By Robert B Adams Presented to The Cleveland Philosophical Club on 4/26/11

A. Introduction

This presentation is another chapter in my ongoing investigation of the consequences of my beliefs. It is also an interim progress report from an ongoing investigation into the nature of something labeled reality, in which I question our ability to relate our perceptions-what I will call the "mental reality" to whatever actually is-what I will call the "actual reality." This statement will alert you to the fact that I believe there exist a physical "actual reality" which exist independent of any life form that may develop the ability to contemplate the question.

This presentation, which is a consequence of that belief, is biased in that it will present arguments only from the scientific point of view. I acknowledge the existence and validity of the many other pathways that people choose in their search for the nature of what they call reality.

I offer this quote from the Buddhist philosophy. "All experience is a mental event, all hallucinations."

B. Some History

It was about 22 years ago when the question of the real nature of reality came to my attention in an indirect manner. At that time I was teaching X-Ray technician students the physics and technologies used in imaging devices like X-Ray machines, CT & PET scanners. The course included a section on the eye-brain system and some general information on the nature of transducers. The eye-brain system was considered important because this system was used to read and understand the film images produced by the various imaging devices in use, and the concept of transducers was introduced because one of the most well established features of any kind of transducer is that the output signal can never contain all the information in the input signal. We also know that transducers and transmission lines add noise to the signal.

One day it occurred to me that all the information the various senses detect and send to the brain must pass through multiple transducers and transmission lines before it reaches the brain. Even assuming that the various sensory inputs to the brain were very good transducers, the final stage of changing the electrical pulse signals into the mental images of what we think we are seeing is yet another transducer system. Suddenly I was aware of the possibility that the brain-produced-construct of my experienced reality might be different from the actual reality I presumed existed.

When first confronted with this possibility, I assumed that the differences between the brain constructed reality - the mental reality - and the actual reality were small, because we all seem to agree on so many different aspects of the mental reality. But what did we actually know about reality? In my first presentation I reviewed the history of how the concept of reality changed down through the ages. From about 6000 BC up to about 1875, reality was thought to be what we experienced of the world. There were the occasional clues along the later years of this span that eventually led thinkers to the belief that the brain was some kind of interpreter, translating the signals experienced by our senses into our interpretation of the reality that our senses encountered. As far as I can tell from what I have read, in the western world the reality experience delivered by the brain was, with few exceptions, assumed to be a very close reproduction of the reality experienced by the senses.

This idea was strongly supported by the discovery that the fields of logic and

mathematics could provide both tools that were useful in formulating new descriptions of the events observed, and equations that could be applied to calculate what had happened in the past and what was expected in the future. The equations discovered by Newton in the fields of motion and gravity, and those of Maxwell in the fields of electricity and magnetism were of particular importance. Suddenly, the known features of reality were thought to be very predictable, and the idea of a "Clock-works" reality was accepted in scientific circles. These ideas were contained in what was later to be called the Classical World View.

One of the exceptions I mentioned earlier was Emanuel Kant. Kant was impressed by Newton's mathematical model of the solar system, and in trying to explain its success he divided reality into 3 parts. The first, which he labeled "Appearance," was the content of our direct sensory experience of natural phenomena. He knew that Appearances were deeply conditioned by the human sensory and intellectual apparatus, so he concluded that we can only explain those facts about the world that we ourselves have created. To Kant, this meant that it would be impossible to understand the underlying reality.

The second part, which he called "Reality," was the underlying reality that lies behind the phenomena. And the third part "Theory" was the human concepts that attempt to connect Appearance and Reality. This seems to be where I am blundering about.

C. Some background Information

In the early 1920s, when the influence of the scientific observer on the possible outcomes of a given event were being discussed, some observers, considering the fact that direct knowledge of the event seemed to exist only in the mind of the observer, decided to interpret this as meaning that the real world was created by the mind - that the state of knowledge in the observer's mind somehow created the real world. It was never clear to me whether the phrase "real world" referred to what I called the mental reality or to actual reality. And I don't recall any discussion of how long a given creation of the mind was to last.

Taking the phrase "real world" to refer to actual reality, I have spent many hours over the years trying to figure out how it is that our "experienced reality" is as coherent as it is, considering that the presumed "actual reality" is constantly being created and recreated by different observer's minds all around the world. And what part do the minds of all the people who are not scientific observers (or not even observers) play in this continuous creation of the real world? Do a few observers create the actual reality that the rest of us experience? I disliked this idea that actual reality could be jerked around by every mind that thought they knew something. If such were to be the case, the universe would be a very unstable place.

I kept trying to use the almost worldwide agreement on what our experienced reality was like, as an argument against the possibility that a thought in a brain could affect or create some aspect of actual reality. I did already believe that a thought in a brain could affect the thinkers perceived reality.

Further consideration revealed that all these areas of agreement within a culture could be the result of cultural indoctrination. For instance, no matter how your brain reproduces the experience of what the rest of us have been told is the experience of blue; when you and the rest of us look at the same thing, and we all tell you that what you are seeing is blue, and you accept our authority to tell you what you are experiencing, your brain is conditioned to identify that particular experience as "blue." This process seems independent of language and culture, so we all agree on the experience "blue" independent of the actual word used or the possible individual

details of how a given biological system processes this experience.

This exercise clarified for me the power of cultural conditioning to control what and how we think. I believe that this process could produce our current common agreement on the nature of the mental reality, even if observers did create the actual reality we experience, because eventually the continuously created actual reality we live in would settle down to a relatively stable state because even the observers whose minds do the creating have been conditioned by the local culture on the general agreement about how to label any particular experience. Eventually, this cultural conditioning, operating at all levels of connection would provide a common world view of the universe, a common mental reality.

Then about 18 months ago, I came across a short paper which I believe was written by Mark M. Lewis. The author made it clear to me that the phrase "real world" could, and probably must mean "the only world available to us, the brain created mental reality." None of the many writings on quantum theories and practices I had previously read had made this new interpretation clear, so I don't know if the people who originated the phrase "the real world is created by the mind of the observer" had the actual reality or the mental reality in mind. I do know that I was enormously relieved by this new interpretation, because it returned a great measure of stability to the presumed actual reality of my experienced universe. Perhaps it may provide a similar measure of relief to you.

As I mentioned before, I have some differences with Kant's statements about what he called "Appearances." When Kant says "We can only know that part of the world that we have created with our minds," I believe he is describing what I have called the mental reality.

I believe that since Kant's time, we have developed the ability to look in more detail at some of the features of these "appearances," and that what we now observe has introduced significant changes in the interpretation of some of the aspects of our mental reality. I currently labor under the possible illusion that some experiences display problems that should be considered as clues to the presumed actual reality.

My argument will start with some brief comments about what I believe are some limitations that scientists have knowingly and unknowingly labored under, and that I think are pertinent to this subject. The first is the mostly unconscious burden of language. We all grow up with the belief that the language we speak can express any concept we can think of. For the most part this is true, because the range of concepts we can think of is conditioned by the language. But this language selected set of concepts is but a sub-set of all the concepts that could be thought of. Thus we should not expect that our language already contains words to express all the possible concepts that might be expressed about the universe we live within.

The second is scientist's deliberate restriction to the job of discovering the features of the experienced mental reality and conceiving of explanations of "how" this discovered reality can be the way it seems to be. I believe this is, in general, a good restriction, initially put in place to escape from the various "authoritative" statements about "why" things were the way they were.

But this limitation to "discover and explain how" has had some unintended and often unrecognized consequences, which seem to be based on the nature of the human personality. I refer to the very human tendency of the discoverers to take emotional ownership of the "successful" explanations they have created, and view any suggestions, corrections or additions as criticisms of themselves, as well as their work. And if their work becomes well established during their lifetime, they can significantly affect what remaining questions will get investigated-

which I believe must inevitably limit both the range of things investigated and the answers we might find.

So, given the nature of human nature, and the limitations of human perception- if we can only directly experience a reality that is created by our mind, as the Buddhist say, "all hallucinations", what do we do if one of these hallucinations is the idea that there may be an actual reality out there that is providing the experiences we use to construct our mental reality.

At the moment we can only ask questions and seek answers to those questions.

My candidate for the first question is - if, as seems very likely to me, some aspects of the mental reality could be significantly different from the actual reality, what are the reasons for this difference?

My current answer to this question is that evolution has provided us with the minimum of biological mechanisms to experience the actual reality in ways that promote our survival in this actual reality. These mechanisms may also limit both the quality and quantity of the information we receive, in order to not overwhelm the brain with information that has little immediate survival value.

The next question is - do the filtered experiences used to create the mental reality provide any clues to the nature of the presumed actual reality?

My current answer to this question is that I believe that there are many possible clues pointing to situations where some of our current concepts on the presumed true nature of things in an actual reality have serious problems. And like all clues, we just don't know what they mean yet. I will provide you with a few of the experienced events that I believe contain possible clues of interest.

D. The evidence

In my view, the first small crack in the Classical World View came in 1864, when Maxwell realized that he could combine the past discoveries about electricity and magnetism into a single framework. Well before this time, the people who studied electric fields existing around charged objects had found it necessary to attribute a property called permittivity to all matter and empty space. This was a measure of the ability of these identified features of the universe to allow the passage of the presumed electric fields. Further, the people who studied magnet fields existing around objects with magnetic properties had found it necessary to attribute a property called permeability to all matter and empty space. This also was a measure of the ability of these features to allow the passage of the presumed magnetic fields. These two parameters varied with the kind of matter involved and in both cases, the values of these parameters did not go to zero when the matter was not present in what was thought of as empty space. These remnant values were named "specific properties of empty space" and were thought to be constants of nature.

When Maxwell combined these two fields of study with his equations, he included these parameters in his new equations for Electromagnetic waves. Later it became clear that the velocity of the Electromagnetic waves in space was related to the product of these two parameters, and when this theoretical calculated velocity of the Electromagnetic waves turned out to almost match the recently measured velocity of light, Maxwell's equations were accepted as a true description of reality. This fortified the strongly held assumption of many that mathematical equations did truly describe reality. I am not aware that anyone commented at the time that this implied that what was called "empty space" now had properties. The historical use

of the word "empty" carried the connotation of "contains nothing" whereas it should have been understood as "contains nothing we know about."

The next crack appeared when Max Planck proposed that Maxwell's equations, which seemed to describe and quantify almost all known information about electricity and magnetism with great completeness and precision, might not be complete. One observation that did not match the prediction of the equations was the measured emission spectrum of a black body radiation source. In 1894, Planck started to investigate this problem. Maxwell's equations had no limits on the wavelengths of the electromagnetic radiation it described, but by 1899 Planck had found that the observed data could be explained only if a certain selected set of wavelengths were allowed, and that there might be a minimum energy amount that could be emitted. At the time, no one could think of how these limitations could occur, but we later created a new model of the structure of the atom which explained both the limited wavelengths and the minimum energy, as you will see.

Very few paid any attention to Planck's finding until 1905, when Einstein showed that he could explain another problem that had come up involving what was called the Photo-electric effect. Maxwell's equations described the energy being conveyed by an electromagnetic wave as being uniformly distributed along the wave. This requirement implied that the rate of energy delivery to the object absorbing the wave was slow and steady and that the total energy delivered was a function of how long in time the wave was being absorbed. The problem, in this case, was that the event of interest, the release of an electron from the metal surface, occurred immediately when the light was applied, well before the known required energy could be delivered if the energy was uniformly distributed along the wave. Einstein reasoned that if the event occurred, then the required energy must have been present. If the energy was present immediately after the wave was incident on the surface, then it could not be distributed along the wave. Thus, Maxwell's equations, which only described long continuous waves, must not be complete.

While looking into this problem, Einstein further discovered that if he used Planck's idea that only certain wavelengths were permitted, and combined it with his idea that all the required energy must be delivered at one time, he could explain the photo-electric effect by proposing that in this case, the light waves seem to act as if they were made up of discrete packages of selected amounts of energy. Since Maxwell's equations and the long continuous waves they described still worked well for all other cases, it seemed to be necessary to use both descriptions of electromagnetic radiation, the continuous wave and the energy packet, each in its appropriate situation. Thus the idea of some part of nature having a dual nature was born.

The above revelations were followed a few years later by the proposal that the only other known sub-atomic particle, the electron, might, in some circumstances, exhibit wave-like properties. Shortly thereafter, Compton demonstrated that in certain cases, the electron did indeed act as if it was a wave.

Now we had both of the so-called fundamental things identified by Classical Physics, light and the electron, that seemed to act as if they were two incompatible things at different times. In some cases they displayed wave like properties, and in other cases they displayed particle like properties. Since the predominant world view was still Classical, and the reality delivered by the brain was still assumed to be very close to the reality experienced by the senses, scientists had no choice but to accept the incompatible properties of these entities as fact. The crack in the Classical World View was wider but not yet very noticeable.

I view this conclusion that some objects in nature have dual conflicting natures as a strong clue that we have a problem with our understanding. I suspect that most of the scientific and philosophical community of that time were very reluctant to accept this dual nature idea, because it seems to violate a very long held premise of logic that a thing must either be this or that. Our language and culture of that time did not contain a way of thinking how this could be otherwise. Even today, it is difficult to find a scientist who will consider that these dual antagonistic aspects of light and electrons are as shadows on the wall that should suggest the possible existence of a different reality.

But there was still the problem of the medium in empty space through which light traveled. One thing thought to be known for sure in the Classical World View was that waves could only travel in some kind of a medium. All water and sound waves did, therefore electromagnetic waves must. Maxwell's equations did not seem to provide any direct hints about this presumed medium. But because all waves (including light waves) demonstrated the phenomenon of interference, it seemed there was an obvious experiment utilizing the well established Doppler effect and the well established motion of the earth around the sun which should easily detect the presence of the presumed medium. When Michelson & Morley's elaborate and extensive experiments, carried out here in Cleveland, could not demonstrate any evidence of a medium, both the question about the nature of a wave that did not need a medium in which to propagate and the nature of the presumed empty space through which all things moved with time came into question. Still, the various equations which indicated that empty space now had additional physical properties were ignored for the most part, because no one could think of a way this could be.

Sometime later, Einstein raised the question about the independence of space and time. One of the founding assumptions of the Classical World View was that the various properties identified to describe the world were independent of one another. Empty space was this infinitely large volume within which everything else took place. Likewise, time was thought to extend an infinite extent forward and backward along the time scale from the immediate time event called "now." This independence allowed the precise calculations of the values of the many classical descriptive parameters.

Then. In the early 1900s, Einstein proposed (among other things) that the classical parameters of space and time were not independent - that all non-material natural things like light propagated through empty space at a fixed velocity, that the so-called rest mass of an object could be represented as a proportional amount of energy, and that the responses of masses to the phenomenon called gravity, as described by Newton's Laws, could be described equally well by allowing that objects with mass caused distortions in the otherwise uniformly deployed matrix of his proposed space-time.

This new proposal about the nature of gravity predicted that even massless light wave paths, heretofore assumed to be straight lines in empty space, would now be straight lines in space-time, but would appear to curve when observed in our experienced 3 dimensional space. When the measured bending of light from distant stars was found to be present as Einstein's proposal predicted, this novel proposal was accepted. Only the space-time distortion approach seemed to explain the apparent gravitational effect on massless light waves. The apparent linkage between space and time, the upper limit on the velocity of things moving through space-time and the mass caused distortions of space-time were eventually accepted as facts of nature, even though no one then or now can think of how this can be.

Now we return to the modified description of the atom I mentioned before. By now the crack in the Classical World view was quite noticeable, but no one yet knew what to do about it. Then Bohr, working on the problem of why the electrons, thought to be held around the nucleus by the electrostatic attraction of unlike charges, did not lose energy and fall into the presumed positive nucleus. He decided that the only way the electron could be in a stable orbit was if the angular momentum of the electron was somehow quantized, that is, restricted to certain values. Heisenberg, working on the problem of what might quantize the electron angular momentum, proposed that the circular orbit radii were determined by the requirement that the orbit circumference be equal to an integral number of wave lengths of the electron.

Bohr then showed that if the single electron in the Hydrogen atom could only occupy orbits around the positive nuclei that were an integer number of wavelengths in circumference, these standing wave orbits offered stability to the array of available orbits for the electron. It also provided a minimum orbit, one wave length long, which kept the negative electron from falling into the positive nucleus. And using two other concepts of Classical Physics, the conservation of energy and the assumed tendency of all systems of objects to fall into the lowest available energy states, it provided a believable source for the discrete set of electromagnetic radiations known to be emitted by hydrogen gas in excited states. It did not take long for the Bohr orbits to be equated to "electron energy levels" in the hypothetical structure of the atom.. The surprising fact was that this simple model, which seemed to explain all the former confusing data, was based on the assumption that the possible activities of the particulate electron were being limited by its own wave like nature.

This simple mechanistic picture of atomic structure, although it seemed to fit into the Classical World View at first, eventually presented a number of problem areas. For instance, there was the problem of where in the presumed orbit the particulate electron was. Planets were in orbits around the sun, and their calculated positions matched their observed positions. The orbiting electron, however, although still presumed to be a classical particle, could only be localized as being somewhere in the hypothetical orbit. There was also the classical problem of what determined when an electron would fall into an available lower energy state, and how long the transition would take. The only outward evidence of such a transition was the emission of a light packet of energy, now called a photon, during the transition. It soon became clear that many classical physics laws and ideas could not be applied to the questions about the structure of the Bohr atom, and it took many more years to conclude that the transition from one available energy level to a lower available energy level occurred as soon as it was physically possible, and seemed to be instantaneous. Our language and classical science did not permit this instantaneous relocation of a material body, so again, no one could think of a way this could be.

And the problems continued to grow, as we explored further. Sometime after we discovered that the electron could display wave properties, someone looked at what would happen if an electron beam replaced the light beam in a classical demonstration of the wave nature of light - that is, the creation of a diffraction pattern when the light waves pass through a 2 slit aperture. The diffraction pattern observed on the screen when a light beam is incident on the 2 slit aperture appeared to be easily explained by the wave theory of light, and the pattern properties could be related to the established properties of light and the apertures.

When the same type of diffraction pattern was observed on a phosphor screen when an electron beam was incident on the 2 slit aperture, the wave nature of the electron seemed to be confirmed, since the same types of relationships between the electron properties and the slit

dimensions could be established.

However, although activity at the slits seemed to be acting on the wave aspects of the electron, the phosphor screen seemed to be detecting the electron as a package of energy that excited the phosphor to emit some light.

But the classical idea that the electron was a particle, even if it sometimes displayed wave like properties, was hard to give up. Since it was inconceivable that the classical particulate electron could be divided into parts, the question of which slit the particle went through came up. And if each electron went through one slit or the other, with an electron beam of many electrons incident on the slit pattern, was it possible that the observed pattern was the result of the interference of waves from different electrons, one through each slit? The experimental test for this possibility was to reduce the intensity of the electron beam to the point where, on the average, only one electron was incident on the 2 slit aperture per minute. At this incident rate, the possibility of an electron in each slit at the same time was essentially eliminated. Thus, from the classical experimenter's point of view, each electron had to pass through one slit or the other.

Obviously, at this low beam intensity, no pattern could be seen on the phosphor screen - only the small light flashes when an electron is detected by the screen. But if a photo film is used to record the location of each of the individual flashes over a time sufficient for many electrons to pass through the slit apertures one at a time, the familiar diffraction pattern is observed. It seems that each electron passing through the 2 slit aperture can interfere with some aspect of itself, such that the electron detected by the phosphor will be in an appropriate position to produce the slowly developing diffraction pattern. No one then could think of a way this could happen if the electron was a particle. Only Heisenberg to my knowledge, ever proposed that the electron was primarily a wave that occasionally acted as if it were a particle.

Further experiments disclosed that if the observer did discover which slit the electron went through, the diffraction pattern would not be generated. This confusing result was initially attributed to the influence of the observer who now knew more than he did before. But once again, no one could think of a way this could be.

Still later it was discovered that if the "which slit" information was recorded so that the observer did not know until later, the pattern was not produced. This seemed to take the observer off the hook, and the results were eventually interpreted as follows: Any modified 2 slit electron diffraction experiment that can determine which slit the electron passes through will not produce the 2 slit diffraction pattern. My current explanation of this is the proposal that the act of detecting the electron, in whatever manner it occurs, destroys the coherence required for the later interference activities. And yes, I recognize that this explanation is based on Classical wave theory.

E. Considerations

In light of these growing and somewhat paradoxical findings, I have decided that my course of action in these studies will be to try to escape the box created by the past. For instance, it has occurred to me in the course of writing this paper that the initial parameters like space and mass and light used in classical physics were developed while dealing with aspects and events that we could directly experience. The information about these experiences were conveyed to the brain, where they were transformed into a mental reality that we could deal with. We see a rock which occupies a region of space that nothing else, including our hand, can occupy at the same time, so we say it is solid. When we pick the rock up our muscles send signals to the brain about

how much effort is required - which leads to the concept of weight, which is eventually converted to the concept of mass. We can put our hand into water, so we generate the idea of a non-solid or liquid.

So far so good. But when we start to investigate the microscopic hypothetical world that we cannot directly experience, like the atom and subatomic particles, we discover that many classical physics concepts do not appear to be applicable. Only the more abstract concepts, like energy and charge and a few other conservation laws appear valid.

So how is the adult brain, so loaded with the concepts considered important in the past, and which appear to create our immediate mental reality by comparing new data with stored data from the past, to generate ideas that are, as they say, "out of the box generated by this past?" I suspect that creating successful "out of the box" thinkers may require some changes in our education system. We keep trying to find some new way to understand these confusing clues in terms of old concepts because most of us are creatures of our culture, and new approaches are hard to generate - and often hard to accept. But I have a few suggestions.

First of all, I would encourage the scientific community (and people in general) to embrace the possibility that language, and the assumptions we draw from language, are far less comprehensive than we often assume. Over the years of thinking and talking about scientific subjects, I have concluded that many people - including some scientists - do not recognize the fact that many of the words we use to identify some aspects of our mental reality (like the "electron") obscure the fact that we know very little about the real nature of the thing called the electron. In an attempt to draw attention to this situation, I have tried to interject the phrase, "act as if" when discussing the nature of these things. I do this to implant the idea that the item being discussed, like an electron, may not actually be a particle or a wave in the common understanding of the words. The few examples I presented make it clear, I hope, that this is very likely the case.

It also seems clear to me-which is to say that it seems clear to my mental reality - that we know very little about the microscopic actual reality. And if this is indeed the case, I am persuaded that only a few of the parameters used by classical physics may be useful in any discussion of the nature of things in the microscopic actual reality. These are the classical parameters of energy, charge, momentum and a few others. We should attempt to describe what little we think (or think we know) about this presumed actual reality using this restricted set of terms. Since the concepts of the stuff identified with the word energy appear to apply in all cases so far encountered, perhaps we should emphasize the energy aspects of the descriptions of things and events.

We also need to examine our concept of "charge." Since two charged things that act as if they were particles can be created from a massless & chargeless photon in the pair production process, we seem to have at least 2 cases. Either the charges do not exist before the transition, in which case the charge appears to be yet another form of energy, or the photon carries the neutral charge which is separated into the + & - active form by the transition. In the first case the Law of charge conservation would not hold. In the second case the Law would hold. I would favor the second case except for the problem of where the neutral charge comes from when the photon is created. So charge may also be another form of energy.

Whatever the form of the electron in the actual reality, it needs to include a form of energy that can act as if it is a charge, whatever that is, and display all the other critical attributes of the electron in appropriate circumstances. And if case 1 is correct, I suspect that we could say

similar things about the photon.

But what else do we really know about charge. We know that the attribute of charge makes a charged entity act as if it were responding to forces created by the presence and actions of other charged entities. But we don't know, even in the classical view, what charge is. We think we know that" it" is, and a great deal about how the electric fields we assume it creates can exert forces on other charges and that it can generate magnetic fields when it moves. But we also know that changing magnetic fields seem to create electric fields. Current theory has it that all photons, which seem to have both field types and no charge, are produced when charged things loose energy.

We are faced with a similar situation regarding the concepts of energy. We think the attribute of energy in the form of rest-mass makes the entity respond to deformations in the space-time matrix that are caused by other collections of rest-masses. But photons (clumps of energy that seem to be without mass also respond to deformations in the space-time matrix. But the phase "deformations in the space-time matrix" is another way of saying "Einsteinian gravitational field" in place of the classical "Newtonian gravitational field." Perhaps it is some energy component of these entities that is responding to the deformations in ways that appear to us as responding to the application of forces.

We don't know, even in the classical view, what is so novel about the energy form we call the rest-mass of a particle. We currently believe , some would say we know, that rest masses locked in the few stable atoms seems to have a great deal of stability in time.

But I believe that we must also consider other "out of the box" ideas if we are to address the possible differences between the mental reality and the microscopic actual reality. For instance, it seems to me that if we were to consider the electron a wave which produced the diffraction pattern (which was not created when we forced the electron to act as a particle by detecting which slit it went through) a great deal of printer's ink could have been put to other uses. There is of course also the major problem of how a presumed non material entity would carry a charge. Since our whole history of the study of charged materials has assumed that the charge was carried by a material particle, I suspect there will be a great deal of opposition to this proposal.

I currently believe that the electron acts as if it is more wave than particle, because it seems to support the above experimental conclusions. But as always, my mental reality state does not provide conclusive proof about what exists in the actual reality. For instance, some of you may have noticed that I said "presumed non-material" when referring to the possible true nature of the electron in the preceding paragraph. I did this because heretofore the possible options seemed to be either a wave, with its connotations of masslessness, or particle with its connotations of mass, and I do not wish to restrict the possible concepts of the nature of the entity we call an electron to these two possibilities.

F. Conclusions

So what can we say about this presumed actual reality that I believe exist. On the macroscopic level, I believe that the mental reality, generated from the filtered and processed information that the brain receives from our interactions with the actual reality, is reasonably close to the actual reality. That is to say that all the things we as life forms believe we can directly experience must be present in some form even if there were no life forms to experience them.

On the microscopic level that we cannot directly experience we are still wandering in the confused state caused by our attempts to interpret our confusing findings using concepts developed for the macroscopic mental reality view.

In conclusion - I do not foresee a quick resolution to this apparent dichotomy between our mental reality perceptions of what is, and what I might believe actually is. But fortunately, the current state of science provides plenty of evidence for those of us who like to explore this particular question. It should be obvious by now that I believe the Buddhist hallucinations of shadows on the wall contain useful clues to contemplate.

Thank you for your attention.