Article

Reflections on an Unromantic Brief Encounter with an Onto-Epic Quantum Physicist

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Abstract

A recent encounter with a quantum physicist has prompted me to examine the claims made by some interpreters of the work of Wojciech H. Zurek, and perhaps by Zurek himself – he does not seem to be clear on this point, that the quantum Darwinian approach to decoherence provides a means to establish the 'objectivity' of the classical world through the quantum 'epiontic' mechanism. A detailed and rigorous philosophical analysis of Zurek's perspective indicates that the kind of objectivity provided by the quantum Darwinian physical-metaphysical perspective corresponds to what Bernard d'Espagnat terms 'weak objectivity', which is in fact a mixture of objectivity and subjectivity. Some of Zurek's remarks seem to indicate that he thinks that his analysis undermines the 'ultimate evidence' that the classical world is entangled and dependent upon consciousness. However, a rigorous analysis shows that the opposite is the case; Zurek's epiontic quantum Darwinian classical universe is ultimately dependent upon consciousness. I also indicate some remarkable points of contact with Buddhist metaphysics.

Keywords: Consciousness, decoherence, epiontic, quantum Darwinism, many worlds interpretation, collapse of the wavefunction, existential interpretation, emergence of the classical world, objectivity, weak objectivity, Zurek, Wheeler, Hawking, Mlodinow, Zeh, Joos, Bohm, d'Espagnat, Buddhist metaphysics, Chittamatra-Yogachara, alayavijnana, Madhyamaka, Dzogchen.

> Measurement – perception – is the place where physics gets personal, where our role and our capabilities as observers and agents of change in the universe (and our limitations as entities subject to the laws of physics) are tested - or, rather, where we get put in our place. I believe that quick solutions, and I include both the Copenhagen interpretation and many worlds here, have a tendency to gloss over the real mystery, which is how do we - that is to say, how does life - fit within the quantum universe. I think we have managed to constrain the possible answers (for example, through research on decoherence), but I believe there is more to come. The virtue of the focus on quantum measurement is that it puts issues connected with information and existence at the very center. This is where they should be.'[1]
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> - Wojciech H. Zurek

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Graham Smetham

Wojciech Zurek has written that the ultimate quantum evidence indicates that the mechanism that determines which one of the alternatives of the Everett many worlds scenario is actualized is in some way connected with the 'epiontic' nature of consciousness.

Dr. OntoEpic

No he hasn't, he can't have – I know him and he would not say something so mistaken. Or you have misunderstood him. You have probably misread popular books on quantum theory and, although I don't want to be offensive, you don't understand quantum theory at all.

Wojciech H. Zurek

…while the ultimate evidence for the choice of one alternative resides in our illusive "consciousness," there is every indication that the choice occurs much before consciousness gets involved and that, once made, the choice is irrevocable.[2]

The Buddha

Form is emptiness;
emptiness is form.

This article was has been prompted by my brief meeting with a quantum physicist at the 2011 Christmas party of the local Buddhist group I am a member of. Dr. OntoEpic, I use this sobriquet because the physicist in question has refused to engage with me further on this issue, was pointed out to me shortly after I arrived as being someone I should spend some time talking to because of the fact that I had written a book on the subject of the interconnections between quantum theory and Buddhist philosophy. I guess it was assumed that as he was at a Buddhist event he would be at least amenable to discussing the subject. This, however, turned out not to be the case.

When I mentioned to Dr. OntoEpic the fact that the currently influential quantum physicist Wojciech H. Zurek had suggested that "the ultimate evidence for the choice of one alternative resides in our illusive 'consciousness'" he told me that I had been reading too many popular books about quantum theory and misunderstood them, and in fact it was clear to him that I did not understand quantum theory at all. I was somewhat surprised at this brusque condemnation because he had not asked me at all what my conclusions were from the Zurek quote, or how I had arrived at them. Furthermore, I knew very well that Zurek had written this because I had read the paper, *Decoherence and the Transition from Quantum to Classical – Revisited*, several times whereas Dr. OntoEpic, by his own admission, had not.

Zurek has developed upon the work of Wheeler, and also that of Hugh Everett III – the 'relative state' interpretation of quantum theory, which was molded into the guise of the 'Many Worlds' quantum vision primarily by Bryce DeWitt. Zurek's development seeks to eliminate what appears to be a fundamentally 'subjectivist' flavor in Wheeler's account, which suggests that quantum theory indicates that in some way the universe was perceiving itself, a view that Wheeler enshrined in his self-perceiving universe graphic (figure 1). Wheeler offered cogent reasons for this view in his analysis of the delayed choice experiment wherein an experimental 'decision' concerning the configuration of the experimental apparatus affects the ontological condition of a quantum 'particle' backwards in time. The physicist Paul Davies has also suggested a cosmic perspective of the Wheeler variety with his notion of the 'Self-Explaining Universe'. Other physicists who consider the backwards in time operation of consciousness to be highly relevant are Amit Goswami and also, more recently, Steven Hawking and Leonard Mlodinow who in their book *The Grand Design* write that:

> Quantum physics tells us that no matter how thorough our observation of the present, the (unobserved) past, like the future, is indefinite and exists only as a spectrum of possibilities. The universe, according to quantum physics, has no single past, or history. The fact that the past takes no definite form means that observations you make on a system in the present affect its past.[3]

And, of course, this must mean that the minds or 'consciousnesses' performing the 'observations' must be involved in some way in 'affecting' the past.

Hawking and Mlodinow are very clear about the involvement of sentient beings in determining the course of the development of our universe. Indeed they have titled a central chapter of their book 'Choosing our Universe'. In this chapter we are told that:

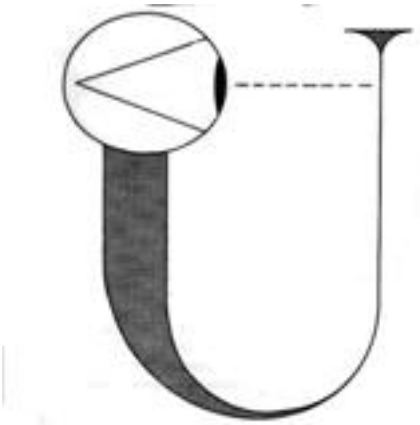

Figure 1

> The idea that the universe does not have a unique observer-independent history might seem to conflict with certain facts that we know. There might be one history in which the moon is made of Roquefort cheese. But we have observed that the moon is not made of cheese, which is bad news for mice. Hence histories in which the moon is not made of cheese do not contribute to the current state of our universe, though they might contribute to others. This might sound like science fiction but it isn't.[4]

According to Hawking and Mlodinow this is not science fiction at all, it is the required conclusion to be drawn from quantum theory. The universe starts out as a mass of potentialities and the inhabitants of any particular universe have 'chosen' the particular universe they end up inhabiting through their observations. John Wheeler, one of Wojciech Zurek's significant mentors, made a similar point as follows:

> Directly opposite to the concept of universe as machine built on law is the vision of *a world self-synthesized.* On this view, the notes struck out on a piano by the observer participants of all times and all places, bits though they are in and by themselves, constitute the great wide world of space and time and things.[5]

Such grand and dramatic, and yet completely consistent with the evidence of quantum phy-sics, perspectives provided the backdrop and inspiration for the quantum physical aspect of my book. Wheeler's suggestion mapped spectacularly onto core metaphysical insights of Mahayana Buddhist philosophy:

> The entire world was created through latent karmic imprints. When these imprints developed and increased, they formed the earth, the stones, and the seas. Everything was created through the development or propagation of these latent karmic potentials.[6]

The concept of 'karma' in Buddhism simply means action, a volitional action carried out by any sentient being, and such volitional actions are said to leave traces of potentiality which can be triggered at later points in time. Even simple perceptions of a 'material' world constitute such karmic actions and so Buddhist metaphysics had come, a couple of thousand years ago, to a similar conclusion as Wheeler. The Dalai Lama put it this way:

> From a Buddhist point a view, the karma of all sentient beings that inhabit the universe plays a role in shaping the formation of the universe.[7]

So Wheeler and, it would seem, Hawking, Mlodinow (and others) have come to a similar conclusion to that of the much earlier Buddhist metaphysics - the entire fabric of the universe, the material world included, came into existence through the perceptual activities of the sentient beings contained within the universe.

Zurek, Laboratory Fellow in the Theory Division at the Los Alamos National Laboratory and an external professor at the Santa Fe Institute, New Mexico, is an expert in the field of decoherence theory and it is within this field that he has produced his 'quantum Darwinism' perspective which accounts to some extent for the 'emergence' of the classically 'objective' world from quantum "dream stuff", as he calls it[8] . Zurek seems to believe that an 'objective' universe of some sort does exist, as long as the 'classical' (i.e. every-day experiential) environment is there to act as a witness. On this basis Zurek apparently thinks that he has managed to eliminate a disturbing element of subjectivism which was introduced into quantum theory by the early 'founding fathers':

> In this manner, he disagrees with two of the founders of quantum mechanics, Niels Bohr and Werner Heisenberg, who suggested that until quantum particles are observed they exist as "wave functions" that can contain a superposition of many properties. But when an observer makes a measurement, the wave function "collapses," yielding a particle that behaves classically. Wojciech and colleagues have formulated a mechanism that eliminates the role of the observer and thus avoids the always uncomfortable question of whether anything exists when nobody is looking at it. They call the theory "quantum Darwinism" because the environment decides which quantum properties are the "fittest" and will ultimately survive to be viewed by observers. The environment is what enables us to measure reality.[9]

On this view, in which the classical 'witnessing' environment is constantly subduing what Zurek himself calls quantum 'dream stuff', thereby restraining it from becoming too subjectively dreamy, it is thought that Zurek and his associates have rescued an 'objective' world from dissolving into an abject quantum nightmare of subjectivism.

However, in this article I will demonstrate that the kind of 'objectivity' restored by Zurek's insights amounts to what quantum physicist and philosopher Bernard d'Espagnat calls 'weak objectivity'[10]. It is not the full 'real' objectivity which physicists thought they had a grip on in the classical era prior to the quantum 'revolution', it 'hovers', rather, somewhere between full objectivity and full-blown quantum-dreamy subjectivity.

The horrific situation that was thought to be facing the quantum physics community due to quantum discoveries, with the subsequent encroachment of subjectivity into the quantum realm, is well summed by the following observation by Bryce DeWitt and Neill Graham:

> No development of modern science has had more profound impact on human thinking than the advent of quantum theory. Wrenched out of centuries-old thought patterns, physicists of a century ago found themselves compelled to embrace a new

> metaphysics. The distress which this reorientation caused continues to the present day. Basically physicists have suffered a severe loss: their hold on reality.[11]

Zurek, it is therefore thought, has given physicists back their hold on 'reality'. As we shall see however the 'reality' that Zurek has given back, as the singer-songwriter Beth Orton puts it, "doesn't live up to all that it used to be:"

> The best part to life it seems
> The best part of life was a dream[12]

Or, as Zurek puts it in more technical terms:

> …quantum states, by their very nature share an epistemological and ontological role – are simultaneously a description of the state, and the 'dream stuff is made of.' One might say that they are *epiontic*. These two aspects may seem contra-dictory, but at least in the quantum setting, there is a union of these two functions.[13]

The full implications of this insight, the quantum fact that epistemology - or the act of perception, and ontology - the fabric of reality – are intimately entangled at the quantum level, for our understanding the nature of Zurek's 'objectivity' of the classical realm will become apparent in due course. My use of the inverse construction to 'epiontic', 'onto-epic', to describe Dr. OntoEpic is, of course, a mischievous way of indicating that his view-point, which seems to be that the ontology of the 'material' world precedes epistemology, seems actually to be the inverse of Zurek's 'epiontic' perspective. For according to Dr. OntoEpic, as he confidently told me, the material environment measures the quantum realm completely independently of consciousness. In this article I will show that this cannot the case.

One crucial aspect concerning Zurek's perspective which needs to be immediately pointed out is that if it is the case that the metaphysical/physical aspects of 'epistemological' perception and the emergence of ontology are so intimately interconnected within the mech-anisms of the quantum 'dream stuff is made of' then it clearly follows that consciousness must be involved to some degree or in some way at some stage, or perhaps at all stages. For how is perception or epistemology possible without the presence of consciousness in some form or other? Indeed the presence of consciousness in some measure is indicated in the following remark from Zurek's important paper *Decoherence and the Transition from Quantum to Classical – Revisited*:

> …while the ultimate evidence for the choice of one alternative resides in our illusive "consciousness," there is every indication that the choice occurs much before consciousness gets involved and that, once made, the choice is irrevocable.[14]

However, this assertion is enigmatic and needs much further elucidation. The question it clearly raises is as follows: if it is the case that the "*ultimate evidence for the choice of one alternative resides in our illusive "consciousness,"* how is it possible that "the choice occurs much before consciousness gets involved?" It is in the resolution of this quantum conundrum which holds the key to understanding the nature of the classical 'objectivity' that Zurek has rescued for us, and much more!

It was my mentioning this quote from Zurek's paper that Dr. OntoEpic objected to. Admittedly I only mentioned the first portion, the bit about the 'ultimate evidence' putting consciousness into

the frame, and he did not respond well to this at all. Dr. OntoEpic had told me that he had read Fritjov Capra's book *The Tao of Physics* and he did not seem to have high opinion of it. I had also shown him a copy of my book and he had leafed through some pages and remarked "interesting" in a fairly non-committal fashion. However when he realized that I considered that quantum physics implicated consciousness in some way as a significant agent in the structure and functioning of the physical world he seemed to conclude that I was hopeless, hence his assertion that Zurek, who he told me was an associate of his, could never have suggested such a thing because it was simply incorrect.

When I later reflected upon this encounter I wondered whether it was possible that I might have misrepresented Zurek's position. I was aware that the crucial metaphysical conclusion that I have drawn from Zurek's work, i.e. that the 'epiontic' appearance of the classical realm is an intersubjective creation in the mode of Wheeler's perspective which must ultimately be traced to the operation of consciousness, do go significantly beyond what Zurek himself actually says or writes about. I therefore decided that it would be prudent to look into this issue in greater detail and show how my conclusion must follow from the evidence. This enterprise would serve as a refutation of Dr. OntoEpic, although he was so dismissive of my capabilities that he indicated complete disinterest in reading anything by me, and also would serve to clarify, amplify and deepen my analysis.

One of the observations I made during my brief interaction with OntoEpic was that it was the opinion of what we might call for convenience the decoherence school within those concerned with the foundations of quantum physics (Wojciech Zurek, H. Dieter Zeh, Erich Joos etc.) that the two interpretations which need to be taken seriously as a starting point are the those of the 'collapse of the wave function' and the Everett 'many worlds' account. To this Dr. OntoEpic scoffed. However if one examines the various papers in the corpus of decoherence studies this fact is easily verified. Thus in his paper *Roots and Fruits of Decoherence* Zeh wrote that:

> I am indeed surprised about the indifference of most physicists regarding the potential consequences of decoherence …, since this concept arose as a by-product of arguments favoring either a collapse of the wave function as part of its dynamics, or an Everett-type interpretation. In contrast to the Copenhagen interpretation, which insists on fundamental classical concepts, both these interpretations regard the wave function as a complete and universal representation of reality[15].

Zurek, in the concluding remarks to his paper *Relative States and the Environment: Einselection, Envariance, Quantum Darwinism, and the Existential Interpretation* remarked in similar vein that the conclusions of the 'existential interpretation', which he considers to be a natural extension of the quantum formulism without significant interpretation, can be usefully contrasted with the Everett and Bohr views:

> We have been led by quantum formalism to our conclusions, but these conclusions are largely beyond dispute. Our "existential interpretation" is in that sense not an interpretation – it simply points out the consequences of quantum formalism and some additional rudimentary assumptions. It is nevertheless useful to see how the two principal interpretations of quantum theory - Bohr's "Copenhagen Interpretation" (CI) and Everett's "Relative State Interpretation" (RSI) fit within the constraints that we have

> derived above by acknowledging paramount role of the environment. To anticipate the conclusion, we can do no better than to quote John Archibald Wheeler (1957), who, comparing CI with RSI, wrote: "(1) The conceptual scheme of "relative state" quantum mechanics is completely different from the conceptual scheme of the conventional "external observation" form of quantum mechanics and (2) The conclusions from the new treatment correspond completely in familiar cases to the conclusions from the usual analysis.[16]

And in his contributions to the recently published *Elegance and Enigma: The Quantum Interviews* Zurek reiterates:

> I firmly believe that pushing even such extreme points of view as many worlds or the subjectivist approach to "the quantum" is a valuable exercise. We have definitely learnt a lot from Everett and DeWitt, and we definitely learnt a great deal from Bohr, who at least some of those pursuing the subjectivist approach cite as their intellectual forefather. I believe the truth lies somewhere between these two extremes: I take from Everett the lesson that quantum theory is the best tool for explaining its own workings, but I take from Bohr (and Wheeler) the firm conviction that when we find out how it works, we will realize that information was an integral part of the machinery. (One might say that this attempt to have the best of both points of view is complementarity).[17]

And, finally, in his paper *Elements of Environmental Decoherence* Erich Joos has written in a section entitled 'Which interpretations make sense?' that:

> I think, we do not have much of a choice at present, if we restrict ourselves to use only wavefunctions as kinematical concepts (that is, we ignore hidden-variable theories, for example). There seem to be only the two possibilities either (1) to alter the Schrödinger equation to get something like a "real collapse" …, or (2) to keep the theory unchanged and try to establish some variant of the Everett interpretation. Both approaches have their pros and cons,…. Clearly collapse models face the immediate question of how, when and where a collapse takes place. If a collapse occurs before the information enters the consciousness of an observer, one can maintain some kind of psycho-physical parallelism by assuming that what is experienced subjectively is parallel to the physical state of certain objects, e.g., parts of the brain. The last resort is to view consciousness as causing collapse, an interpretation which can more or less be traced back to von Neumann. In any case, the collapse happens with a certain probability (and with respect to a certain basis in Hilbert space) and this element of the theory comprises an additional axiom.[18]

So it would seem that an analysis of these two quantum interpretive perspectives, with special consideration of the role of consciousness will provide a suitable foundation for our exploration of Zurek's developments.

One thing which stands out from the above quote from Joos is that he quite clearly takes the possibility that consciousness is involved in the phenomenon of the 'collapse of the wave function' to be a serious suggestion. Indeed Joos tells us in a footnote regarding the Everett view that his concluding section:

> …owes much to discussions with Dieter Zeh, who finally convinced me that the Everett interpretation *could* perhaps make sense at all.[19]

But his inclination to hold to the view that consciousness *is* involved in some way is surely suggested by his very last paragraph:

> So it seems that both alternatives still have conceptual problems and both are hard to test because of decoherence. We should not be surprised, however, if it finally turned out that we do not know enough about consciousness and its relation to the physical world to solve the quantum mystery.[20]

It clearly follows that if Joos thinks that not knowing enough about consciousness and its relation to the physical world will block our solving the 'quantum mystery', then consciousness must be a pretty important factor. Joos' conclusion brings to mind the observation by Rosenblum and Kuttner:

> Consciousness and the quantum enigma are not just two mysteries; they are *the* two mysteries; first, our physical demonstration of the quantum enigma, faces us with the fundamental mystery of the objective world 'out there;' the second, conscious awareness, faces us with the fundamental mystery of the subjective, mental world 'in here.' Quantum mechanics seems to connect the two.[21]

It was this connection, the fact that consciousness at least *appears* to 'collapse' the wave function of potentiality, which has consistently produced consternation within the field of quantum physics.

We have noted that it was, apparently, with great difficulty that Zeh managed to convince Joos that the many-worlds scenario could be considered to 'make sense at all'. Zeh, however, seems quite comfortable with this view of the quantum situation and in the conclusion to his paper *Roots and Fruits of Decoherence* writes concerning the implications of decoherence for the many-worlds view that:

> …a consistent interpretation of this theory in accordance with the observed world requires a *novel and nontrivial identification of observers* with appropriate quantum states of local systems which exist in certain dynamically autonomous *components* of the global wave function. Accordingly it is the observer who "splits" indeterministically – not the (quantum) world.[22]

The italics are in the original and the italicized portions, again, clearly indicate that the issue of the nature of 'observation' or consciousness is crucial for our appreciation of significant interpretations. Indeed we can see that the 'collapse-by-consciousness' viewpoint and the many-worlds perspective are symmetrical mirror images of each other, and which view one prefers will depend upon one's intuitions about the effectiveness of an individual consciousness, a component of the global wave function, in 'choosing', at least to some degree, its fate within the welter of possibilities contained within the global wave function.

In the 'collapse' account an individual consciousness (or a community of consciousnesses) is considered to somehow directly affect the quantum superposition of possibilities contained within the mathematically described 'wave function' and thereby 'reduce' it to just one

possibility which thereby becomes actuality. The first suggestion of this type was made by Max Born with his probabilistic interpretation of the Schrödinger equation[23]. The Schrödinger equation produced a wave equation spread out over a significant extent which instantaneously collapsed to a localized point when an 'observation' was performed. Such an instantaneous jump was not consistent with special relativity so Born suggested that 'our knowledge of the system suddenly changes.'[24] Physicists John D. Barrow and Frank J. Tippler, in their 1986 book *The Anthropic Cosmological Principle* wrote concerning this development that:

> With this interpretation, a property of Man in the role as observer of the physical universe enters the formulism of physics in an essential way.[25]

Thus the scene was set for the subsequent attempts to explain how the apparent 'objec-tivity' of the experienced world could somehow 'emerge' from the subjectivity which seemed to be entangled within the quantum realm.

The nature of this at least apparent dependence upon consciousness for the transition from quantum to the 'classical' everyday is worth pondering for a moment or two. Another expression I used in conversation with Dr. OntoEpic which seemed to cause him intense pain and consternation, putting another nail in the coffin of my quantum philosophical aspir-ations, was that of 'a field of quantum potentiality'. 'It appears', I said, 'that prior to obser-vations there is only a field of quantum potentiality.' For Dr. OntoEpic it seems that such language is seriously misleading. But, if this is the case one has to ask why such language can be easily found in reputable books on the subject. The very first paragraph in Jonathan Allday's excellent book *Quantum Reality: Theory and Philosophy* for instance is:

> The world is not what it seems. Behind the apparent solidity of everyday objects lies a seething shadow world of potentiality. This world defies easy description, as its form is so different from our everyday experience. Yet our common or garden world of solid tables, cricket balls, stars, and galaxies somehow arises from what transpires underneath. We do not know how this comes about.[26]

Admittedly Allday does not use the term 'field', but this is a pretty established notion within the field of physics, isn't there a field of enquiry called 'quantum field theory?' According to Stapp the quantum realm can be conceived of as:

> *'potentialities for future psychophysical events*': i.e. as a representation of *objective tendencies*, created by past psychophysical events, for the occurrence of future psychophysical events.[27]

Even Zurek, putatively an associate of Dr. OntoEpic, has no problem with the idea of quantum potentiality. This is from his important paper *Decoherence and the Transition from Quantum to Classical – Revisited*:

> The problem of measurement has a long and fascinating history. The first widely accepted explanation of how a single outcome emerges from the multitude of potentialities was the Copenhagen Interpretation…[28]

So it would seem that the notion that the quantum realm can be conceived of as potentiality or potentialities is fairly acceptable, one surely would not expect the use of the fairly standard notion of a 'field' as used in physics should cause problems. What else would one call it? It certainly isn't a realm of materiality.

According to Dr. OntoEpic the wavefunction is *only* a mathematical formulism, as if it represented nothing beyond itself. But such a view is clearly unacceptable, or if one thinks it not unacceptable then it is an assertion within the field of the foundations of quantum theory which requires philosophical justification. Indeed a crucial issue within the field of debate within the foundations of quantum theory is exactly that of the meaning of the wavefunction. According to Joos the following three issues are *the* outstanding quantum conundrums of deep significance:

1. The meaning of the wavefunction
2. The exact nature of the mechanism of the collapse
3. The connection between the quantum and classical realm. [29]

According to Stapp the quantum 'field' or the quantum wavefunction can be conceived of as consisting of 'potentialities for future psychophysical events'. Furthermore the realm of the wavefunction must be 'mindlike' or 'idealike' precisely because it is a field of potentiality for psychophysical experiences to arise on the basis of some kind of interaction with embodied consciousness:

> We live in an *idealike* world, not a matterlike world.' The material aspects are exhausted in certain mathematical properties, and these mathematical features can be understood just as well (and in fact better) as characteristics of an evolving idealike structure. There is, in fact, in the quantum universe no natural place for matter. This conclusion, curiously, is the exact reverse of the circumstances that in the classical physical universe there was no natural place for mind.[30]

According to Stapp, then, quantum theory clearly tells us that the ultimate 'stuff' of reality is immaterial and has an essential mind-like aspect.

John von Neumann was the first to give a fairly rigorous formulation to the notion of wavefunction collapse in his 1932 work *Mathematical Foundations of Quantum Mechanics*. In this work von Neumann presented an axiomatic presentation in which he described how quantum mechanics requires two fundamental processes, the first is the smooth and contin-uous evolution of the wavefunction solution to the Schrödinger equation and the second is a discontinuous change which occurs when a measurement takes place. Barrow and Tipler write concerning this:

> Since it is the observer who ultimately defines which experimental apparatus is employed, in effect the necessary presence of the observer in quantum physics is recognized by an explicit axiom. Von Neumann regarded the two processes of time evolution as irreducible. He did however, point out that there was no hard and fast dividing line between the two. We might choose to say that the second process, the collapse of the wave function, occurs somewhere in the experimental apparatus itself, or we might want to say that the apparatus is part of the quantum system and the collapse of the wave function occurs in the consciousness of the human observer.[31]

The first alternative, that the apparatus somehow 'collapses' the wavefunction, requires that we give an account of the nature of the seemingly material world which moves it into the realm of the quantum. In fact the only account of this sort which can make any sense is some kind of decoherence account, but, as we shall see, even this does not fully resolve the situation. The second alternative, that consciousness somehow produces the collapse, however, is problematic for the reason given by Zurek when he states that although the "ultimate evidence" implicates

consciousness it also is the case that "there is every indication that the choice occurs much before consciousness gets involved." However an important point which must be held in mind is that when Zurek talks about 'consciousness' here he clearly is referring to *individual* consciousness. This is a significant point which we will return to shortly.

The view that individual consciousnesses were capable and indeed did collapse wavefunctions was famously held by Eugene Wigner, London and Bauer, and von Neumann. According to Wigner 'the wave function collapses when it interacts with the first conscious mind it encounters'.[32] With reference to the famous 'Schrödinger cat' situation:

$$\Psi_{\text{cat-human}} = (\Psi_{\text{dead cat}} \text{ x } \Psi_{\text{human sees dead cat}}) + (\Psi_{\text{live cat}} \text{ x } \Psi_{\text{human sees live cat}})$$

London and Bauer make the following dramatic claim regarding the wavefunction collapsing capacity of consciousness:

> The observer … has within *himself* some relations of a completely special character; he has at his disposal a characteristic and quite familiar faculty, which we may call the "faculty of introspection". He can thus give an account of his own state in an immediate manner. It is in virtue of this "immanent knowledge" that he claims the right to create for himself his own objectivity, that is to say, cut the chain of statistical coordinations expressed [by the equation] by certifying: "I am in the state $[\Psi_{\text{human sees live cat}}]$ or more simply "I see the cat alive…"[33]

The notion that individual human beings can somehow collapse wavefunctions by flexing mental muscles or beaming rays of intentionality, of course, is clearly very unlikely. However, anyone who assesses the evidence dispassionately and with integrity should surely come to the conclusion, with Zurek, that "the ultimate evidence for the choice of one alternative resides in our illusive "consciousness,"". There is certainly no reason for hand-wringing, teeth-gnashing, squirming and grimacing with assumed intellectual superiority, or attributions of mental defectiveness when in the presence of someone who has assessed the evidence and concluded that consciousness is indeed implicated, especially if they can describe the mechanisms involved in some detail. The number of reputable physicists who have moved in this direction is not insignificant. Here is quantum cosmologist Andre Linde:

> Is it possible that consciousness, like space-time, has its own intrinsic degrees of freedom and that neglecting these will lead to a description of the universe that is fundamentally incomplete? What if our perceptions are as real as (or maybe, in a certain sense, are even more real) than material objects?[34]

And, of course, any unbiased evaluation of quantum theory must reach the conclusion, as does Stapp, that Cartesian-Newtonian type matter "does not exist." But the term 'matter' as generally understood denotes precisely Cartesian-Newtonian type matter; any other type must include a dash of mind so to speak. The latest quantum craze is for quantum information, but information must inform some mind-like aspect of reality.

It would seem that one of the motivations underlying Zurek's work is to establish a perspective upon the quantum situation which minimizes the implication that consciousness is somehow

entangled at the quantum level. In his paper *Pointer basis of quantum apparatus: Into what mixture does the wavefunction collapse?* he indicates this motivation:

> …if one denies (in disagreement with original proposals of von Neumann, London and Bauer, and Wigner) any special role to consciousness, there is seemingly nothing that could keep one from describing an arbitrary system, no matter how large, by a state vector and Schrödinger equation.[35]

And this line of thought leads us towards an Everett style many worlds scenario which pretends to eliminate the collapse by asserting that all the possibilities contained within the universal Schrödinger equation exist with equal ontological weight (although there is a version which asserts that branches with lesser probability have reduced ontological weightiness). But even this perspective still involves consciousness in a crucial manner. Consider the following fragment from Zurek's aforementioned paper:

> We have to agree with von Neumann that adding more and more apparatuses only delays the moment when the reduction of the wave packet would have to occur. This infinite regress can be terminated only if there are some entities in the Universe which can put an end to the unitary evolution, be it macroscopic objects of Copenhagen interpretation or conscious beings preferred by von Neumann himself, as well as by other prominent physicists. Alternatively, one could resign himself to the unitary evolution predicted by the quantum theory for the Universe. Then it is the individual consciousness alone which appears to evolve in a nonunitary fashion choosing a single path in this labyrinth, "many world" Universe. Both of these opposing views of the collapse problem have been criticized and defended. What is important for us is that both of them agree on one absolutely crucial point: To describe the world "as we know it" there must be two distinct types of evolution-the reversible, deterministic one, which has been confirmed for the microworld, as well as the irreversible, random one which must provide for the choices experienced by the consciousness.[36]

In other words in the many-worlds scenario there are a multitude of 'individual consciousnesses' which think they are being constantly subjected to 'nonunitary' 'collapses' as they 'choose' "a single path in this labyrinth 'many world' Universe." So the nature and capacity of consciousness clearly must be a significant feature of any kind of many-worlds perspective. As Zeh says:

> ….one has to assume that 'our' (quantum correlated) minds are located in a component of the universal wavefunction…[37]

And for this to be the case then the quantum realm must be the kind of 'dream stuff' that 'minds' or consciousnesses can be 'located' in. This means that it must be the kind of 'stuff' which produces the experience of individuated consciousness for each 'component', or each sentient (quantum correlated) 'being' that is choosing a single path in this labyrinth, 'many world' Universe."

Everett, in keeping with the rampant mechanistic materialism of the time, considered the situation of 'classical' recording robots wending their way through the dream stuff of the universal wavefunction (figure 2):

> As models for our observers we can, if we wish, consider automatically functioning machines, possessing sensory apparatus coupled to recording devices capable of registering past memory data and machine configurations. We can further suppose that the machine is so constructed that its present actions shall be determined not only by its present sensory data, but by the contents of its memory as well.[38]

Today, however, such a metaphysically repugnant notion that we can coherently locate 'classical' objects within the quantum realm is clearly unacceptable. Zeh, in his short and punchy article *There are no Quantum Jumps, nor are there Particles!* tells us that:

> The most important underivable assumption in a kinematically nonlocal (i.e., nonseparable) quantum world seems to be the locality of the ultimate (subjective) observer in spacetime (required in some vague but essential form). Quantum decoherence is meaningful (or 'relevant') only with respect to local parts of the nonlocal quantum world. None of these open problems indicates an inconsistence or limitation of the description of the whole world by means of the Schrodinger equation - only a lack of knowledge about important details (mainly about the quantum physical description of an observer). Hence, there does not seem to be any reasonable motivation (other than traditionalism) for introducing concepts like particles, quantum jumps, superselection rules, or classical properties on a fundamental level.[39]

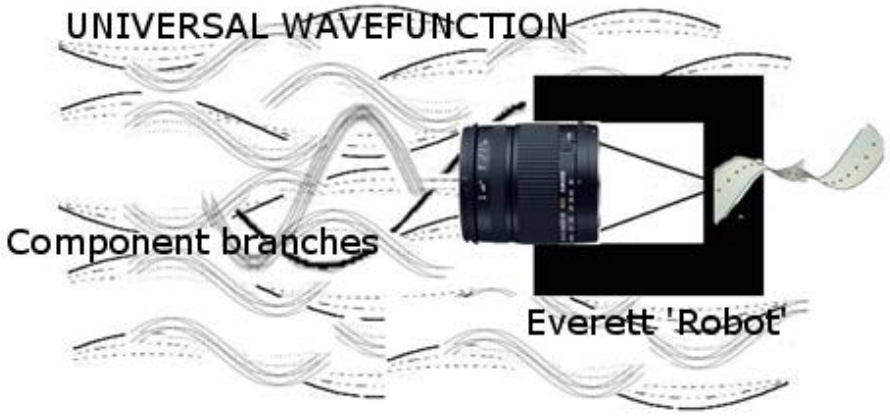

Figure 2

Here Zeh indicates a vital question which we shall answer at a later point, how come local subjective observers come to be 'located' within the nonlocal global universal wavefunction. After all there were, presumably, none around at the time of the big bang. Setting this issue aside for the moment, however, Zeh tells us that notions such as particles and classical properties are out of place in the quantum domain. Joos has gone as far as to suggest that the distinction between the quantum realm and the classical realm is a 'delusion,'[40] everything is quantum and it is only the deluded senses of the local subjective observers which produce the 'appearance' of the

classical world. Given this situation the notion that it is coherent to situate fully paid up classically material recording devices within the quantum realm, even if only in thought, is hard to take seriously.

This is an important point because often one finds that physicists employ language with remarkable imprecision, an imprecision they would obviously never contemplate when doing the quantum math, when discussing metaphysical implications. Consider this observation by Max Tegmark:

> I believe that consciousness is the way information feels being processed. Since matter can be arranged to process information in numerous ways of varying complexity, this implies a rich variety of levels and types of consciousness.[41]

This view is close to what must be the case but it also hides essential aspects because it is couched in an idiom close to materialism. It gives the impression that 'matter' is an ultimate ontological category of reality which has the capacity to 'process' quantum information and thus produce the experiential realm of consciousness. But if 'matter' is able to process information in order to produce the qualitative experiential world of consciousness then it follows that all three of these must have a common aspect or qualitative dimension which enables them to interact with each other and produce individualized consciousness. Now we know that solid, lumpy Cartesian-Newtonian type matter 'does not exist', to re-quote Stapp, or as Zeh has told us, 'there are no particles', so if we wish to be more precise we would have to replace the notion of 'matter' with something like 'localized structures of quantum dream stuff having the classical appearance of individual sentient beings', and Tegmark's use of the term 'information' actually denotes the 'dream stuff' of the universal wavefunction. This means that the appearance of the classical world derives from quantum dream stuff processing itself!

Unpacking Tegmark's belief we arrive at the far more precise and workable view that individualized consciousness arises when localized structures within the global wavefunction process the 'informational' stuff that the global wavefunction is made of. But what is it made of? Well when it is 'processed' it produces consciousness so the 'dream stuff' of the wavefunction must at least be potential consciousness, perhaps mixed with something else. But what else could the quantum potential consciousness be mixed with? 'Matter' does not ultimately exist, so one can only say provisionally that the quantum dream stuff must be some kind of field of potentiality which produces the individualized consciousnesses of sentient beings and the appearance of the material structures of the classical world, and such a 'dream stuff' must have both a substantial and qualitative aspect of consciousness.

In his discussion of the many-worlds scenario in the joint paper (with Piet Hut and Mark Alford) *On Math, Matter and Mind* Max Tegmark refers to the many-worlds situation of component 'observers' as moving from a 'birds eye' view to a 'frog view', the frog being inside the process of the wavefunction (figure 3). According to this presentation what the frog, which is moving inside the universal wavefunction of reality, sees as 'particles' moving and interacting in space and time, the external soaring bird, which is not confined within the internal process of the wavefunction, sees as various forms of continuous 'spaghetti':

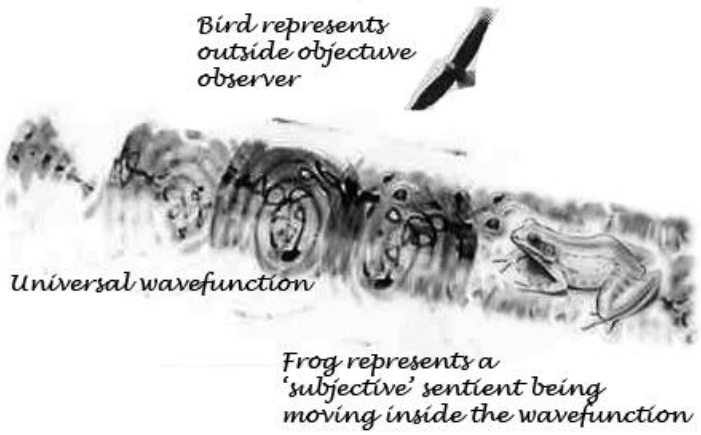

Figure 3

> If the frog sees a particle moving with constant velocity, the bird sees a straight strand of uncooked spaghetti. If the frog sees a pair of orbiting particles, the bird sees two spaghetti strands intertwined like a double helix.[42]

In this analogy the frog represents a subjective centre of experience which is moving inside the universal wavefunction and, through the interaction produced by the movement, 'unfolds' the illusion of material particles from out of the stuff of the wavefunction. The bird, on the other hand, is outside the process and so sees just the movement taking place within the wavefunction without experiencing the results of the internal interaction. Tegmark then goes on to tell us that:

> The frog itself is merely a thick bundle of pasta, whose highly complex intertwining corresponds to a cluster of particles that store and process inform-ation.[43]

But here Tegmark is letting his metaphorical creativity get the better of him because again he ends up with particles where none should be. Tegmark's frog must, if it is inside the wave-function, be ultimately made of the same kind of stuff as the wavefunction. We could reuse Zeh's final remark of the quote at the top of page 14 and say:

> Hence, there does not seem to be any reasonable motivation (other than tradi-tionalism) for introducing concepts like particles, frogs, bundles of pasta, storing and processing of information, or classical properties on a fundamental level.

What there is, however, would seem to be quantum 'dream stuff' interacting with itself, through the agency of 'localized components', to produce individualized consciousness and an *appearance* of a material and 'objective' world.

In several place Zurek has pointed out the similarity, amidst the surface level opposition, between the 'collapse-be-consciousness' and many-worlds perspectives. Here is what he says in *Decoherence and the Transition … Revisited* (the Copenhagen Interpretation of course is far from clear but in the following we can take it as representing collapse by embodied consciousness):

> At first glance, the Many Worlds and Copenhagen Interpretations have little in common. The Copenhagen Interpretation demands an a-priori "classical domain" with a border which enforces a classical embargo that enforces a classical "embargo"' by letting through just one potential outcome. The Many Worlds Interpretation aims to abolish the need for the border altogether. Every potential outcome is accommodated by the ever-proliferating branches of the wave function of the Universe. The similarity between the difficulties faced by these two viewpoints comes apparent, nevertheless, when we ask the obvious question, "Why do I, the observer, perceive only one of the outcomes?" Quantum theory, with its freedom to rotate bases in Hilbert space, does not even clearly define which states of the Universe correspond to the "branches". Yet, our perception of reality with alternatives-not a coherent superposition of alternatives-demands an explanation of when, where, and how it is decided what the observer actually records. Considered in this context, the Many Worlds Interpretation in its original version does not really abolish the border but pushes it all the way to the boundary between the physical Universe and consciousness. Needless to say, this is a very uncomfortable place to do physics.[44]

Here we see that Zurek is aware that both of these perspectives threaten to actually meta-physically conflate the world of consciousness and physicality, this aspect becoming most serious in the many-worlds perspective. Indeed, as Penrose points out, in order to have an acceptable account of the 'many-worlds' viewpoint:

> …we would need a theory to explain that aspect of conscious perceptions which allows only individual detector responses to be consciously perceived, whereas superpositions of responses with non-responses are never consciously perceived![45]

In other words we need a theory of consciousness! In fact it should be quite clear to anyone who does think about the issue with clarity that the functioning of consciousness, although as we shall see this need not be limited to individualized consciousness, is a crucial aspect in attaining a precise understanding of either of these two perspectives.

Unfortunately many proponents of the many worlds viewpoint content themselves with a metaphysically imprecise understanding. Because the mathematical formulism of quantum theory indicates many alternatives at the quantum level it is assumed by many-worlders that it must follow that the consciousnesses of all sentient beings are constantly splitting into a multitude of paths. This bizarre notion is simply taken for granted without being able to give an account of exactly what consciousness is. However, two possibilities seem to be spring to mind, either the interaction of the quantum component subsystems coursing through the 'dream stuff' of the wavefunction produces the experience of consciousness, or each subsystem consciousness is unendingly split apart at every moment in time. In the current state of apparent perplexity as to what consciousness is, however, how one could decide such an issue is indeed beyond determination. In the case of the consciousness causes collapse proposal, again, some account of what consciousness *is* is required. In any of these cases, however, consciousness and the quantum conundrum are clearly interrelated.

Zurek is clearly aware of this when he says that the many-worlds perspective pushes the quantum measurement issue "all the way to the boundary between the physical Universe and

consciousness." Furthermore he explicitly reveals his discomfort with this situation. The central reason for this discomfort seems to be the fact that Zurek simply does not think that consciousness is 'physical' and, when considering the problem of the nature of the processes which could be responsible for producing "our awareness of definite outcomes", he tells us that:

> If these mental processes were essentially unphysical, there would be no hope of formulating and addressing the ultimate question – why do we perceive just one of the quantum alternatives? – within the context of physics.[46]

And because of this horrific specter looming on the quantum horizon Zurek seems to declare a metaphysical war on the 'ultimate evidence' that consciousness is an intrinsic aspect of quantum reality, an intrinsic aspect which also has ontological clout upon quantum reality (this is odd because Zurek's resistance to this view seems remarkably at odds with the notion that quantum 'dream stuff' is 'epiontic'). Thus he now writes in his concluding remarks of *Revisited*:

> Indeed, one might be tempted to follow Eugene Wigner … and give consciousness the last word in collapsing the state vector. I shall assume the opposite. That is I shall examine the idea that the higher mental processes all correspond to well defined, but at present, poorly understood information processes functions that are being carried out by physical systems, our brains.[47]

The first issue which arises is that as to what exactly Zurek, or for that matter anyone, means by the term 'physical'. Often it stands in as a kind of soft proxy for the term 'material', although perhaps it should be reserved for the notion of what is measurable and amenable to mathematical analysis and representation within the realm of physics. It is another concept which physicists tend to use with remarkable imprecision. In the above quote it would appear that Zurek is employing the term in a vaguely materialistic sense, although he clearly knows that the ultimate nature of reality must be quantum in nature. He considers our brains as 'physical systems' as if existing independently of the quantum realm, although he muddies the conceptual mix by invoking 'information processes' taking place within the 'physical' brain, although in other contexts Zurek considers information to be a quintessentially quantum phenomenon.

By analyzing the situation from this point of view Zurek now tells us that decoherence must take place within the physical stuff of the brain and because of this Zurek tells us that "awareness becomes susceptible to physical analysis" and:

> …any quantum superposition of the states of the neurons will be destroyed far too quickly for us to be conscious of the quantum "goings on." Decoherence, more to the point, environment induced superselection, apples to our own state of mind.[48]

Zurek's main point here seems be to that, because decoherence applies to the brain, it is acceptable to treat the mind as being a classical kind of object and, indeed, he proceeds to give a classically 'focused' account of why it is that we are not aware of quantum superpositions and have ended up living in a 'classical' world:

> There is… another reason for this focus on the classical that must have played a decisive role: Our senses did not evolve for the purpose of verifying quantum mechanics. Rather they have developed in the process in which survival of the fittest played a central role. There is no evolutionary reason for perception when nothing can be gained from

> prediction. And … only quantum states that are robust in spite of decoherence, and hence, effectively classical, have predictable consequences.[49]

It is hardly surprising that Zurek mentions evolution in his discussion as the title he has given his perspective is 'quantum Darwinism'. In fact in the light of this it is surprising that he does not say more on the subject as, as we shall see, the understanding of how quantum Darwinism underlies the process of 'classical' level Darwinism is of great significance.

Zurek is not the only scientist to propose that the reason why sentient beings live in a classical world is simply that the sense faculties are only 'designed' by the evolutionary process to deal with the classical world. The monarch of materialism Richard Dawkins has also speculated in such a manner:

> …our brains have evolved to help us survive within the orders of magnitude of size and speed which our bodies operate at. We never evolved to navigate in the world of atoms. If we had, our brains probably would perceive rocks as full of empty space. Rocks feel hard and impenetrable to our hands precisely because objects like rocks and hands cannot penetrate each other. It's therefore useful for our brains to construct notions like "solidity" and "impenetrability," because such notions help us to navigate our bodies through the middle-sized world in which we have to navigate.[50]

However, when one read accounts like this without thinking too hard it is almost impossible not to buy into the notion that the classical world 'really' does exist as it appears to us. In fact of course rocks are not hard because of the existence of any Cartesian-Newtonian type matter; they appear hard because of the atomic forces of repulsion between the surfaces which appear to be in contact (in fact they are not), and these forces are ultimately generated at the quantum level. So the emphasis upon the importance of dealing with the classical world in considering the manner in which sense faculties evolved has a serious drawback. In a quantum universe, which is to say a universe which has an ultimate quantum nature, quantum Darwinism must metaphysically speaking, and also probably physically speaking also, precede classical Darwinism. As Stapp points out in this context:

> …no such brain exists; no brain, body, or anything else in the real world is composed of those tiny bits of matter that Newton imagined the universe to be made of.[51]

And this also applies to all the seemingly organic structures of the senses.

When one understands this the crucial issue becomes: Why does a quantum field of potentiality which existed at the moment of the big bang organize itself into an apparent world of materiality within which some of the material structures, sentient beings, acquire seemingly independent structures of consciousness of various degrees of sophistication.

In an essay on the Copenhagen Interpretation Heisenberg wrote:

> There is no use in discussing what could be done if we were other beings than we are. At this point we have to realize, as von Weizacker has put it, that "Nature is earlier than man, but man is earlier than natural science." The first part of the sentence justifies classical physics, with its ideal of complete objectivity. The second part tells us why we

> cannot escape the paradox of Quantum Theory, namely, the necessity of using classical concepts.[52]

This was in the days when the 'founding fathers' mistakenly convinced themselves, and others, that it was humanly impossible to understand quantum reality because human beings were ineluctably trapped within the confines of 'classical' language. We shall see later that this is false. The preceding assertion, that the fact the 'Nature is earlier than man' 'justifies classical physics we now know to be entirely false for, as Zurek points out:

> The natural sciences were built on a tacit assumption: Information about the universe can be acquired without changing its state. The ideal of "hard science" was to be objective and to provide a description of reality. Information was regarded as unphysical, ethereal; a mere record of the tangible….Quantum theory has put an end to this Laplacean dream about a mechanical universe. Observers of quantum phenomena can no longer be just passive spectators. Quantum laws make it impossible to gain information without changing the state of the measured object. The dividing line between what is and what is known to be has been blurred forever. While abolishing this boundary, quantum theory has simultaneously deprived the 'conscious observer' of a monopoly on acquiring and storing information. Any correlation is a registration; any quantum state is a record of some other quantum state. When correlations are robust enough, or the record is sufficiently indelible, familiar classical "objective reality" emerges from the quantum substrate.[53]

There are several crucial insights in this dense passage which need to be fully appreciated. Crucially in the last sentence there is the indication that essential nature of 'Nature' is quantum, the 'substrate' from which "familiar classical 'objective reality' emerges" is quantum. Thus Heisenberg's notion of 'Nature' justifying classical physics has been overturned.

Zurek begins by telling us that the notion of a 'mechanical universe' which is entirely independent of observation has to be abandoned. The fundamental revelation of quantum theory is that 'it impossible to gain information without changing the state of the measured object.' This corresponds to Zurek's earlier assertion that 'the ultimate evidence for the choice of one alternative resides in our illusive "consciousness."' It certainly *appears* that consciousness is implicated in the 'collapse' of the wavefunction, and because of this Zurek has no qualms in asserting that 'the dividing line between what is and what is known to be has been blurred forever.' This opinion would puts Zurek amongst the good guys in the eyes of Anton Zeilinger who has spoken of John Wheeler's:

> …realisation that the implications of quantum physics are so far-reaching that they require a completely novel approach in our view of reality and in the way we see our role in the universe. This distinguishes him from many others who in one way or another tried to save pre-quantum viewpoints, particularly the obviously wrong notion of a reality independent of us.[54]

However, in the next portion of his discussion Zurek resurrects his new flavor of 'a reality independent of us' when he tells us that the conscious observer has been deprived of "a monopoly on acquiring and storing information." According to Zurek the 'quantum dream stuff' of reality' is 'epiontic' itself, which means that the quantum information which underpins the

appearance of the classical world proliferates within the quantum environment because it is resistant to quantum obliteration in its interaction with the environment. The last sentence of the quote also gives a hazy indication of how the classical world emerges. An 'element of reality', to use a phrase coined in the EPR debate, emerges when quantum 'correlations' or 'registrations' between quantum states 'are robust enough' or the records are 'sufficiently indelible.'

In his quantum Darwinism proposal Zurek appears to suggest that somehow a kind of quantum "advertising billboard" springs into existence advertising classical reality when quantum correlations become 'robust enough':

> The main idea of quantum Darwinism is that we almost never do any direct measurement on anything … the environment acts as a witness, or as a communication channel. … It is like a big advertising billboard, which floats multiple copies of the information about our universe all over the place.[55]

In other words there is a kind of quantum 'matrix' of the classical world which, through an unexplicated mechanism (as we are told how it sustains but not how it comes into being), has become resistant to obliteration through the process of observation, floats so many copies of itself all over the quantum environment that it becomes the source of the apparent 'objectivity' of the classical world.

Zurek's theory of Quantum Darwinism can be outlined as follows[56]. Human (or sentient in general) measurements are not the only mechanism for producing decoherence or 'collapse' of superposed or entangled quantum states into classical states. The primary mechanism causing decoherence lies in the interactions that a quantum system has with its environment. Typically quantum systems undergo a vast number of environmental interactions which selectively destroy entangled quantum states. This is called environment-induced-super-selection ('einselection'). This process does not produce a single classical state but, rather, a 'menu'[57] of classical possibilities. The result of environmental interactions, or environmental monitoring, is that a small number of quantum states, called pointer states, are able to survive and evolve for any sustained period of time in a deterministic, classical manner. Their prolonged survival is due to the fact that these pointer states survive interactions with the environment, decoherence leave them unchanged. They alone are able to survive in the face of environmental monitoring. Zurek says that:

> Using Darwinian analogy, one might say that pointer states are most 'fit'. They survive monitoring by the environment to leave 'descendants' that inherit their properties. Classical domain of pointer states offers a static summary of the result of quantum decoherence. Save for classical dynamics, (almost) nothing happens to these einselected states, even though they are immersed in the environment.[58]

Because the pointer states are the only ones able to survive decoherence, and as interactions with the environment pass information concerning the quantum state to the environment, a quantum system's environment becomes heavily imprinted with a great many redundant copies of information indicating the quantum system's pointer states.

It is these environmental copies that we actually experience and from which we gain information concerning quantum systems in almost all cases. For instance quantum systems are in continual

interaction with the vast number of photons in their immediate environment. When we observe an object visually we are actually accessing information that has been imprinted on photons during previous interactions with the quantum system under observation. It is this redundant imprinting of information in the environment that makes this information available to multiple observers and provides the basis for our classical concept of objectivity or the ability of numerous observers to access and confirm the same information. And it is because of the vast proliferation of the information which is accessed by a multitude of observers that the original states underlying the classical world can remain resilient to observational obliteration. Zurek, in discussion with science journalist Philip Ball, described the delicate situation of quantum 'dream stuff' as follows:

> Because, as Zurek says, "the Universe is quantum to the core," this property (that observation disturbs quantum reality) seems to undermine the notion of an objective reality. In this type of situation, every tourist who gazed at Buckingham Palace would change the arrangement of the building's windows, say, merely by the act of looking, so that subsequent tourists would see something slightly different. Yet that clearly isn't what happens. The sensitivity to observation at the quantum level … seems to go away at the everyday, macroscopic level…[59]

And the reason that the everyday macroscopic world remains stable is that the classical world arises through the mechanism of decoherence:

> Decoherence selects out of the quantum 'mush' states that are stable, that can stand the scrutiny of the environment without getting perturbed…[60]

This mechanism has been dubbed by some as 'collapse without collapse' precisely because it, apparently, removes the central role of conscious observers, the quantum environment itself now seems to be 'epiontically' observing itself and passing the information along so to speak. Thus John Campbell, in his article *Quantum Darwinism as a Darwinian process* says of Zurek's work:

> Hopefully this treatment will finally lay to rest the interpretational confusion around the role of a human observer in quantum measurements that has been prevalent in many treatments and taken to anthropomorphic extremes by some such as Wigner. Zurek's work makes it clear that decoherence takes place whenever there is an information transfer to the environment. No human observer need be in attendance.[61]

However as we shall see shortly, whilst it is true that humans are not required to be 'in attendance' at all times to keep the classical world in operation Zurek's quantum Darwinism perspective does not, cannot, remove the 'epiontic' role of observers and consciousness entirely. For one thing the decoherence project does not completely solve the 'measurement problem' because it still leaves a 'menu' of classical type alternatives. Joos has pointed out:

> Does decoherence solve the measurement problem? Clearly not. What decoherence tells us, is that certain objects appear classical when they are observed. But what is an observation? At some stage, we still have to apply the usual probability rules of quantum theory.[62]

And Zeh:

> Decoherence by itself does not yet solve the measurement problem … This argument is nonetheless found widespread in the literature … It does seem that the measurement

> problem can only be resolved if the Schrödinger dynamics … is supplemented by a nonunitary collapse…[63]

And Penrose:

> The issue of environmental decoherence … provides us with a merely stopgap position … 'lost in the environment' does not literally mean that it is *actually* lost, in an objective sense. But for the loss to be subjective, we are again thrown back on the issue 'subjectively perceived – by whom?' which returns us to the consciousness-observer question.[64]

However, this issue is actually irrelevant for our investigation for, as we shall see, even if Zurek's account had completely solved the measurement problem far from removing cons-ciousness from the ontological market place, it places it in the prime position.

The clue lies in the putative reason offered as to why the significance of decoherence was 'overlooked.' Zurek tells us for instance that:

> The idea that the "openness" of quantum systems might have anything to do with the transition from quantum to classical was ignored for a very long time, probably because in classical physics problems of fundamental importance were always settled in isolated systems.[65]

It seems that according to Zurek the fact that classical physics was able to investigate classical phenomena by isolating the phenomenon misled physicists (from Zurek's point of view) into thinking that the same is true in the investigation of quantum phenomena. From Zurek's perspective, however, the phenomenon of decoherence changes this situation drastically, because of decoherence we can forget the fact that 'the ultimate evidence for the choice of one alternative resides in our illusive "consciousness"' because decoherence give us back an objective reality of sorts. In one of his musings on the quantum conundrum Penrose once wrote:

> Undoubtedly the world is strange and unfamiliar at the quantum level, but it is not unreal. How, indeed, can real objects be constructed from unreal constituents?[66]

To this Zurek offered a reply in his paper *Relative States and the Environment: Einselection, Envarience, Quantum Darwinism and the Existential Interpretation*:

> How to account for objective existence of "classical reality" using only "unreal" quantum ingredients? The answer turns out to be surprisingly simple: Continuous monitoring of ***S*** by its environment results in redundant records in ***E***. Thus many observers can find out the state of the system indirectly, from small fragments of the same ***E*** that caused decoherence.

Figure 4 shows Zurek's diagrams and explanations concerning this mechanism in which an already decohered environment continuously monitors and thereby decoheres the 'fragile' quantum system thus forcing it to fall in line with decoherence which has already been established. Quantum states which 'survive' this process are said to be the 'fittest' and through this process the 'epiontic' 'dream stuff' which, according to Zurek himself, makes up the 'fragile' realm of fundamental quantum reality, produces the "objective appearance of preferred pointer states." Thus, Zurek thinks that he has answered Penrose's question as to how 'real' classical entities emerge from 'unreal' quantum constituents. But he has not answered Penrose's question.

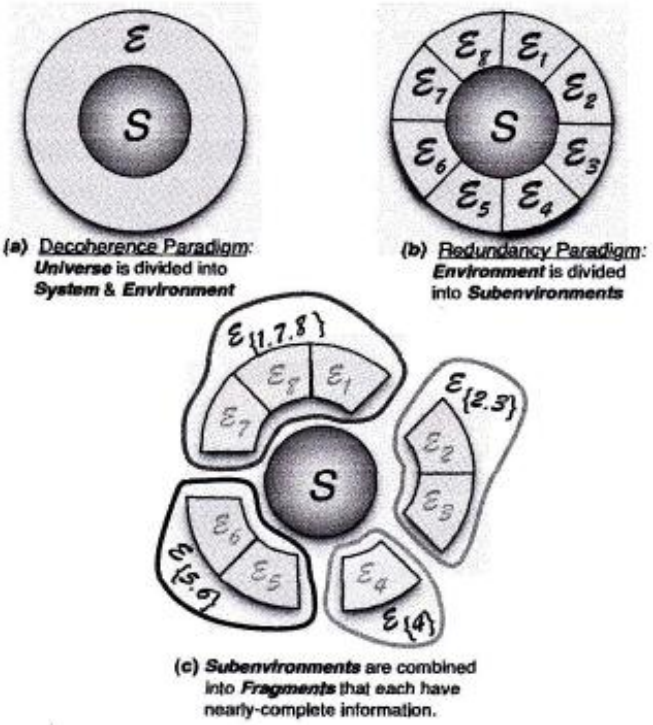

FIG. 2 *Quantum Darwinism and the structure of the environment.* The decoherence paradigm distinguishes between a system ($\mathcal{S}$) and its environment ($\mathcal{E}$) as in **(a)**, but makes no further recognition of the structure of $\mathcal{E}$; it could be as well monolithic. In the environment-as-a-witness paradigm, we recognize subdivision of $\mathcal{E}$ into subenvironments – its natural subsystems, as in **(b)**. The only real requirement for a subsystem is that it should be individually accessible to measurements; observables corresponding to different subenvironments commute. To obtain information about the system $\mathcal{S}$ from its environment $\mathcal{E}$ one can then carry out measurements of *fragments* $\mathcal{F}$ of the environment – non-overlapping collections of the subsystems of $\mathcal{E}$. Sufficiently large fragments of $\mathcal{E}$ that has monitored (and, therefore, decohered) $\mathcal{S}$ can often provide enough information to infer the state of $\mathcal{S}$, by combining subenvironments as in **(c)**. There are then many copies of the information about $\mathcal{S}$ in $\mathcal{E}$, which implies that some information about the "fittest" observable that survived monitoring by $\mathcal{E}$ has proliferated throughout $\mathcal{E}$, leaving multiple informational offspring. This proliferation of the information about the fittest states defines quantum Darwinism. Multiple copies allow many observers to find out the state of $\mathcal{S}$: Environment becomes a reliable witness with redundant copies of information about preferred observables, which leads to objective existence of preferred pointer states.

Figure 4 – taken from *Relative States and the Environment: Einselection, Envarience, Quantum Darwinism and the Existential Interpretation*:

He has answered a question which, although closely related, is very different. Zurek has answered the question as to how *the appearance of an objective world* arises from 'unreal' quantum 'dream stuff'.

The kind of 'objectivity' which Zurek has rescued is quite clearly nothing like the objectivity that the 'classical' physicists of the late nineteenth century thought they had access to. The objective reality of the late nineteenth century was inherently and absolutely objective. It had by no measure any reliance upon the consciousness or consciousnesses of the observers and it was clearly thought to have its own internal mass and internal 'inherent' solidity. In his paper *Elements of Environmental Decoherence*, in a section headed 'Lessons' Joos states that:

> …typical classical properties, such as localization in space, are *created* by the environment in an irreversible process and are therefore not inherent attributes of macroscopic objects.[67]

And here Joos locates the crucial difference between the 'real' classical type 'objective' stuff imagined by the nineteenth century physicists and the dreamy pseudo 'objectivity' delivered by Zurek's decoherence of 'fragile' quantum 'dream stuff'. Furthermore, this lack of inherent substantiality in all phenomena was two thousand years ago and of course still is, a central insight of the Buddhist *Madhyamaka* or 'Middle Way' metaphysics. The Buddhist Madhyamaka philosophical analysis places the concept of 'inherent existence', or *svabhava,* as a central construct in its philosophical deconstruction of reality. *Svabhava*, or 'inherent existence' is something that sentient beings imagine phenomena to have whilst in reality it is an essence which all phenomena actually are 'empty' of. The notion of 'inherent existence' plays a central and crucial role in the Madhyamaka philosophical investigation and analysis of reality; it is, according to this analysis, something which is entirely non-existent within the Universe. A phenomenon which has its own self-enclosed svabhava, or independent and substantial inner essence, is as nonexistent as 'the horns of a rabbit.'[68] Indeed the core Madhyamaka doctrine of *shunyata*, or 'emptiness', asserts that all phenomena are 'empty' of inherent existence. As the Buddhist scholar Jeffrey Hopkins explains the Buddhist Madhyamaka viewpoint:

> Phenomena are empty of a certain mode of being called 'inherent existence', 'objective existence', or 'natural existence'. This 'inherent existence' is not a concept superimposed by philosophical systems but refers to our ordinary sense of the way that things exist…[69]

The natural and naturalistic view deeply embedded in the human psyche, is exactly that the phenomena of the classical everyday world do have some kind of inner core of self-enclosed independent existence which is all their own so to speak; it is this 'naturalistic' perception of the way things exist which is rejected by the Buddhist doctrine of emptiness. And it is now a view of reality which is also rejected by quantum physics.

Quantum physicists, however, seem to be often unconvinced, or suspicious of their own discoveries. As Buddhist translator and philosopher Karl Brunnhölzl has pointed out:

> …according to quantum physics there are no such things as matter, roads, cars, or bodies, so who or what is driving home after an exciting day at the quantum lab.[70]

In other words, although quantum physicists have clearly discovered the fact the 'classical' material world is not real in the sense that classical physics assumed that it was real they persist in attributing a 'reality' to the appearance that it does not deserve. As Jeffrey Hopkins writes concerning the Buddhist Madhyamaka view of 'classical' reality:

> A 'truth' is what exists the way it appears, whereas conventional objects appear – even in direct perception – to be inherently existent; hence, conventional objects are not truths in fact. Ignorance affirms the false appearance of inherent existence. Everything that we see is … taken by ignorance to exist the way that it appears; but actually appearing in one way and existing in another; these appearances are fraudulent.[71]

From a Buddhist perspective the fact that the classical, or conventional, world does not exist in the way that it appears has great significance for Buddhist practice and for this reason this quantum aspect of reality is emphasized. Zurek, however, seems to want to play down such implications.

Western science and philosophy seems have great problems with the notion of 'reality' and one finds the concept itself slipping and sliding according to personal taste. For example the science writer Jim Baggott, at the end of his quest to find 'reality' in his book *A Beginner's Guide to Reality*, tells us that:

> There is simply nothing we can point to, hang our hats on and say *this is real*.[72]

This conclusion results from various modes of investigation culminating in the most dramatic – quantum theory. However, in an apparent volte face, in his more recent book *The Quantum Story* Baggott seems to have revised his opinion somewhat on the matter of 'reality' as he now tells us that Heisenberg's assertion that the results of quantum exploration can only reveal 'nature exposed to our method of questioning' rather than nature as it objectively is in itself :

> …does not mean that quantum particles are not real. What this does mean is that we can ascribe to them only an *empirical* reality. This is a reality that depends on our method of questioning…[73]

It would seem, then, that Baggott's more recent view is that quantum 'particles' have *only* an empirical 'reality'. This view, at first sight, seems to contradict the conclusion reached by Zeh in his paper '*There are no Quantum Jumps, nor are there Particles!'* that there is no "reasonable motivation … or introducing concepts like particles, quantum jumps, … or classical properties on a fundamental level."[74] However, it is quite clear from the context of his book that Baggott is using the term 'real' in the manner that a Buddhist philosopher would, which is to say that an entity or aspect of reality is considered to be 'real' if it is objectively established as an independent existent which has an objective, self-enclosed and self-sufficient ontological status which is completely independent of any observing consciousness. This, of course, is what Einstein and colleagues meant by the term 'element of reality' in the EPR paper. This notion is referred to in Buddhist terminology as being 'inherently existent' or 'established from its own side'. This usage corresponds very well to the online dictionary definition of the philosophical meaning of the term 'real': 'Existing objectively in the world regardless of subjectivity or conventions of thought or language.'

So it seems that the root (and 'real'!) meaning of the notion of 'real' both within basic Western philosophical parlance and Buddhist terminology carries a fundamental implication that the entities to which reality is ascribed should exist independently of the human sense faculties and mind in order warrant the attribution of being 'real'. Using this understanding of the meaning of the term 'real', then, means that apparent 'entities' cannot be considered 'real' in this ultimate sense precisely because they do not indicate independently existing entities which exist in an external reality which is completely separate from the human, or any other, sentient mind. For this reason a modern Buddhist exponent says:

> We come to understand the importance of knowing the difference between apparent reality and genuine reality, between the way things appear and the way they really are.[75]

And a clear definition of what a 'real' entity consists of is given:

> We need to understand what it is to say that something truly exists. What characteristics would something need to have in order to be truly existent? It would have to exist independently, with its own inherent nature; it would have to exist without depending on anything else and be impervious to causes and conditions acting upon it. If it were like that, then we could say that it was real.[76]

The point is that in 'classical' reality this is exactly how the entities of the experiential world *appear* to us, as self-enclosed independent entities. Thus the notion of what a 'real' entity is *is* essentially a 'classical' concept; it derives from our experience of the classical world of mostly solid objects which were always, mistakenly, taken within classical Newtonian based physics to be exactly what they appeared to be – independent self-existing entities. Such a view obviously involves the idea that 'real' independent entities have some kind of *real* independent internal substantial basis. The following characterisation by David Bohm of the classical worldview presents precisely this point of view:

> …the world is regarded as constituted of entities which are *outside of each other*, in the sense that they exist independently in different regions of time and space (and time) and interact through forces that do not bring about changes in their essential nature.[77]

This is the, *ultimately* mistaken, classical, conventional worldview of a world made up of inherently 'real' entities. And it should be clear that Zurek's type of 'objectivity' does not provide us with this kind of full-blown 'inherent reality,' it only has a kind of derivative 'empirical' reality.

The Madhyamaka metaphysical analysis provides a more subtle way of conceiving of the quantum-classical situation which is suggested by the observations provided so far. Zeh tells us that we must abandon the notion of the reality of 'particles' 'on a *fundamental* level', Baggott, on the other hand, suggests that we must consider that the 'particles' which appear to come into existence when reality is questioned by a 'particle-producing' method must be considered to have a different, non-fundamental, or *empirical* level of reality. It would seem, then, that we may have to adjust our notions of 'reality' in order to take account of two types, the first being a fundamental quantum reality within which there are no particles to be found, and the second being a less fundamental empirical reality wherein particles *appear* to exist. Remarkably this

ontological division of reality into a two tier system corresponds precisely to a metaphysical division of reality made by central Buddhist Madhyamaka philosophical analysis:

> The seeming and the ultimate-
> These are asserted as the two realities.
> The ultimate is not the sphere of cognition.
> It is said that cognition is the seeming.[78]

In this assertion the 'seeming' corresponds to Baggott's 'empirical' level of reality whilst the 'ultimate' corresponds to the fundamental-quantum level. Furthermore, it is significant that there is an implication that the act of cognition, which as we shall see can be considered to be a quantum-measurement, is a central feature of the realm of the 'seeming' or 'empirical.' We can also use this division to address Zurek's comment that:

> …while the ultimate evidence for the choice of one alternative resides in our illusive "consciousness," there is every indication that the choice occurs much before consciousness gets involved and that, once made, the choice is irrevocable.[79]

In fact the mapping between the 'two realities' (often translated as the 'two truths') of the Buddhist Madhyamaka and Zurek's Quantum Darwinism is quite remarkable because we shall see that it is precisely an inter-subjective and deeply unconscious coordinated cognitive process that gives rise to the seeming reality of an independent sphere of materiality within which it clearly appears that "there is every indication that the choice occurs much before consciousness gets involved and that, once made, the choice is irrevocable." It is worth noting in this connection that Wheeler was clearly drawn to the notion that the collapse of the wavefunction is an inter-subjective phenomenon and, furthermore, this phenomenon provides a mechanism for bringing into being the Universe from the 'ultimate' quantum ground of potentiality:

> John Wheeler has been intrigued by the notion of collapse by inter-subjective agreement, but he confesses that he does not see any way to make the idea mathematically precise. What really interests him about [the possibility] is that it would be a mechanism of bring the entire Universe into existence!

Such a Universe, however, is not an 'inherently real' Universe.

Zurek's entire analysis screams 'unreal', illusion, 'dream stuff' and yet he seems, especially when interpreted by hard-core realists such as John Campbell, determined to rescue some kind of fully 'objective' 'reality' from the dream. At this point he almost seems to qualify as one of those who, according to Zeilinger, who is trying:

> to save pre-quantum viewpoints, particularly the obviously wrong notion of a reality independent of us.[80]

Here Zeilinger indicates that, however much the ineluctable appearance of the material world might appear to be completely independent of the minds of the observers, it nevertheless remains the case that 'the ultimate evidence for the choice of one alternative resides in our illusive "consciousness"' even though the appearance also seems clearly independent of individual consciousnesses. The vital issue to comprehend, then, is precisely how the two levels of reality function and interrelate.

A first necessary issue to clear up before we can make headway in this area is that of the current mistaken notion that the phenomenon of 'consciousness', at the current state of knowledge, is utterly and overwhelmingly impenetrable. Those who make assertions of this nature are invariably requiring some kind of materialistic or scientific-physicalistic account of the phenomenon, either crude or subtle. From this point of view, of course, the nature of consciousness does appear beyond accountability for, given that the usual notion of 'matter' which is due to Descartes defines it as being utterly devoid of the qualities of consciousness, there is simply no way that one could coherently give an account of the production of something from its ultimate opposite. Such crude materialistic attempts of accounting for consciousness are doomed to failure. There are, however, more subtle types of physicalism which can operate even within a perspective which on the surface deny materialism. Such perspectives still seem to operate with an underlying view that it might be possible to physic-cally locate some kind of hidden subtle mind-stuff which can then be purely 'objectively' described with precise theories; many of the current practitioners of 'Consciousness Studies' seem to fall into this camp, as perhaps does Henry Stapp, despite his many insights and achievements in this arena.

The Buddhist scholar and philosopher B. Alan Wallace has referred to what he calls *The Taboo of Subjectivity*, which he explores in his book of that title. This taboo is the "scientists' long term resistance to the first hand study of consciousness." The core thesis of this book is the claim that the dogmatic and quasi-religious commitment to a materialistic metaphysics which operates within science in general precludes the possibility of taking seriously any form of first-person direct investigation of subjective experience, as practiced in advanced Buddhist meditation for instance, as relevant for our scientific knowledge of consciousness. One aspect of this prejudice is simply the refusal to accept that it is necessary to say that one essential aspect of consciousness is the direct subjective qualitative experience of being conscious in all its varieties. And in particular one can say that the fundamental essence of consciousness must be what is common to all experiences within consciousness which we may call pure awareness. As Wallace says, taking William James as his mentor:

> Rather than regarding consciousness or matter as primal substance of the universe, James proposes that the one primal stuff out of which everything is composed is "pure experience"; and the function of knowing is a special sort of relation among components of experience. That relation itself is a component of pure experience. Thus consciousness, the knower, the subject, or bearer of knowledge, is one "term" of pure experience; objects of knowledge are the other "term." James says that "the instant field of the present is at all times what I call the 'pure' experience. It is only virtually or potentially either object or subject as yet. For the time being, it is plain, unqualified actuality, or existence, a simple *that*. While in the state of pure experience there is no self-splitting of this reality into consciousness and what the consciousness is *of*. Its subjectivity and objectivity are functional attributes…[81]

According to James the ultimate 'stuff' from which subjectivity and objectivity arises is "plain, unqualified actuality, or existence, a simple *that*." And according to one approach to Buddhist philosophy, although all particular experiences are 'seeming,' their seemingness is given the directly experienced ontological weight of being experienced exactly because a fundamental aspect of the ground of reality is pure experiential 'thusness' (*tathata*). Furthermore, according

to the Buddhist Chittamatra or Mind-Only school of metaphysics the subjective and objective realms emerge in exactly the same process as suggested by James:

> A seed or predisposition is activated and simultaneously produces both an object and a cognizing subject, much as in a dream.[82]

In this metaphysical analysis of the functioning of reality all the coordinated subject-object events which make up the process of reality emerge from a deep nondual layer of reality which is essentially mind-like or of the nature of mind, although not individuated mind:

> all phenomena are merely mind-the all-ground consciousness manifesting as environment, objects and the physical body, as a result of residual tendencies stored within the all-ground.[83]

This leads us to the picture of the Quantum Mind-Only view of the functioning of the process of reality. According to the Mind-Only school of Buddhist philosophy the dualistic experiences of the 'seeming' world arise from a deep level of awareness called the *alaya* (all-ground) which can be thought of as a foundational experiential potentiality which has an internal function of cognition. When the cognitive function activates the potentiality of the *alaya* it becomes the *alayavijnana*, the ground-consciousness, which is an increasingly divided process of awareness becoming individuated into the dualistic realms of consciousness and objects of consciousness, giving rise the mental continuums of all sentient beings. The all-ground consciousness operates by receiving impressions from all the activities of the higher levels which are 'stored' for later activation when surrounding co-operating conditions act as a resonant triggering mechanism. We shall see that this metaphysical perspective is entirely consistent with Zurek's Quantum Darwinism.

The idea that quantum physics requires the recognition that the phenomena of the dualistic world, both subjective and apparently objective, must arise from a deeper immaterial inter-connected layer of reality has played a role in the thinking of many physicists who have engaged quantum issues on a philosophical level. David Bohm for instance wrote:

> If matter and consciousness could in this way be understood together, in terms of the same general notion of order, the way would be opened to comprehending their relationship on the basis of some common ground. Thus we could come to the germ of a new notion of unbroken wholeness, in which consciousness is no longer to be fundamentally separated from matter.[84]

However, it is important to be aware that his use of the term 'consciousness' indicates *individuated* consciousness. Bohm is also aware that the common ground, what he calls the implicate order, must be of the nature of consciousness, although obviously not the same level, degree or specific quality of consciousness as experienced within embodied beings:

> … consciousness has to be understood in terms of an order that is closer to the implicate than it is to the explicate. … The question which arises here, then, is that of whether or not (as was in a certain sense anticipated by Descartes) the actual 'substance' of consciousness can be understood in terms of the notion that the implicate order is also its primary and immediate actuality.[85]

A similar observation is made by Bernard d'Espagnat of the University of Paris, a leading authority on the conceptual foundation of quantum physics:

> …some data are now available that tend to suggest that, far from being a mere efflorescence from neurons, thought has structures that might be, somehow, directly connect to those of 'the Real.' … They consist of a kind of parallelism between, on the one hand, the structures of thought and, on the other hand, the structures of quantum mechanics…[86]

And quantum cosmologist Andre Linde has observed:

> Is it possible that consciousness, like space-time, has its own intrinsic degrees of freedom and that neglecting these will lead to a description of the universe that is fundamentally incomplete? What if our perceptions are as real as (or maybe, in a certain sense, are even more real) than material objects?[87]

Many examples of similar conclusions can be garnered from the literature but space requires moderation, however it is worth noting the following remarks from two of the 'founding fathers' of quantum theory. According to Schrödinger, for instance:

> Mind has erected the objective outside world … out of its own stuff.[88]

And Max Planck came to a similar conclusion:

> All matter originates and exists only by virtue of a force... We must assume behind this force the existence of a conscious and intelligent Mind. This Mind is the matrix of all matter.[89]

More recently, in an article in the New Scientist (23rd June 2007) Michael Brooks, commenting on quantum entanglement experiments carried out by teams led by Markus Aspelmeyer of the Austrian Academy of Sciences and Anton Zeilinger of the University of Vienna, tells us that the conclusion reached by the physicists involved is that:

> … we now have to face the possibility that there is nothing inherently real about the properties of an object that we measure. In other words measuring those properties is what brings them into existence. [90]

And Vlatko Vedral, quantum researcher at the University of Leeds commented that:

> Rather than passively observing it, we in fact create reality. [91]

The headline for the article proclaims that:

> To track down a theory of everything, we might have to accept that the universe only exists when we are looking at it…[92]

A conclusion which echoes Wheeler's observation that:

> The universe does not 'exist, out there,' independent of all acts of observation. Instead, it is in some strange sense a participatory universe.[93]

The question which remains is how we can harmonize such conclusions, that a deep level of consciousness is ontologically potent and necessary in the production of the appearance of the classical world, with Zurek's apparent resurrection of an 'objective' world which appears to produce itself so to speak, and which one has to say certainly seems to be 'out there.'

The end section of the Zurek quote previously considered on page 18 states that:

> Any correlation is a registration; any quantum state is a record of some other quantum state. When correlations are robust enough, or the record is sufficiently indelible, familiar classical of "objective reality" emerges from the quantum substrate.

Here Zurek indicates that beneath the upper levels of individuated consciousness, which are mediated and individuated by the brain, the 'epiontic' 'quantum substrate' is somehow constantly 'registering', or 'correlating, or interacting, or exchanging information and only 'when correlations are robust enough' does a 'classical' reality emerge. Thus the emergence of the classical world depends on the solidification, so to speak, of a natural internal process of self-registration. Such a manner of saying things implies that the 'epiontic' informational processes of the quantum environment are perfectly capable of producing a 'classical' world without any need of the consciousnesses of observers. In another paper Zurek wrote that:

> In our quantum universe the environment is promoted from a passive role of a reservoir selecting destroying quantum coherence to an active role of an amplifier selectively proliferating information about the system.[94]

In other words it would appear that there must be an internal *amplificatory* tendency within the epiontic functioning of the quantum realm itself, there is nowhere else from which it could arise. Presumably at the moment of the big bang there was no environment conveniently hanging around to provide the amplificatory role, so such an amplificatory functionality must be an innate aspect of quantum functioning itself.

At this point it is necessary to step back and realize that the discussion itself is couched within the idiom of separations: consciousness and the apparent material world, quantum and classical, system and environment and so on. However, in a universe which, as Zurek says "is quantum to the core" all such dichotomies arise from the quantum level itself. The most fundamental level of description of the quantum realm is quantum field theory and it is vital that we maintain awareness that at the quantum field level of analysis there is no substantiality whatsoever. In his recent book Jonathan Allday tells us that within quantum field theory, at the lowest level of quantum analysis, there is no substance, the quantum field is actually 'empty' of substance. He writes:

> Now, from a philosophical point of view, this is rather big stuff. Our whole manner of speech … rather naturally makes us think that there is some stuff or *substance* on which properties can, in a sense, be glued. It encourages us to imagine taking a particle and removing its properties one by one until we are left with a featureless 'thing' devoid of properties, made from the essential material that had the properties in the first place. Philosophers have been debating the correctness of such arguments for a long time. Now, it seems, experimental science has come along and shown that, at least at the quantum level, the objects we study have no substance to them independent of their properties.[95]

Because there is no substantiality within quantum field theory the term 'particle' is dropped and the term 'quanta' is used, and these are 'objects which have properties but not substances'.[96] As the quantum field is the ultimate level of analysis we must therefore conclude that the ultimate sphere of reality *is* 'empty' of substantiality.

So what kind of 'stuff' is the quantum field made of? As we know Zurek has used the term 'epiontic' in this context indicating that quantum states, and therefore by implication the quantum fields which underlies these states have "an epistemological and ontological role". But when we put this together with the understanding given to us by Zeh, and others, that *ultimately* "there are no particles" we must take the epistemological role as primary. A fundamental feature of quantum field theory is that fields are said to capable of creating and destroying quantum states; mathematically this is represented by creation and destruction operators. Zurek indicates that the classical realm emerges because of 'correlations' or 'registrations' between quantum states. In his article *The Computational Universe* Seth Lloyd indicates that the universe computes itself by 'registering itself'[97] and this process must begin long before life gets on the scene:

> Life is not the original information processing revolution. The very first information processing revolution, from which all other revolutions stem, began with the universe itself. … The big bang was a bit bang. Starting from its very earliest moments, every piece of the universe was processing information. The universe computes. It is this ongoing computation of the universe itself that gave rise naturally to subsequent information-processing revolutions such as life, sex, brains, language…[98]

And of course a crucial element missed out in Lloyd's list is embodied consciousness, as life arose so did the ascent towards ever greater degrees of conscious-awareness embodied within increasingly complex organisms.

According to Stephen Hawking and Leonard Mlodinow in their book *The Grand Design: New Answers to the Ultimate Questions of Life*:

> We are the product of quantum fluctuations in the very early universe. [99]

The big bang was the first cascade of 'creation operations' within the pre-existing quantum field of potentiality which eventually gave rise to the current universe. And as this quantum field, with its necessary internal 'amplificatory' function, gives rise to the apparent world of materiality as well as the qualitative aspect of awareness or consciousness which is embodied within sentient beings, it is necessarily the kind of epiontic 'dream-stuff' which is capable of somehow creating both the apparent world of materiality and the embodied consciousness with sentient creatures inhabiting the apparent world of materiality.

> The quantum field contains information about the whole environment and about the whole past, which regulates the present activity of the electron in much the same way that information about the whole past and our whole environment regulates our own activity as human beings, through consciousness.[100]

This field of potentiality is posited as being the common ground of the dualistic realm of subject-object experience, the experiential poles of dualistic mind and matter. And, as we have seen, Bohm indicates that this foundational quantum realm has an aspect of consciousness. Hawking and Mlodinow also indicate the crucial epiontic role that consciousness plays in the development of the universe:

> Quantum physics tells us that no matter how thorough our observation of the present, the (unobserved) past, like the future, is indefinite and exists only as a spectrum of possibilities. The universe, according to quantum physics, has no single past, or history. The fact that the past takes no definite form means that observations you make on a system in the present affect its past.[101]

As did Wheeler:

> The coming explosion of life opens the door to an all encompassing role for observer-participancy: to build, in time to come, no minor part of what we call its past – our past, present and future – but this whole vast world.[102]

The creative role of consciousness, then, seems to spread out in all temporal directions, operating through the quantum realm to 'materialize' reality from its quantum origins:

> The universe is a self excited circuit. As it expands, cools and develops, it gives rise to observer-participancy. Observer-participancy in turn gives what we call tangible reality to the universe … Of all the strange features of the universe, none are stranger than these: time is transcended, laws are mutable, and observer participancy matters.[103]

But whilst it appears that, as Wheeler, Hawking, Mlodinow, Stapp and many others indicate in various ways, "observer participancy matters" and in fact observer participancy appears to create the appearance of matter, this is not the entire story because it also appears that the universe must have been epiontically 'registering itself', 'observing itself', 'computing itself' etc. long before sentient beings came into being. The universe is around 14 billion years old and life has been explicitly within in for just over three billion. It would seem then that we would have to say that the evolution of the universe is the result of a deep level of non-individuated consciousness acting within the quantum field of potentiality. How else could the universe register, compute or observe itself?

This view is a kind of quantum pan-experientialism based on the implication that the entire edifice of the so-called 'classical' world of dualistic experience ripples up from a quantum ground through a multitude of resonant levels of quantum functioning, all driven by the creative function of the universal inner cognitive functioning which is an innate aspect of the quantum realm. Such a view is clearly consistent, in fact even required by Zurek's 'epiontic' 'Quantum Darwinism':

> … the appearance of the classical reality can be viewed as the result of the emergence of the preferred states from within the quantum substrate through the Darwinian paradigm, once the survival of the fittest quantum states and selective proliferation of the information about them throughout the universe are properly taken into account.[104]

The insight that Zurek has given is that 'states that exist are the states that persist' and this is a persistence within a quantum realm which consists of, as Zurek puts it, 'the dream stuff which reality is made of'[105]; and the mechanism that underlies this persistence is 'an objective consequence of the relationship between the state of the observer and the rest of the universe'[106]. But prior to the evolution of such observers the universe is clearly epiontically creating the conditions and paving the way for the emergence of such high level observers. As we shall see

the mechanism which underlies this process is the quantum amplificatory Zeno effect, which is the implied quantum fact that the more often a particular quantum state is observed, or 'registered', to be a particular way the more likely it is to be observed in the same way in the future. Zurek describes his view as follows:

> The main idea of quantum Darwinism is that we almost never do any direct measurement on anything … the environment acts as a witness, or as a communication channel. … It is like a big advertising billboard, which floats multiple copies of the information about our universe all over the place.[107]

But what he does not seem to home in on is the amplificatory aspect. The quantum advertising campaign for the classical world get more solidified the more it is bought into.

The Quantum Amplificatory Zeno Effect is an extension of the accepted quantum Zeno effect which must be operational at the dream quantum level in order to account for the emergence of Zurek's 'preferred states' from the potentiality of the quantum field. In his discussion of the "axioms that provide a textbook summary of quantum foundations" Zurek list the first two as follows:

1) The state of a quantum system is represented by a vector in its Hilbert space.
2) The evolution of the vector is unitary as generated by the Schrödinger equation.
3) Immediate repetition of a measurement yields the same result.
4) The measurement outcome is one of the orthonormal states – eigenstates of the measured observable.

As Zurek points out it is the incompatibility of the first two with the second two which constitutes the "measurement problem", how many quantum alternatives 'collapse', apparently in interaction with consciousness (or a classical measuring apparatus), into one actuality. Of course Zurek considers that he has at least partially solved this problem with the notion of einselection (environment induced superselection):

> …einselection is caused by the transfer information about selected observables. Hence, the ontological features of the state vectors - objective existence of the einselected states - is acquired through the epistemological "information transfer".[108]

It is this 'objective' information transfer' which Zurek suggests takes place independently of observing consciousnesses. This seems to be the case. However, as we have seen this does not rid the universe of some deeper level of consciousness to epiontically produce the preferred states which are imprinted into the quantum "advertising billboard" which is responsible for doing the einselecting. It is this deeper level on non-individualized consciousness which eventually becomes embodied to various degrees in sentient beings. It is no surprise therefore that the manner in which the consciousnesses of human beings appear to interact with the quantum level of potentiality within quantum experiments at the micro level gives a clue to the way in which the "advertising billboard" of the quantum matrix of the classical world came into being.

The clue to this mechanism lies in the third quantum axiom, which is the quantum fact that immediate repetition of a measurement yields the same result. This is called the quantum Zeno effect. Given a superposition expressed in some basis:

$$|\Psi> = P_1|b_1> \text{ x } P_2|b_2> \text{ x } P_3|b_3> \ldots \text{ x } P_n|b_n> \ldots$$

When a measurement is performed this will 'collapse' into one of the eigenstates with and all the other possibilities disappear. At the exact moment of collapse the state will be:

$|\Psi> = P_x|b_x>$ where $P_x = 1$ and $|b_x>$ is the resulting eigenstate.

As time progresses this state will smear out into a spread of possibilities but if measured again immediately the same result will be obtained precisely because the probability is one. Thus quickly repeated measurements can pin a quantum state. There is also an inverse Zeno effect which was originally proposed by Aharonov and Vardi who showed that, by performing a dense sequence of measurements along a presumed path, a quantum system can be forced to follow an arbitrarily chosen path. Johnjoe Mcfadden has proposed that the inverse quantum effect may be a crucial factor in the evolutionary process:

> Both the quantum Zeno effect and the inverse Zeno effect are really aspects of the same phenomenon: the ability of quantum measurement to interact with, and *shape* the dynamics of a system. The special relationship between quantum objects and quantum measuring devices draws out classical reality from the quantum world. If you will allow me one last analogy, the process may be compared with the kind of Improvisation Theatre pioneered by the American artist Viola Spolin in the 1930's. Spolin's revolutionary approach to the theatre was to throw away the script. Instead the actors would respond to the reactions and prompting of the audience by improvising the ensuing action. At the start of each performance the improvised play can be said to be *indeterminate* in the same way that the word 'note' is indeterminate. The play has certain potentialities dependent on the set of characters present, but no defined plot. With no audience present, we could imagine a *quantum play* in which all possible plots were acted out as a quantum superposition. However, in a real performance, the interaction between the actors and their audience *draws out* the course of action, the plot for that night's performance. Just as the audience of an improvised play *draws out* from the infinity of possible plots, a single reality for each live performance, so measurement of a quantum system *draws out* from the quantum superposition of all possible states, a single reality for the physical world. As Niels Bohr said, '*one must never forget that in the drama of existence we are ourselves both actors and spectators*'. [109]

And if Hawking and Mlodinow are correct in their participatory account of the way the universe evolves:

> In this view, the universe appeared spontaneously, starting off in every possible way. Most of these correspond to other universes …. Some people make a great mystery of this idea, sometimes called the multiverse concept, but these are just different expressions of the Feynman sum over histories. … The histories that contribute to the Feynman sum don't have an independent existence, but depend on what is being measured. We create history by our observations, rather than history creating us.[110]

The actual spread of probabilities must change over time in an excruciatingly slow evolution of potentialities over vast time periods. There is no other way to account for the evolution of a universe, perhaps even involving quantum processes spanning successive universes. Repeated 'registrations', 'interactions', correlations' 'observations' within quantum dream stuff must make the potentiality for the same quantum possibility increase to an unimaginably tiny extent,

and over vast time periods this mechanism builds up the quantum "advertising billboard" of classical reality.

This is actually exactly the mechanism proposed by the Chittamatra-Yogachara or Mind-Only Buddhist metaphysics:

> The minds of beings accumulate individual karmas, and these account for the variety of animate life. The mind is thus the principle factor. In addition, there is the common karma that individual minds share and that brings forth different inanimate environments…[111]

It is the collective karma, actions, or reinforced perceptions, which produces a shared world of experience which is embodied in potential form in the alayavijnana, which clearly has a resemblance to the 'objective' wave-function. In his commentary *Transcending Ego: Distinguishing Consciousness from Wisdom* Khenchen Thrangu Rinpoche explains the fundamental karmic operation of consciousness as follows:

> The ground consciousness is the foundation and location for mind because all karmic latencies are stored in the ground consciousness. A momentary visual consciousness instantly ceases (when the next instant appears). Similarly, a mental consciousness is created and ceases instantly; sometimes a mental consciousness does not appear at all. However, the latencies for the arising of these consciousnesses are contained within the ground consciousness. Thus we can remember a visual perception that occurred in the past; and remembering it, strengthens the latency.[112]

According to the Chittamatra-Yogachara view a fundamental feature of consciousness is that even the tiniest movement of energy within the structure of consciousness leaves a trace within the ground consciousness *which increases the probability that the same movement of energy will occur at a later point in time*. This reinforcing process takes place at all levels of consciousness, including those deep structures of psychophysical embodiment not available to direct awareness. This mechanism, described by Chittamatra-Yogachara Buddhist philosophy, is exactly the quantum mechanism which produces the probability distribution within wavefunctions; the repeated quantum activity of perception, a mechanism which is clearly indicated by the collapse of the wavefunction, a mechanism through which meaning is 'injected' into the universe. According to this perspective the more often a perception of the appearance of materiality is made, the more potent becomes the advertising billboard campaign, or the environmental template, or matrix, for that perception of material reality to occur again at some future point. Stapp has made a similar point in the following way:

> Each subjective experience injects one bit of information into this objective store of information which then specifies … the relative probabilities for various possible future subjective experiences to occur.[113]

This is the fundamental mechanism of the self-creation of the universe from a deep level of non-individuated consciousness or nondual awareness, a mechanism which eventually becomes embodied within the collective and individual, conscious and unconscious activities of all sentient beings:

> …since beginningless time we have been perceiving sights, sounds, smells, tastes and bodily sensations and these perceptions have been creating imprints or latencies in the ground consciousness. Habituation of having experienced a certain visual form will create a latency for that very form. Eventually, that latency will manifest from the ground consciousness as a visual form again, but it will be perceived as external to ourselves.[114]

In this understanding of the process of reality all sentient beings have a collective and individual, although the individual contribution is vanishing tiny, impact upon the future potentialities and probabilities which are latent within the quantum pool of future potentiality. Thus it is the *collective* entanglement of sentient quantum intentionality, interacting with quantum potentiality which has the most significant determining influence upon deep aspects of the manifestation of quantum reality into the experiential worlds of the sentient inhabitants of a universe (here we are leaving the issue of the existence of a multiverse open).

According to Hawking and Mlodinow (and Wheeler, Stapp etc.) it is this collective determining quantum mechanism which underlies the appearance of the material world. Thus one of the central chapters in *The Grand Design* is entitled 'Choosing Our Universe':

> The histories that contribute to the Feynman sum don't have an independent existence, but depend on what is being measured. We create history by our observations, rather than history creating us.[115]

In other words the observers, or what Wheeler called 'observer-participants,' are able to weed out possible universes, and thereby select those which remain in the possibility mix, even backwards in time.

> The idea that the universe does not have a unique observer-independent history might seem to conflict with certain facts that we know. There might be one history in which the moon is made of Roquefort cheese. But we have observed that the moon is not made of cheese, which is bad news for mice. Hence histories in which the moon is not made of cheese do not contribute to the current state of our universe, though they might contribute to others. This might sound like science fiction but it isn't.[116]

And this understanding of the formation of the fabric of the universe is clearly articulated within Buddhist metaphysics. As the Dalai Lama has pointed out:

> From a Buddhist point a view, the karma of all sentient beings that inhabit the universe plays a role in shaping the formation of the universe.[117]

'Karma' simply means actions which leave traces for future potentialities and even simple perceptions are karmic actions. Thrangu Rinpoche has indicated this:

> The entire world was created through latent karmic imprints. When these imprints developed and increased, they formed the earth, the stones, and the seas. Everything was created through the development or propagation of these latent karmic potentials.[118]

These 'latent karmic potentials' correspond to Zurek's 'advertising billborad'. They are the 'congealed' resonance of the infinity of epiontic perceptions and actions of vast numbers of sentient beings over an incomprehensible span of time. It is this feature which explains Zurek's observation that whilst the *ultimate* evidence, evidence which is derived from experimentation at

the micro level, indicates that it must be consciousness that is responsible for the selection of a quantum alternative, decoherence provides a kind of objectivity which is independent of consciousness. A deeper analysis of the situation, however, shows that, whilst the apparently independent and material world is independent of individual consciousnesses, it cannot be entirely self contained on an ultimate level.

It would seem then that the entire epiontic process of the evolution of reality is geared towards the production of ever greater levels of sentient awareness and the material world is an 'advertising billboard' for a realm of solidity amidst the 'unreal' 'dream stuff' of the quantum realm within which individualized consciousness can grow to fruition. And the reason that the apparent solidity of the apparently material universe comes into being is because the universe is nothing more than an enormous and multitudinous ultimately *immaterial* epiontic information exchange which takes place within the quantum 'dream stuff is made of'. Zurek says that "the ontological features of the state vectors - objective existence of the einselected states - is acquired through the epistemological "information transfer".[119] A crucial aspect of this process is the way in which there is an appearance of 'objectivity' between observers within the emergence of the classical realm. As Zurek points out if one focuses on the situation of an individual observer 'collapsing' a quantum soup of potentiality into actuality:

> …one can make a persuasive case that such states are subjective, and that quantum state vectors are merely records of the observer's knowledge about the state of a fragment of the universe …. However, einselection is capable of converting such malleable and "unreal" quantum states into solid elements of reality.[120]

So here we have Zurek's answer to Penrose's question as to how "unreal" quantum events can produce reality. It is through the process of 'einselection'.

But what exactly is 'einselection'. This is where the 'Darwinism' is brought into the quantum realm. Classical reality 'emerges' "through the Darwinian paradigm, once the survival of the fittest quantum states and selective proliferation of the information about them throughout the universe are properly taken into account."[121] But analysis indicates that the reality which emerges is not the kind of substantial and completely independent reality mistakenly relied upon by classical physicists. This is precisely because the 'information exchange" which underlies the appearance of an apparently 'objective' world is a result of a vast multitude of acts of epiontic non-individuated and then individuated and collective consciousnesses which have their ground in a deep pool of 'empty' potentiality and innate quantum perceptual and cognitive functioning. It is this innate quantum epiontic cognitive function, which is an internal quantum functionality indicated at the micro level by the 'collapse of the wavefunction', which underlies the macroscopic evolutionary appearance of individuated sentient beings.

In this process the apparently 'material' and 'objective' world serves as a container for a deep level of consciousness to individuate into. Buddhist philosophers clearly knew this. The material aspect of reality is ultimately an illusion lacking any inherently and independently existing essence, which is why the eleventh century Buddhist adept Dromtonpa declared:

> Now I shall cast to the winds concepts of solid objects with mass.[122]

This assertion prefigured Planck's later observation that 'There is no matter as such'[123] by eight hundred years. And it is salutary to remember that in the early phase of his scientific career Planck thought that 'matter' was the solid, continuous and independent material 'stuff' of reality, whereas at the end of his quantum investigation of the matter of the stuff of reality he came to the conclusion that:

> I regard consciousness as fundamental. I regard matter as derivative from consciousness.[124]

And it is because *ultimately* the appearance of the classical and material world is derivative from the epiontic functioning of a universal pool of potentiality. And, because this pool of potentiality has an inner nature of consciousness and *ultimately* depends on consciousness, it only has what Bernard d'Espagnat terms in his book *Veiled Reality* 'weak objectivity'. In his discussion of Zurek's proposals d'Espagnat says:

> …it attributes the fact that some systems exhibit features we call classical not to actual properties that these systems would 'inherently possess' (as would classical physics) but just that the systems in question unavoidable interact with their environment…[125]

In his notion of 'weak objectivity' d'Espagnat seeks to encompass both the subjective and objective aspects of the quantum situation. So, whilst he clearly acknowledges the subjective element of quantum theory, he also emphasizes the objective:'

> We sometimes build up quite beautifully rational theories that experiments falsify. Something says no. This something cannot be just "us". There must be something else than just "us".[126]

In this he anticipated aspects of Zurek's viewpoint and the kind of objectivity which obtains within the quantum situation he therefore called 'weak objectivity':

> All statements in physics are, of course, objective. But this assertion is, to some extent, deceptive for, … there are two distinct types of objectivity, *strong* and *weak* objectivity. Strongly objective statements are those that a conventional realist can (and therefore would) interpret as bearing on reality - as describing *as they really are* some features of an external reality, the existence of which - this the conventional realist takes for granted – is independent of our existence and knowledge. … some of the axioms of standard quantum mechanics … are not strongly objective. They refer in a basic way, for example, to "measurements" – to the very *notion* of measurement, irrespective of who actually performs the operation. Should such statements be viewed as "subjective"? No, since they are valid for everybody. So we have there a category of statements that are neither strongly objective nor merely subjective. These are the statements we called *weakly objective*…

Thus d'Espagnat's notion of 'weak objectivity' describes an objectivity which derives from subjectivity and thereby has an ontological status somewhere between the two. And the same is exactly true of Zurek's 'weak' objectivity. This is at least implicit in Zurek's metaphysical balancing act between the extremes of the Copenhagen and Many Worlds view:

> Two alternatives are usually listed as the only conceivable answers. The possibility that the state vector is purely epistemological (that is, solely a record of the observer's knowledge) is often associated with the Copenhagen Interpretation (Bohr 1928). The

> trouble with this view is that there is no unified description of the Universe as a whole: The classical domain of the Universe is a necessary pre-requisite, so both classical and quantum theory are necessary and the border between them is, at best, ill-defined. The alternative is to regard the state vector as an ontological entity-as a solid description of the state of the Universe akin to the classical states. But in this case (favored by the supporters of Everett's Many Worlds Interpretation), everything consistent with the universal state vector needs to be regarded as equally "real." The view that seems to be emerging from the theory of decoherence is in some sense somewhere in between these two extremes. Quantum state vectors can be real, but only when the superposition principle - a cornerstone of quantum behavior - is "turned off" by einselection.[127]

But the 'reality' given to us through the 'turning off 'of the superposition principle only produces a weakly objective reality of which the *ultimate* source, whilst not traceable to the 'elusive' consciousnesses of individual sentient beings, is clearly located within a more universal pool of consciousness. Whilst it may be true that the notion of human beings firing beams of quantum intentionality and thus 'collapsing' wavefunctions in the mode of Wigner or London and Bauer is mistaken, this does not invalidate the ultimate evidence.

Wheeler indicated the process of the 'epiontic' generation of the apparently material world with his adage 'It from bit' by which he referred to the view that the 'its' of the material world emerge from the perceptual 'bits' of quantum epiontic information. Anton Zeilinger says of this perspective:

> …it may very well be said that information is the irreducible kernel from which everything else flows. … It might even be fair to observe that the concept that information is fundamental is very old knowledge of humanity, witness for example the beginning of gospel according to John: "In the beginning was the Word".[128]

This view, however, also requires that there must be some cognitive function internal to quantum reality in order to understand, and unravel, the 'Word.' In this context it is worth considering Dieter Zeh's remark that:

> However you turn it: *In the beginning was the wave function*.[129]

But according to the theory of the wavefunction of the universe, developed by Wheeler and DeWitt, time is frozen. The wavefunction of the universe contains all the possibilities which are potential within the universe but time is not an aspect of this description. So:

> Thus we see that without introducing an observer, we have a dead universe, which does not evolve in time. This example demonstrates an unusually important role played by the concept of an observer in quantum cosmology. John Wheeler underscored the complexity of the situation, replacing the word *observer* by the word *participant*, and introducing such terms as a 'self-observing universe'[130]

Thus we see that 'self-observation', or 'self-awareness' must be also an intrinsic aspect of quantum reality. For how otherwise could derivative sentient beings have any form of self-awareness? This fundamental perspective seems to be endorsed by Zeh when he lyrically characterises the scenario by quoting the Greek philosopher Anaxagoras:

> The things that are in a single world are not parted from one another, not cut away with an axe, neither the warm from the cold nor the cold from the warm. When Mind began to set things in motion, separation took place from each thing that was being moved, and all that Mind moved was separated.[131]

It requires the movement of 'Mind' to start the process of internal separation of potentialities within the universal wavefunction. Such considerations have led Henry Stapp to speculate in a quantum theological direction:

> This situation is concordant with the idea of a powerful God that creates the universe and its laws to get things started, but then bequeaths part of this power to beings created in his own image, at least with regard to their power to make physically efficacious decisions on the basis of reasons and evaluations.[132]

Such notions of a quantum transcendent God may be concordant, but they also certainly go quite a way beyond the evidence.

However current quantum theory is entirely consistent which Buddhist metaphysics which, stated in the Buddhist Dzogchen idiom, asserts that the process of reality is an 'empty' appearance within a field of Mindnature potentiality. Such a view accords well with Max Planck's quantum conclusion that:

> All matter originates and exists only by virtue of a force... We must assume behind this force the existence of a conscious and intelligent Mind. This Mind is the matrix of all matter.[133]

Buddhist writer Herbert V, Guenther, in his book on Dzogchen metaphysics *The Matrix of Mystery* describes the beginning phases of the evolution of the manifested and materialized world of dualistic experience from the 'evolutionary zero point' according to the Dzogchen worldview as follows:

> It is excitatory intelligence that provides the necessary programming information for initiating a dramatic unfolding process (the big bang) tending towards ever greater degrees of complexity (the evolving universe) while simultaneously, throughout all its phases, retaining the intelligence that initiated the process. When this big bang occurs, the surging of intelligence-qua-isotropic radiation develops a special envelop-like structuring of radiation field…The unitary process as an envelope-like structure which results from this surging of intelligence is termed the meaning-saturated field as pristine cognitiveness. [134]

Thus we are returned, within a Buddhist context, to Wheeler's vision of the universe as a 'self-synthesized' universe, or the Dzogchen 'self-excitatory universe', which comes into being through an infinite web of internal self-perceptions. In order for the universe to 'unfold' from its state of potentiality the ground state must contain both the potentialities and the mechanisms of cognitive ', or 'epiontic', unfoldment within its own nature:

> In Dzogchen thought there is the additional factor of intelligence which inheres in the very dynamics of the universe itself, and which makes primordiality of experience of paramount importance. The atemporal onset of this unfoldment occasions the emergence of various intentional structures…[135]

John Wheeler summarized his talk on 'Thoughts on the Origin of Spacetime' as follows:

> In what medium does spacetime itself live and move and have its being? Is there any other answer than to say that consciousness brings all of creation into being, as surely as spacetime and matter brought conscious life into being? Is all this great world that we see around us a work of imagination?[136]

The following account is from physicist David Bohm:

> We can say that human meanings make a contribution to the cosmos, but we can also say that the cosmos may be ordered according to a kind of 'objective' meaning. New meanings may emerge in this over all order. That is we may say that meaning penetrates the cosmos, or even what is beyond the cosmos. For example there are current theories in physics that imply that the universe emerged from the 'big bang'. In the earliest phase there were no electrons, protons, neutrons, or other basic structures. None of the laws that we know would have had any meaning. Even space and time in their present well-defined form would have had no meaning. All of this emerged from a very different state of affairs. The proposal is that, as happens with human beings, this emergence included the creative unfoldment of generalized meaning. [137]

And compare such quantum conclusions to Buddhist metaphysics, in this case Dzogchen:

> …intelligence … is inherent in the process of Being's auto-projective coming-into-presence as its own actuality. Intelligence, as here understood, is never an after-thought, nor a by-product of random motions of matter. [138]

It is quite clear that Buddhist philosophers for at least the past two thousand years have had a pretty good grasp of the metaphysical implications of quantum theory, whilst, of course, not knowing the detailed theory as currently understood within physics. Dr.OntoEpic, on the other hand, seems to know very little about the metaphysical implications of the latest quantum paradigms. Speaking in April 2003 to the American Physical Society John Wheeler, one of Zurek's mentors, made the following remarkable; perhaps one might say 'mystical', sequence of remarks:,

> The Question is what is the Question?
> Is it all a Magic Show?
> Is Reality an Illusion?
> What is the framework of the Machine?
> Darwin's Puzzle: Natural Selection?
> Where does Space-Time come from?
> Is there any answer except that it comes from consciousness?
> What is Out There?
> T'is Ourselves?
> Or, is IT all just a Magic Show?[139]

To Wheeler's question as to the possibility that reality might be an illusory 'Magic Show' Buddhist philosophy answers in the affirmative:

> Phenomena as they appear and resound
> Are neither established or real in these ways,
> Since they keep changing in all possible and various manners

Just like appearances in magical illusions.[140]

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