when the waves are near their center location does their ampltitude become relatively large. Knowing the origin of the in-waves, as in Figure 4, we realize they do not violate causality and time does not run backwards! What a relief!

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We are Part of the Universe
Although we can envision each particle separately as a pair of IN and OUT waves, that pair cannot exist without the presence of all the other particles in the universe. It has no meaning alone. Every particle in the universe depends on all other particles to create its IN wave. Thus in a very real sense, we humans are part of the universe and the universe is part of us. We are totally inter-dependent.

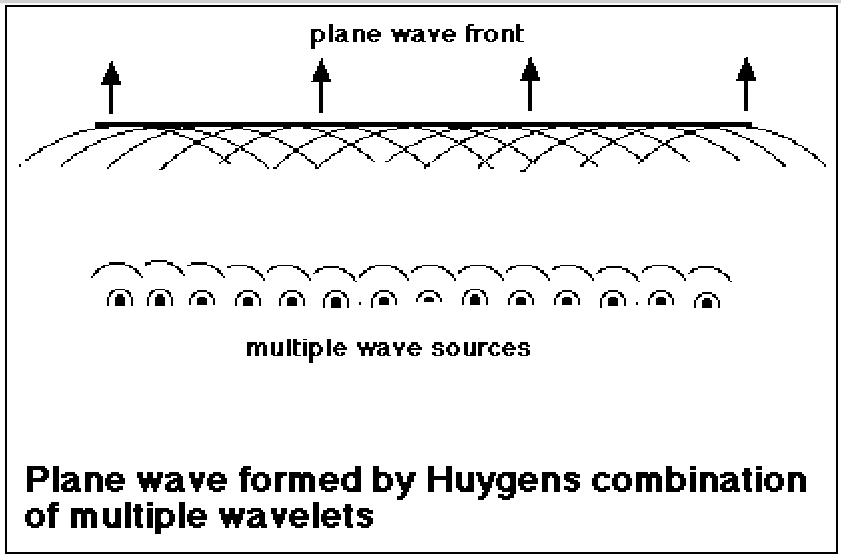

Figure 3. Formation of a Huygens Combination. ***The waves from the plane array of sources combine and form a new plane wave front which behaves like a single wave front.***

Take a breath now! ..... This forced conclusion is awesome. We have to think of ourselves, our bodies, our brain and its mind, as inextricably joined with other matter of the universe. Every atom and molecule within us depends on the rest of the universe. If the rest of the universe did not exist we could not exist.

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At this point we have to take a hard look and ask ourselves, "Is this crazy? Is this just philosophical speculation? Just a science fantasy? Or is there a way to prove that the universe really behaves this way?" The answer is: "Yes, the evidence is clear." In fact, it is much clearer than the old physics. The evidence is seen in the origin of the natural laws that have never been understood before. Let's look at them....

The Evidence

Before the wave theory of matter, all laws of physical phenomena were obtained from empirical observations. That is, they were experimentally observed to be true but were not predicted from any underlying mathematical or physical cause. Their truth and existence was a matter of faith in Nature. Nature played the role of a God. Now using the mathematical wave description of the electron, the natural laws are predicted to be as observed.

At last, there is a physical origin of the natural laws. They are not God-given but are based upon the matter wave structure of the universe. The existence of the many natural laws as predicted is overwhelming evidence that the matter wave description is correct. Below is a brief summary of the origin and predictions of the Natural laws:

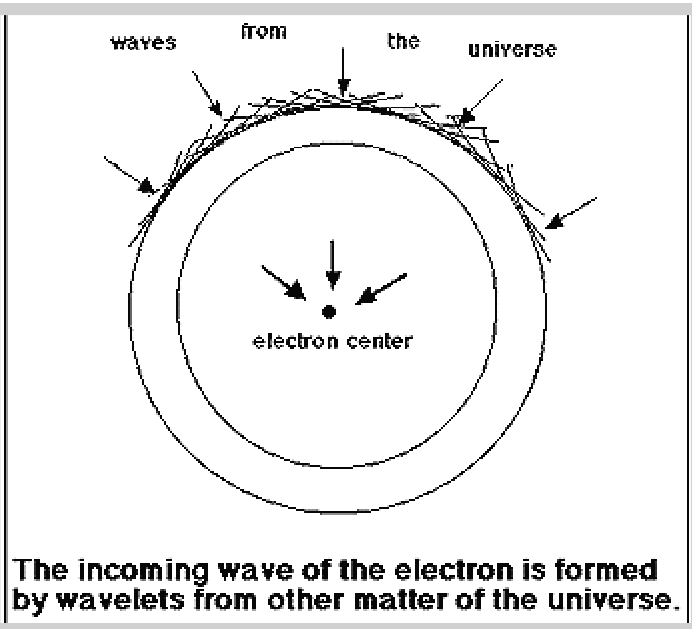

Figure 4. Source of the In-waves. ***Wavelets reflected from the other matter of the universe, are in phase when they arrive back at the location of the initial electron. This Huygens combination of wavelets is the in-wave of the initial electron.***

1. Mach's Principle. Mach's Principle (Mach, 1893) is contained in *Principle II* of the Wave Structure of Matter which states that the quantum wave ether is established by all the matter of the universe. The ether becomes the absolute reference frame for accelerated motion of objects. Thus we observe a force F = ma due to energy exchange of the object with the ether which appears as a change of the relativistic mass. We can also regard the change as kinetic energy relative to our own reference frame.

It is an extension of Principle II that all other laws of nature as well as Mach's Principle depend on the matter of the universe. In general, wave properties usually depend on the wave medium. This is true here for matter waves, thus the laws and the natural constants c, e, m, and h depend on the space ether medium, which in turn depends on all the matter in it.

2. EPR Effect. This effect occurs when two separate quantum states are potential receivers of an energy exchange from a single source state. The exchange cannotoccur unless all three states have suitable initial conditions for the exchange. The suitability rquirement is that total wave amplitudes are less after the event than before, thus satisfying the MAP (Principle III). Establishing initial conditions before the event, is the role of the in/out waves of the three participants. This appears to take place magically and instantaneously. Actually it is done by the in/out waves at their normal speed c. We don't notice it because we can onlyobserve actual energy exchanges, which take place after the activity of the matter waves.

3. Conservation of Energy. Energy exchange occurs between two resonant states with *identical*frequencies. When it occurs, a source state always shifts frequency downward and a receiver state shifts frequency upward. This equality produces the observed conservation of energy. Note that equal frequency changes are equal energy changes from the relation $E=mc^2=hf$.

4. Magnetism. Magnetic force is a change of the static electric force between two charges whenever two charges are in relative motion. Thus the magnetic force is proportional to the product of relative velocity [v/c] and the two charges. Rearrange any force formula to see this. In practice, magnetic force changes are small (10^{-7}) compared to the electric force so we don't often notice this relation. The force is so small that the energy exchange can, like inertia, be transferred to the ether and appear instantaneous.

5. Mass Increase of Relativity. This is due to the Doppler effect on both the in- and out-waves of two electrons (charges) in relative motion. Each electron receives changed frequencies from the other electron. The calculation uses wave solutions obtained from *Principle I* with relative velocity v/c. Since hf =

mc^2, the frequency changes are also mass changes which exactly match the experimental mass increase. The dilation of length and time are not predicted by the Doppler effect.

6. Electric Charge. The wave amplitudes of the solutions of the *Principle I Wave Equation* vary according to 1/r. Thus the resulting forces are proportional to $1/r^2$ as observed. Attraction and repulsion of charges result from *Principle III* (MAP) which requires that "The total wave amplitude in space attempts to minimize itself." Thus if charges are alike, the sum of their identical waves is minimized if they move apart. Conversely, opposite charge waves are equal and opposite so their total wave amplitude is minimized if they move together, as observed. The wave theory also predicts that force at zero distance between charges is finite. This agrees with observations. In contrast, the old Coulomb theory predicts infinite forces which are not observed. (SeeWolff, 1995.)

7. Spin of the Electron.'Spin' is a unique quantum property of the electron wave structure. It is due to the rotation and phase shift of of the in-wave of an electron when it changes direction to become the out-wave. The predicted value is the same as observed. No other competing origin has been proposed or is needed because the Dirac Equation (below) is satisfied by a pair of in/out waves obtained from *Principle I*. (See Wolff 1997B, web page.)

8. The deBroglie Wavelength (basis of quantum mechanics). The deBroglie wavelength is a Doppler effect on the combined in-waves and out-waves between a source charge and a detector charge which have a relative velocity v/c. The calculation from *Principle I* is the same as 5 above. The predicted deBroglie wavelength is L=h/mv, as observed.

9. Anti-matter. A particle and its anti-particle from *Principle I* have opposite amplitudes of their in- and out-waves. Both structures have the correct anti-properties. For example, since they have opposite wave amplitudes, they annihilate if superimposed. They have the correct CPT (charge-parity-time) properties and agree with 'Feynman diagrams.' (See Wolff, 1995, 1996.)

10. Dirac Equation. The in-out wave pair fits the mathematical definition of a Dirac 'spinor'. This wave-pair spinor yields a unique electron-positron pair when operated on by Dirac matrices. That is, there are two solutions: one is the positron with +spin, and the other is the electron with -spin. In short, the math matrix method of Dirac gives the same result as the wave theory of matter. (See Wolff, 1997B.)

11. Action at a Distance (of gravity and magnetism). These two tiny perturbationsof electric charge force produce energy shifts between the particles and the surrounding ether of matter waves. Since the forces are small, no waves need travel, and energy exchange takes place immediately in the adjacent space. This agrees with planetary measurements which *appear*instantaneous. Actually, all waves travel at c velocity, including the subsequent adjustment to equilibrium of space density. There is only one wave velocity for all phenomena, c.

12. Time, Length and Mass S**cales** . Our human length scale and time scale (frequency) are determined by the frequency and wavelength of the space resonance (charged particles). As for all waves in nature, these properties depend on the ether medium of wave propagation. Charge waves carry all the energy exchanges of our human sensory experiences. Thus the electron's time and length scales are common to all particles and everyone experiences the same passage of time. (See Wolff, 1997A.)

13. Unified Origin of the Natural Laws. The above listing shows that the natural laws have a common origin - the wave structure of the particles. Further, the natural constants and other fixed properties depend on the ether medium. Since the ether density is proportional to the waves of all particles in the universe, the result is that every particle depends on all other particles. We live in an inter-dependent universe.

This unified origin is both a prediction and result of understanding the wave structure of matter. The

prediction of the natural laws by the wave structure of matter and the verification of the prediction by the existence of the laws is overwhelming proof of the theory.

In this real sense, our universe is not mathematically infinite but has a finite radius depending on the age since creation of the matter in ourselves and our laboratory instruments.It has been suggested (Jayant Narlikar and Halton Arp, 1993) that the Hubble red shift may be due to this phenomenon. That is, stars at a greater distances from us are younger and thus their properties are 'younger' leading to a longer wavelength of their spectral radiation.

Tetrode's Conclusion

We see that when an energy exchange takes place there must occur a resonant condition between the source particle and the ultimate detector particle. Resonance can occur when there is coupling between the quantum states of the two particles. These resonances cannot be established until the suitable boundary conditions (MAP) are established. The traveling in and out waves determine if boundary conditions are satisfied, as shown in Figure 5.

The existence of this pre-determination is the information exchange which has puzzled experimenters investigating the EPR effect ('entangled states'). This information travels at velocity c, but... the carrier is the matter waves, not e-m waves so there is no energy exchange visible to us. We therefore mistakenly imagine that the information travels instantly.

The Size of the Universe

The matter waves from our Earth, which travel outward, reflect from other matter, and return as in-waves, determine the size of the universe that we can learn about. We can only get information about the space they traverse. But this space is not fixed. The volume of space traversed by the waves is continually being enlarged by the time to travel. Thus the 'universe' for any particle is contained within the range that waves can travel at velocity c after the creation of the particle.

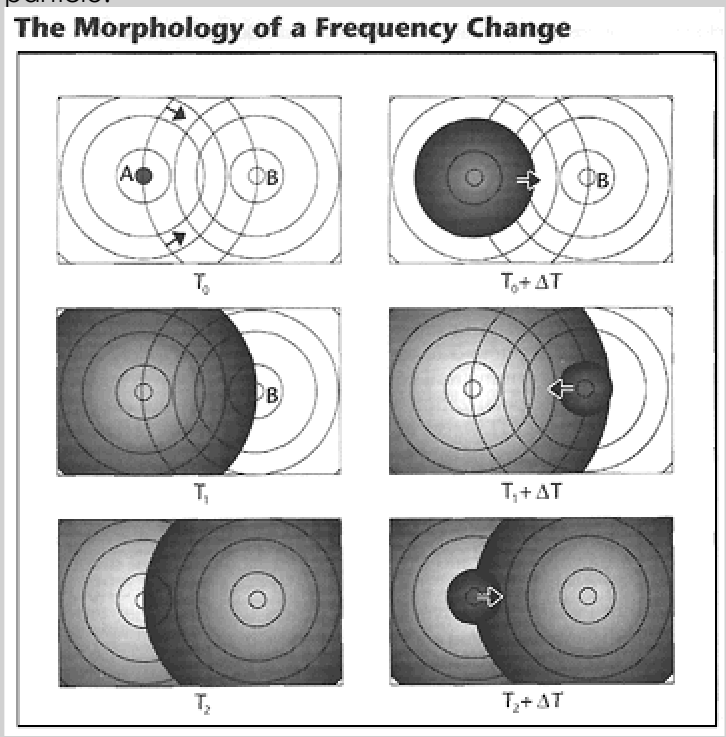

Figure 5. Matter Wave Communication.*The IN and OUT waves of two atoms, A and B, carry information about the state of the other atom. If conditions are suitable, the two atoms shift frequency to obtain a lower total wave amplitude in the surrounding space. The receiver (A) will shift frequency upward, and the source (B) will shift equally downward, behaving like coupled oscillators*.

Was Tetrode justified? He was right. When the process of wave 'coupling' is applied to Tetrode's statement we can conclude that in order for the resonance in the star and the resonance in his eye to begin an energy exchange, each of them had to have their IN and OUT waves at the location of the other particle; both of them had to be at least 100 years old. No coupling could take place between particles which are more distant than the travel range of the OUT and IN waves. So we can deduce that the molecules of his eye's retina pigments had to exist before he was born. They existed before but were recycled into his eye. Tetrode's conclusion is no longer puzzling. But how did he know that 70 years ago?

Final Speculation on the Origin of Consciousness.

It is evident that the matter waves of the universe are the underlying source of the action we observe in our human energy world, even though the matter waves are unseen - like the puppeteer behind the curtain. This process is available for use by nature in designing our evolutionary development. Did it happen? If it did, then it is not unreasonable that our brain and other parts of our neural physiology are interconnected by an unseen communication network that coordinates and regulates behavior of certain parts of the body. Since energy exchange is not involved at this matter wave level, we would not have a sensory impression of logical thought, only an awareness of ourselves and our body. More research is needed to know, but in view of the intricacy of our neural structures, the work will not be easy.

The range of experiments needed to verify consciousness or extra-sensory perception is almost as large as human imagination. An example is the philosophy of my daughter Jennifer, who was the illustrator and artist for my book (Wolff, 1990) which first described the wave structure of matter. After reading the book, my daughter has acquired new beliefs on consciousness. As a scientist, I cannot propose beliefs not based on laboratory facts, but my daughter has no such inhibitions. She uses the matter wave theory to explain things that had formerly puzzled her. She explains, "Consciousness can be active. If I pray that a sickfriend's cancer will be cured, I visualize my thoughts traveling on matterwaves that connect my mind to my sick friend's mind."

The matter wave theory has been happily integrated into her existing beliefsystem. She says "I just ignored the complex math, I don't understand it.Perhaps what we think of as God, is only the interconnections between us atthis wave/particle level" and "I don't care if it is God or matter waves, alll need to know is that all human beings are connected to each other and thatprayer and my human thoughts are powerful and using the consciousness of mymind communicates them for me."

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Glossary: Definition of important terms and concepts.

Matter waves and *quantum waves* are the same kind of wave traveling in the same ether medium. Howeverthe term 'matter wave' refers to solutions of the single Particle Wave Equation (Principle I of the Wave
Structure of Matter) whereas the term 'quantum wave' generally refers to solutions of the SchroedingerEquation involving combinations of particles. The Schroedinger Equation can be obtained from the ParticleWave Equation.

Electromagnetic (e-m) *waves* are the large scale observed appearance of energy transfers between quantumstates of electrons in atoms. E-m waves should not be considered a basic process of nature because the e-m
waves are the result of many transfers due to many charges moving relative to other charges in wires or atoms. One must be carefulnot to directly compare e-m waves with quantum waves - confusion results.

Energy transfer is always the stimulus of our human senses, the result of laboratory experiments, the means of the production ofknowledge and data storage. There is no other way. For example, an exchange is always required to darken a film, move a needle,record a bit, or fire a neuron. The basic element of energy transfer is a single energy transfer betweenquantum levels of an atom or between two atoms.

The *Energy ExchangeMechanism* underlies the force laws because the force laws describe force as thechange in energy over distance, F = dE/dr. The mechanism is a resonant coupling between two quantum statesin a atom or molecule; one is a source and the other a receiver. Matter waves are the vehicle of coupling, andthe dense ether at particle centers produces the coupling. Conservation of Energy results from the equal and opposite frequency shifts required in a resonant coupling.