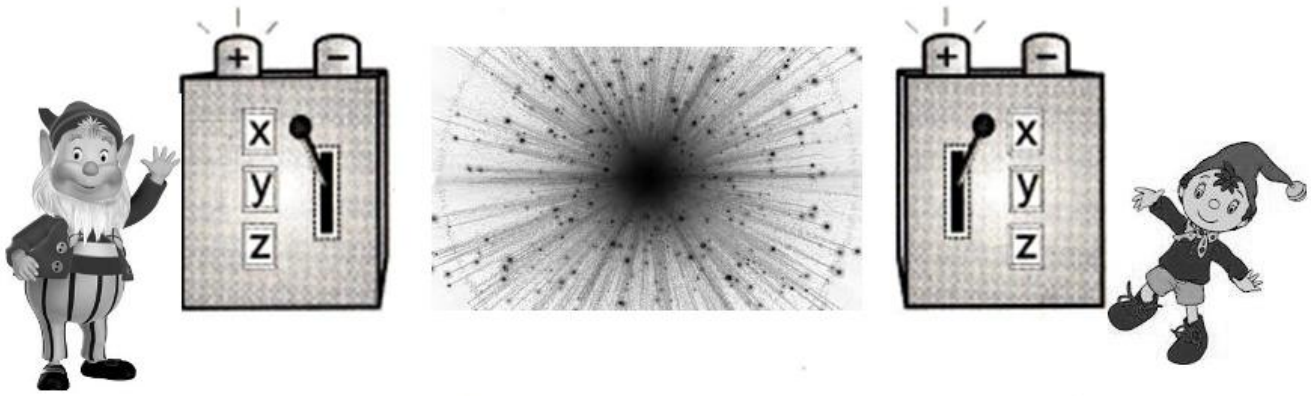
Article

The Matter of Mindnature:

Bell's Theorem Tolls for Dogmatic 'Middle Way' Scepticism and Rings Out for 'Experimental Metaphysics' and 'Quantum Mindnature'



Graham P. Smetham*

* Correspondence: Graham Smetham, http://www.quantumbuddhism.com E-mail:graham@quantumbuddhism.com

Like the waves of the ocean, set in motion under windy conditions,
Arising like a dance – and there is no interruption –
The stream of basic Mindnature is in a similar manner set
Constantly in motion by the wind of cognitive objects
And the varied waves of consciousness arise as in a dance.[1]

Abstract

In recent years there has developed a movement in the West which seeks to convince people that the original teachings of the Buddha were far more mundane than his later followers would have us believe. An extreme recent example of this is the book *The Trouble with Buddhism* in which Dr. Robert Ellis claims that every Buddhist who has ever lived has been 'scandalously" confused about the central doctrines of Buddhism, especially the 'Middle Way' philosophy, which is a central teaching of all Buddhist schools. He also claims that if one takes Humean scepticism 'seriously', as he thinks one should do, it follows that it is impossible to know anything with any certainty. Metaphysics therefore become a 'foolish' dream. In fact according to Ellis it is "foolish" to think that quantum physics supplies "evidence about the universe itself." This article considers Ellis's claims regarding metaphysics and physics in detail, particularly focusing on the implications of the quantum violation of Bell's theorem, in order to show that we must be sceptical of extreme scepticism.

Keywords: Metaphysics, 'Reality', scepticism, dogmatism, Buddhist philosophy, Bell's theorem, quantum non-locality, Madhyamaka, the 'Middle Way,' Hume, Popper, Kuhn, Feyerabend, Nagarjuna, Dzogchen, Matter, Mindnature.

In his book *The Trouble with Buddhism* Dr. Robert Ellis makes some startling and controversial assertions. According to Ellis every Buddhist who has ever lived, including perhaps the Buddha, he is not clear on this point, has been "scandalously" confused about the central doctrines of Buddhism, especially the 'Middle Way' philosophy, and he also opines that it is "foolish" to think that quantum physics supplies "evidence about the universe itself." Quantum physics, Ellis tells us:

> …may cast doubt on some previously held views about material reality, but does not tell us anything at all about Reality.[2]

So it would appear that, according to Ellis 'material reality' is not part of, or indicative in any way of the nature of, 'Reality'. In this article, along with parts of my other articles in this issue which elucidate aspects of Buddhist metaphysics in detail, I shall investigate this and related issues in order to determine where the f-word really applies.

In his outline of the philosophical scepticism which is supposed to underlie Ellis's personal version of the 'Middle Way' philosophy, which he seems to consider to have been misunderstood by, perhaps, the Buddha and, definitely, all subsequent Buddhists, he tells us that "the insights of classical scepticism as to the limitations of our knowledge are important ones, shared with Hindu and Buddhist thought, and stimulating much later Western philosophy by issuing a profound challenge to it."[3] Indeed it is precisely because a lot of philosophical moves that Ellis employs are derived from a distorted understanding of Buddhist philosophy that his thought provides a strange territory for a Buddhist philosopher, like looking at a beautiful landscape through a monstrously distorting lens.

The thoroughgoing scepticism required by his version of the Middle Way', he says, is based on arguments like the following:

- As finite beings occupying a limited point in space, the information that we have access to is always necessarily limited.
- Given our limited mental capacities, it is unlikely that the concepts we form are capable of accurate representation of reality.
- Our senses are limited in what they can detect (for example, we only see objects that reflect light between certain wavelengths), so we cannot gain true perceptions of objects through the senses, since we might be missing crucial features.
- Given evidence and arguments for one belief, alternative evidence and arguments that appear to support opposing beliefs can always be found.
- Our conceptual frameworks for understanding the world are limited by our cultural and linguistic background.
- No conclusive proof can be offered that one's current experience (or any given past experience) is not illusory. You may be dreaming at this moment.
- Given how often we have made mistakes in the past and had to alter our beliefs, it seems likely that we will make more mistakes and have to alter them again. At least some of our current beliefs thus seem likely to be mistaken, and we do not know in advance which ones.[4]

On the basis of taking such arguments 'seriously' Ellis tells us we must reach a thoroughgoing 'agnostic scepticism' rather than a 'negative metaphysics'; and his form of 'agnostic scepticism' is indeed radical:

> Agnosticism is the recognition that we don't know, and it can be applied to every possible belief. For beliefs about things that lie *beyond* our experience we can have no evidence, and thus it is clear that we cannot know about them. For beliefs about things that lie *within* experience there is still plenty of room for doubt, because any assertions we make on the basis of our experience are limited in their justification by the limitations of our senses, the limitations of our viewpoint, and the limitations of our prior assumptions and categories for interpreting our experience. … Agnosticism is thus the most balanced and rational response to the lack of total justification for our beliefs: we may not know anything, and we cannot and should not affirm either that we know or that we do not know.[5]

Remarkably however, as anyone who goes on to Dr. Ellis's website, moralobjectivity.net, will quickly see, he seems to think that he 'knows' quite a lot. Even though Ellis suggests we must extend radical doubt to that which lies both *beyond* experience and *within* experience, which is pretty much every possible kind of experience and non-experience, he at the same time claims that *he knows* that:

> … we may not know anything, and we cannot and should not affirm either that we know or that we do not know.[6]

But, immediately, we know that he cannot know this; for how can anyone know that there is no possibility of that very knowing without undermining the very possibility of knowing the lack of knowing? According to Ellis the term 'knowing' as used in Western analytic philosophy employs a 'conventional account of 'knowledge',' which simply uses the term in a 'weakened' sense' which "distracts our attention from the extent of our ignorance", and because of this we need to maintain a strong definition of knowledge so "that we can fully appreciate that we may know nothing."[7]

So obviously we need to know Ellis's "strong" definition of knowledge. However it seems that we are not given a direct definition (not on his 'concepts' page anyhow); his implied definition is lumped in with his discussion of 'metaphysical agnosticism' a term which means that we cannot 'know' anything, which also means that we should not be able to 'know' that 'metaphysical agnosticism' is the correct way of 'knowing.' But according to Ellis, although we cannot 'know' anything, what we can have is 'incremental' 'justifications'. 'Justification' says Ellis, is 'incremental' whereas, according to him, 'knowledge' is all or nothing, we either know the absolute reality of something or we do not. This is an important point, for if one uses or understands the term 'knowledge', as most people do, on a sliding scale depending upon context, one runs into problems with Ellis for whom knowledge seems to be all or nothing:

> Agnosticism does not remove the possibility of justification from our beliefs, because justification, unlike knowledge, is an incremental term which can be calibrated in relation to experience. Justification depends on the extent to which we have removed the conditions of ignorance which prevent us from assessing our experience objectively. The conditions of ignorance include the assumptions either that we "know", or that we "don't know" about what we are dealing with, when all we actually have access to is degrees of justification.[8]

This is an important insight which we will return to when we come to consider how physics has come to 'know' various 'metaphysical' things about 'reality' through an 'incremental' process. But for the moment it is important to note that one problem with Ellis's perspective, which is implied by the preceding sentence, is that, at least on the surface, it looks as if what Ellis is doing is simply rearranging language use, replacing the term 'justification' for the term 'knowledge' as used in its weak contextual sense, whilst presenting his philosophy as some radical new discovery, the discovery of the *real* 'Middle Way', as opposed to the incompetent Buddhist version.

Ellis claims that he (almost alone it would seem) practices *the* 'non-dogmatic' true 'Middle Way'. This is his own personal 'discovery' of the true 'Middle Way', which is a central, yet, according to him, misunderstood by Buddhists, notion within the Buddhist tradition. Indeed Ellis's presentation of his 'Middle Way' seems to imply it is a discovered metaphysical entity, like a mathematical truth which was eternally destined to be just the way he describes it. Furthermore, according to Ellis, all Buddhists have and still do misdescribe it.

Thus in a talk given to the men's order of the FWBO (Friends of the Western Buddhist Order) entitled '*The death of metaphysics and the birth of the Middle Way'*, Ellis tells his listeners that "after applying central insights of Buddhism to Western philosophy and other Western thought" he "discovered" results that seemed "radical and important"[9]. And part of his

discovery seems to concern the fact that, as he phrases this insight in his later book *The Trouble with Buddhism*:

> …at the very starting point of Buddhism, there are confusions to clear up. These confusions suggest to me that the Buddhist betrayal of its own insights is no recent phenomenon, but started very early on in its history or was perhaps even there in confusions from the beginning.[10]

So his claim is that all Buddhists, and possibly the Buddha himself (although in email correspondence he has backtracked somewhat from this claim) are desperately confused about the real 'Middle Way'. *His* discovered reformulation, however, provides the *real* philosophical 'Middle Way', and this remedies a 'scandalous' 'betrayal' or 'confusion' within the Buddhist tradition. But, as we shall see, it is the claims made by Ellis concerning the incompetence, intellectual confusion and general weakness of insight on the part of Buddhists which are, indeed, scandalous.

The notion of the 'Middle Way' ('*Madhyamaka*' or sometimes '*Madhyamika*'[11]), is indeed central within Buddhist practice and philosophy. The Buddhist scholar T, R.V. Murti wrote a significant book about it called *The Central Philosophy of Buddhism: A Study of the Madhyamaka*; and in this work Murti clearly considers the Madhyamaka to be a form of metaphysics as he contrasts it with other Indian philosophies of the nature of the absolute, the Buddhist Vijnanavada or Consciousness-Only metaphysics and the Hindu Vedanta:

> In all these systems the absolute is transcendent, totally devoid of empirical determinations .... The Absolute is immanent too, being the reality of appearance. The Absolute is the phenomena in their essential form.[12]

And in his fundamental definition of the approach of the 'middle way' Murti specifically indicates that it is not a form of scepticism:

> The middle path is the avoidance of both the dogmatism of realism (the reality of objects) and the scepticism of Nihilism (the rejection of objects and consciousness both as unreal).[13]

It must be admitted however that Ellis's use of the term 'scepticism' is not the same as Murti's; Ellis's view would seem to be that we cannot assert realism, nihilism or anything else with certainly.

In the earliest Buddhist teachings of the Pali Canon the notion of the Middle Way applied primarily to the manner of practice. The Buddha had spent some time practicing intense ascetic austerities in pursuit of 'enlightenment', which is the direct and unmediated knowledge of the nature of 'Reality.' He eventually decided that it was mistaken to think that extreme mortification of the body was the correct method and therefore, once he had achieved enlightenment (according to traditional Buddhism), he went on to teach a middle course of lifestyle which steered between excessive indulgence and excessive asceticism. The idea was that the body should be kept in a healthy condition in order to provide the basis for meditative practice leading to direct insight into the nature of 'Reality'.

But in the early Pali Canon the notion that the 'middle way' was a metaphysics which avoided metaphysical *extremes* was clearly evident. Thus Ajahn Payutto ('Ajahn' indicates a Theravadin monk of some standing so if Ellis is correct we must brace ourselves for some form of 'betrayal') in his exposition of the 'middle teaching' of the Pali Canon tells us that:

> This Right View is a very balanced kind of view, one which does not tend to extremes. Thus the principle of Dependent Origination is a law which teaches the truth in a median and unbiased way, known as the Middle Teaching. The 'median-ness' of this truth is more clearly understood when it is compared with other teachings … the principle of Dependent Origination differs from these extreme views…[14]

The principle of Dependent Origination and the early doctrine of the 'middle avoiding extremes' is elucidated in detail in another article in this issue (*The 'Epiontic' Dependently Originating Process of Cyclic Existence According to Early Buddhist Metaphysics*). The point necessary for the present is that the 'right view' of the 'middle teaching' of the early Pali Canon avoided extreme views of many kinds, but one central pair of extreme views highlighted are those of absolute 'existence' and absolute 'non-existence'. This teaching became central within Buddhist Madhyamaka philosophy after the remarkable philosophical work of the second century C.E. Buddhist philosopher-practitioner, or 'madhyamika' (a practitioner of the Madhyamaka), Nagarjuna. Nagarjuna is considered by the Mahayana tradition to be one of the greatest philosophers of the tradition but according to Ellis's his work "illustrates very well the Buddhist tradition's betrayal of its own insights"[15].

The Madhyamaka emphasized that the ultimate nature of 'Reality', as far as it can be expressed conceptually, lies neither in 'permanence' nor in 'annihilation', it neither 'exists' nor does it 'not exist', in a sense it hovers between the two. Thus, as the Madhyamika Bhavaviveka (1^{st}-2^{nd} century) indicated the character of reality is:

> Neither existent, nor nonexistent
> Nor both existent and nonexistent, nor neither.
> …true reality
> …is free from these four possibilities.[16]

Which is a formulation which anticipates in a remarkable fashion the discoveries of modern quantum theory, for as the eminent quantum physicist Giancarlo Ghirardi, in his book *Sneaking a Look at God's Cards*, clearly indicates, this paradoxical existential configuration lies at the heart of the quantum situation. When describing the existential possibility configuration for a quantum chair, i.e. a chair considered as a quantum object, he writes:

> What meaning can there be in a state that makes it illegitimate to think that our chair is *either* here or in some other place? … only potentialities exist about the location of the chair, potentialities that cannot be realized, unless we carry out a measurement of position? How can it be understood that, attached to these potentialities, is a *nonepistemic* probability that in a subsequent measurement of position the chair will be found here or there (which is equivalent to asserting that, before the measurement was carried out, the chair could be neither here nor there, nor in both places, nor in neither place)?[17]

The (in the original) italicized word 'nonepistemic' is emphasized because the situation of 'hovering' between possibilities of existence is not a matter of our lack of knowledge; it is the ontological condition of the quantum entity. The Buddhist metaphysical employment of the notion of the 'Middle Way' then led them to assert the same metaphysical existential configuration to fundamental 'Reality' as quantum physics.

According to Ellis, however, all such insights concerning the metaphysical nature of reality are deeply mistaken because the 'Middle Way' approach must involve metaphysical agnosticism:

> …all claims to knowledge (or to its absence) are metaphysical, and the Middle Way involves systematic navigation between positive and negative metaphysical claims. The practice of the Middle Way thus begins with agnosticism as an underlying attitude, and is undermined by claims to knowledge of any kind. Instead, the practice of the Middle Way requires the use only of provisional claims.[18]

So, whereas all the great Buddhist practitioners and scholars consider that Bhavaviveka, and his colleague Nagarjuna, were making claims about *both* the nature of conceptuality and the metaphysical nature of 'Reality', Ellis considers the 'Middle Way' is chained to metaphysical 'agnosticism'. Furthermore Ellis identifies any claim to knowledge (or its absence) with metaphysics, which he defines as follows:

> The term 'metaphysics' comes from a Greek word coined by Aristotle, and meaning the study of things beyond the physical world. However, the physical world in itself is beyond our experience - all we have access to is what our senses tell us about what we assume to be the physical world - so the word has been more usefully employed in philosophy to mean the study of things beyond our experience. Traditionally, religions have made claims about 'truths' beyond our experience, known through revelation or intuition. The rationalist tradition in Western philosophy has also made claims about truths beyond experience known through reason. Both of these kinds of claims may be described as metaphysical, and both are rejected in Middle Way philosophy. It is argued in Middle Way philosophy that metaphysical beliefs are beyond any method of non-dogmatic justification.[19]

Ellis's form of 'Middle Way' philosophy, which he admits is derived from the Buddhist version, having from his point of view expunged all the confusions introduced by what he considers to be Buddhists' misunderstanding of their own insights, is supposed to skilfully navigate its way between the dangerous reefs of positive and negative metaphysical claims without making any claims of its own.

Already in this presentation, however, we can detect an immediate 'metaphysical' position which is adopted by Ellis in his supposed derivation of the necessity for avoiding all metaphysics. We are told that "the physical world is beyond our experience." What is this if it is not a metaphysical claim about reality? It is clearly a dualistic metaphysical-ontological claim that "physical world in itself is beyond our experience" - all we have access to, apparently, is what our senses tell us about what we assume to be the physical world." Thus the realm of the "physical", which Ellis seems at this point to identify with 'Reality', is asserted to be dramatically and irrevocably 'beyond" our experiences which are generated by the senses.

Presumably Ellis would agree that sense faculties are themselves "physical" so it seems then, on this view, that there must be some kind of nebulous sphere of experiential 'unreality' which is generated by the physical bits of 'us' interacting with the physical bits of 'Reality' which are 'not-us'. But where does the conclusion that experience is not part of 'Reality' come from? It looks suspiciously like a metaphysical assumption. However such an assumption has no more validity than the assumption that experience itself is physical, and there is nothing beyond the physicality of experience, as cogently argued for by, for instance, Galen Strawson in his essay '*Realistic Monism*'[20].

In this case one might claim as Buddhists do that because experience is part of 'Reality' itself, there is a way of experiencing which gives direct and unmediated access to reality ('enlightenment'). If we take 'Reality' to be a concept which embraces all aspects of experience and anything that lies beyond, if anything does 'lie beyond', then sentient beings, including 'physical' senses and the experiences generated by the senses, are clearly part of 'Reality', so the possibility of direct 'non-conceptual' (as Buddhists refer to this immediate experience) knowledge cannot be ruled out a-priori.

However, in line with the early twentieth century logical positivists, Ellis considers that metaphysics is a kind of nonsense because it, *according to him*, goes beyond the bounds of experience, although how he can possibly know this with absolutely certainty, on the basis of his own presuppositions, is a mystery. For, as we do know, he clearly refers to our need to "fully appreciate that we may know nothing"[21]. In fact, he clearly states (with reference to my own work) that to indulge in metaphysical claims that even science can tell us anything about reality is "foolish":

> …some Buddhists have foolishly pounced on quantum physics as evidence about the universe itself…

The problem with this assertion, of course, is that just about all physicists consider that physics, and quantum physics in particular, provides 'evidence about the universe itself'; although it has to be said that most quantum physicists agree that the nature of the reality revealed by quantum theory is very hard to comprehend. Thus the author of the thousand page exposition of modern physics, *The Road to* ***Reality***, Sir Roger Penrose, who was knighted for his services to science (why didn't someone tell the queen about the extent of his foolishness? – for according to Ellis: "from an epistemological point of view there is no distinction between 'Reality' and 'metaphysics'"[22]) wrote in a previous book:

> 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?[23]

So it is clear that the actual real status of 'Reality', so to speak, is put into a paradoxical configuration by the advent of quantum physics, but the notion that quantum physics bears absolutely no relation to our knowledge of 'reality' would, for Penrose and most other physicists, be an assertion beyond the paradoxical, probably venturing in to the realms of the absurd. Ellis, however, has decreed, on the basis of taking sceptical arguments 'seriously' that we can ignore what physicists have to say on the nature of 'Reality'.

At the outset of his book *Veiled Reality*, however, quantum physicist and philosopher Bernard d'Espagnat indicates that he completely disagrees with the kind of view promulgated by Ellis:

> This whole book centers on the conviction that whoever tries to form an idea of the world – and of man's position within the world – has to take the findings of quantum physics most seriously into account.[24]

In other words for d'Espagnat only someone who has a grasp of quantum physics can possibly say something significant about 'Reality'. Ellis, however, not only admits to knowing very little about quantum theory, he considers that issues concerning whether or not aspects of 'Reality' can be known or not (or neither!) can be known to be not known through armchair philosophizing on the basis of simple and homespun observations; the findings of physics are of absolutely no relevance whatsoever. As we have seen, Ellis considers such a

viewpoint such as that proposed by d'Espagnat to be "foolish"; it is, says Ellis, 'Scientism', which:

> …appeals to science as the basis of our information about facts, treating it as the source of information about 'laws of nature', rather than merely justified theories. By treating the subject matter of science ontologically rather than epistemologically, it encourages a focus on its results rather than its method, and distracts attention from the provisionality of all scientific results whatsoever - a provisionality which can be easily established by basic sceptical arguments.[25]

So here we find that it is what Ellis calls the 'provisionality' of scientific theories upon which he pins his hopes of not knowing anything.

We shall find, however, that his notion of 'provisionality' is hopelessly over played. Quantum physics for instance, has been around for about a hundred years and the fundamental features have not changed, although the details have been dramatically enhanced. Classical Newtonian mechanics still functions adequately within its own domain of application, and when it is tweaked relativistically was used to send human beings to the moon. So just how 'provisional' is such knowledge? To answer this question we will have to briefly survey the work of some of the twentieth century philosophers of science: Karl Popper, Thomas Kuhn, Paul Feyerabend, Abner Shimony and Bernard d'Espagnat. When we do so we shall find that the often reiterated notion that physics in particular is constantly undergoing dramatic and seismic 'revolutions', a notion derived in particular form the work of Kuhn, is a mistaken paradigm.

Ellis's assertion that physics tells us nothing at all about 'Reality' seems particularly out of place in the context of the work of John Bell. The following, which concerns the analysis of the conditions which must apply for the existence of a 'locally' or 'non-locally' causally interconnected 'Reality', is an appreciation of the profound implications of the work of the hugely significant mathematician and quantum physicist John Stewart Bell, for our understanding of the metaphysical nature of reality, by James T. Cushing, who was at the time Professor of Physics at the University of Notre Dame:

> Bell never wrote down a single, local deterministic theory. Rather, he proved, without ever having to consider any dynamical details, that no such theory can in principle exist. The entire class was killed at a stroke - a classic "no-go" theorem. [Further,] Bell's theorem really depends in no way upon quantum mechanics. It refutes a whole category of (essentially) classical theories without ever mentioning quantum mechanics. Abner Shimony has appropriately given the name "experimental metaphysics" to this type of definitive empirical resolution of what appears to be a metaphysical question.[26]

The 'metaphysical' fact that 'Reality' is 'nonlocal', which means that it exhibits a fundamental, immediate and 'mysterious' interconnectedness between distant elements, has been established, to the satisfaction of the community of physicists beyond all "reasonable doubt."[27] Abner Shimony has been described as "one of the most eminent of present day philosophers of science"[28] but is also a physicist so his views on this matter ought, perhaps, to bear a little weight. In his excellent book on the theory and philosophy of quantum physics *Sneaking a Look at God's Cards* Giancarlo Ghirardi writes that Bell's theorem:

> …has been described by experts in the conceptual and philosophical foundations of quantum mechanics as - to use Nobel laureate Josephson's words - the most important

> recent contribution to science: namely, the derivation by John Stewart Bell of his (now) famous inequality. When Bell died so unexpectedly and prematurely at age 62 in October 1990, many of his colleagues spoke of him as the only man of his generation who could be same level as Bohr and Born for his profound understanding of the conceptual implications of the theory. He was referred to as "the man who proved Einstein wrong" (New Scientist, November 24, 1990) …[29]

Indeed, after Bell's work the notion that quantum physics is "experimental metaphysics" has found a deep resonance within the physics community, and, as we shall see, one of the reasons for this is the profound and far-reaching implications of the mathematical inequalities derived by Bell, which were then famously investigated experimentally by Alain Aspect in Paris and subsequently by others to more precise levels of detail, for the possible nature that any 'Reality' can have. A full appreciation of the proof of the non-locality of 'Reality' clearly indicates the mistakenness of Ellis's assertions about physics not being able to tell us anything about 'Reality.' For it shows us that some versions of 'Reality' can be ruled out once and for all.

None of the above considerations, however, will have any impact on Ellis because he thinks that his sceptical arguments show that the insights of physics, however seemingly profound, are irrelevant to knowledge of the ultimate nature of 'Reality'. The crux of his argument is contained in the following snippet from an email correspondence between us:

> We are flesh-and-blood beings, with specific positions in time and space, with limited perceptions and a limited mental capacity to process those perceptions. This is certainly the case with all human beings I have ever observed, and I presume I am not corresponding with a god here! Therefore all our observations are non-absolute. We cannot justify absolute claims from this because we do not have access to observations of the whole universe or knowledge of all conditions. Thus if we make claims that are believed to be always and invariably true, it is extremely likely that we will be making mistakes that do not take into account the enormity of conditions that we have not observed. It seems very odd to have to say this to a scientist. What proportion of the universe have we observed? What proportion of the human brain? A minute proportion, almost infinitesimal. How many previous theories in human history have been proved wrong? The vast majority. How about a bit of scientific humility?

Now on the face of it this seem like quite a reasonable observation which, with appropriate scientific humility, reduces all human beings the same level of insight, all having the same 'limited perceptions and a limited mental capacity to process those perceptions'. However, it only takes a few moments thought to see that it is not true. It is quite clear that there are levels of capacity for insight within the vast expanse of human embodiments, otherwise we would all be on the intellectual level of a Buddha, Einstein, imbeciles or somewhere between these possibilities.

On the other hand, one could say that, even by his own claims as to the necessity for metaphysical agnosticism, we cannot know that his assertions are true. According to certain Buddhist teachings, for instance, there may be fully or partially awakened beings in our midst, for the purposes of this article I can remain quite happily agnostic about this, but the fact remains that just because Ellis tells us that "all human beings I have ever observed" have such limited capacities, does not, by his own assertion, mean it is true. For as *he* says:

> As finite beings occupying a limited point in space, the information that we have access to is always necessarily limited.

But this is clearly a limited observation based on his own limited capacities. He is assuming at the outset that all human beings are as limited as himself, and thereby ruling out the possibility of the existence of techniques for achieving direct metaphysical insight into the ultimate nature of reality at the outset.

Another of his dogmatic epistemological assumptions is that "our conceptual frameworks for understanding the world are limited by our cultural and linguistic background" clearly applies to his own position. The following remarks by Buddhist philosopher Anne Klein are relevant:

> Virtually no contemporary western thinker would take seriously, much less agree with, the notion that conditioned persons can have an experience outside of historical, cultural, psycho-social, and other sets of conditionings. Neither Derrida, Foucault, Lacan, nor those following Kant, for example, would postulate or even seek a resolution between their own positions and the Buddhist claim that there are states of mind unaffected either by personal or cultural histories or by epistemic limitations. Here, the conditioning role of social and personal histories is emphasized in ways that are foreign to Buddhism. From the viewpoint of contemporary theories, Buddhist soteriological theories are but one more example of cultural construction.[30]

But such views concerning the necessary metaphysically limiting fetters of psycho-social and cultural frameworks are, as Klein intimates, themselves part and parcel of a particular, mostly academic, limiting fetter of a Western psycho-social and cultural framework. And if this particular fetter, adopted as an epistemological absolute, were to be incorrect then it would indeed be a 'fetter' which possibly cuts off an avenue to an absolute and unconditioned metaphysical insight.

Ellis's own adoption of this fettering perspective is radical to the point of extremity for he makes the assumption that his own limited perceptions can be used as the basis for, not only the claim that there are, probably in his estimation, no enlightened sentient beings, but also, more baffling, that it is invalid to make *any* claim to metaphysical knowledge, even ones based on the precise and detailed investigations of physics, a claim which can, as we shall do shortly, be refuted by a consideration of Bell's theorem and quantum entanglement.

Ellis rejects the argument that his derivation of 'metaphysical agnosticism' requires an initial metaphysical commitment of his own, he calls his sceptical starting point to be a non-absolute 'general claim':

> This is not an absolute claim, but a general claim based on an observation of the conditions of all human experience.[31]

But the problem with such a 'general claim' is that it treats the observation of the "conditions of all human experience" made by a self-confessed 'being with limited capacities' as being valid and sufficient for clearly establishing an all embracing claim as to what can and cannot be claimed. But the observation is clearly dubious; *the observation is dubious on the basis of the claim based on the observation*. This seems absolutely clear, it is circular and self-defeating.

But this is not the end of Ellis's metaphysical circles of self-immolation. For the observation, that "you cannot make absolute claims based on non-absolute observations" is meant to be

the source of Ellis's claim that it is "foolish" to think that quantum physics can be taken as "evidence about the universe itself." This assertion is based on Ellis's claim that: "we are flesh-and-blood beings, with specific positions in time and space, with limited perceptions and a limited mental capacity to process those perceptions" which he tells us is just a 'general' observation. But, if quantum theory is correct in some sense as a 'real' depiction of reality, then the borderline between the quantum realm and the 'classical' realm of "flesh-and-blood beings," is, according to quantum physicist Erich Joos, a delusion:

> The disturbing dichotomy between quantum and classical notions was only a delusion.[32]

In other words if quantum theory were to be true then Ellis's basis for rejecting quantum theory as relevant for our understanding of reality, "we are flesh-and-blood beings…" and so on would, from an ultimate point of view, be false. Indeed if Gerard 't Hooft and Leonard Susskind's 'holographic universe' proposal were to be true (see Jim Kowell's article in this issue *What is Reality in a Holographic Universe*) then what appears to be "flesh-and-blood beings" would actually be some form of illusion:

> …the theory suggests that the entire universe can be seen as a two dimensional informational information structure "painted" on the cosmological horizon, such that the three dimensions that we observe are only an effective description at macroscopic scales and at low energies.[33]

Of course, such considerations would seem on the face of it to support at least part of Ellis's sceptical position:

> No conclusive proof can be offered that one's current experience (or any given past experience) is not illusory. You may be dreaming at this moment.

And to a degree this is true. However, the essential point is that such seemingly wild notions such as the holographic principle which are based upon the findings of modern physics, which are all part and parcel of quantum physics, do not lead to the radical view that 'knowledge' of 'Reality' is an impossibility and metaphysics a foolish mistake. How could they, for what they indicate is that the 'may' in the above observation by Ellis is unnecessary; Quantum theory shows us that in a very real sense we are 'dreaming at this moment!'

The holographic universe proposal is one metaphysical possibility 'justified', to employ Ellis's preferred terminology, by the scientific method through the experimental evidence and mathematical analysis. It is one metaphysical possibility amongst a infinite number of metaphysical impossibilities, such as, for example, that all the phenomena of the universe are caused by Noddy and Big Ears manipulating wooden levers on the edge of space. One would have thought it quite possible to return a negative evaluation upon this metaphysical suggestion, if anyone were to be so "foolish" as to suggest it! In a sense this extreme example is only slightly extended for irony's sake for there has been a recent not so tongue in cheek suggestion by some physicists that we might all be living in a vast computer simulation organized by aliens. Even physicists have their off days in philosophical mode. One has to bear in mind that if we take Ellis's "serious" acceptance of scepticism seriously then all manner of ridiculous metaphysical possibilities would have to remain in the agnostic box, perhaps even the metaphysical potency of Noddy and BigEars. I suppose Ellis would say we are overwhelmingly and 'incrementally' 'justified' in supposing this not to be true, but there still remains a tiny possibility that it might be true!

The 'metaphysical' suggestions based upon the evidence of physics are those which are entirely coherent with our experience as revealed within 'physical' experiments. This is the case because 'experience' is embedded within 'Reality' and not banished outside of it; and there are 'metaphysical' suggestions, the existence of Cartesian type 'matter' for example, which can be completely ruled out because they are entirely inconsistent and incoherent with experience gained by physics.

If 'Reality' were to be radically and absolutely beyond and unrelated to our experience there would be no conceivable way in which it could have anything to do with experience. The Buddhist philosopher Chandrakirti put this, in another context, as follows:

> If something can arise from something other than itself,
> Well then, deep darkness can arise from tongues of flame,
> And anything could issue forth from anything.'[34]

If two ontological aspects of the world are considered to be absolutely antithetical and unconnected in essence then there can be no connection between them. So if 'experience' were to be completely beyond the pale of 'Reality' then obviously we could never 'know' it in any shape or form. But such a notion is clearly incoherent precisely because it is only through 'experience' that we can have any notion at all about 'Reality', 'Reality' is clearly revealed, admittedly in degrees of 'veiled' forms, through experience. One assumption which is shared by physics, hopefully Western philosophy (even in spite of Hume) but certainly Buddhist philosophy is that 'Reality' is at basis coherent, and the notion that the interdependent realms of 'Reality' and 'experience' are absolutely and irredeemable antithetical is clearly incoherent; for if this were the case then 'Reality' would have nothing whatsoever to do with our experience, in which case from whence cometh experience?

With this in mind we can return to the matter of 'matter'. The notion that Cartesian type 'matter', which is conceived of as extended, continuously solid 'stuff' that is supposed to be independent in all respects from the ontological category of 'mind', 'exists' is entirely incoherent with experience as revealed in quantum experiments which have been repeated over and over again. And it is worth considering the extraordinary precision of such experiments. The miniscule scale of these quantum experiments is staggering. For instance it is possible to fit in the order of 100000 atoms across the width of a human hair and the scale of the quantum experiments that have been conducted, which involve the constituents of atoms, are at an order beneath this. The breathtaking scale and precision of experiments which delve beneath the sphere of atomic 'particles' into the realm of deeper quantum phenomena has been constantly refined to ever more unimaginable and mind warping tiny scales of accuracy. Physicist Robert Oerter describes the accuracy required for these investigations as that 'you would need to shoot a gun and hit a Coke can – if the can were on the moon'[35]. Richard Feynman, one of the most significant physicists of the twentieth century, compared the accuracy of quantum experiments to measuring the distance between New York and Los Angeles to the precision of the width of one human hair![36]

And on the basis of such experiments quantum physicist Henry Stapp has concluded, with just about all others, that from an ultimate quantum level:

> …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.[37]

It is important to be aware, however, that Stapp is not denying the existence of a structure of apparent materiality that we call the 'brain' which functions at the 'classical' level of reality; he is indicating that quantum physics has uncompromisingly shown that it is not composed of 'tiny bits of matter'. In fact Jonathan Allday, in his recent book *Quantum Reality: Theory and Philosophy*, tells us that according to the lowest level analysis of 'Reality', quantum field theory, that there is no 'substance' to be found anywhere:

> 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.[38]

Ellis, however, feels he is 'justified' in waving his agnostic anti-philosophical wand to render any such evidence irrelevant:

> If the theory is about properties and does not posit or identify substances, that is very far from proving that there are no such substances, or claiming that the world is "ultimately" non-substantial.[39]

However, such a statement demonstrates not only his self-confessed complete lack of knowledge of physical theory, but also his determination to ignore clear philosophical implications in order to promote his own particular non-philosophical agenda. Whilst it is true that it might be possible to concoct a new conception of 'substance' in order to try and save the appearance of a substantial world, attempts have been made in this direction, if, however, one operates with the common and garden notion derived from Descartes, which is still the primary use of the notion, then quantum field theory clearly rules out the existence of 'substance' at the ground level of reality, there can be no doubt, physical or philosophical, about this.

The following snippet is another example of Ellis's flouting not only of philosophical implications, but straightforward common sense:

> If consciousness is shown to have a role in giving us the impression that things exist, this shows that the observation of consciousness is necessary for the experience of observing something and believing it to exist, not that it is sufficient. It does not demonstrate that the object concerned does not exist as an independent entity. I think this is the most basic philosophical error behind almost everything else you are saying.[40]

The introduction of the 'necessary and sufficient' distinction is quite obviously irrelevant. If, as quantum physicists Planck, Schrodinger, Pauli, Wheeler, Bohm, Rosenblum and Kuttner, Stapp, Zurek, Zeh, Penrose … etc. etc. all conclude that in some manner consciousness is required for the appearance of the apparent experienced world of substantiality from an insubstantial quantum ground of potentiality, then, quite clearly, the entities of experienced realm are *dependent* and therefore *not independent*. This is why the quantum physicist Professor Anton Zeilinger refers to the pre-quantum viewpoint as involving:

> …the obviously wrong notion of a reality independent of us.[41]

This is really a matter of definition of words: if something *depends* upon something else then it is *not independent*, this has nothing to do with philosophical analysis into necessary and sufficient conditions. It appears that in Ellis's mode of philosophizing he thinks it is necessary to bring in irrelevant distinctions in the hope that they may be sufficient to bring unnecessary confusion into the issue.

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. [42]

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

> Rather than passively observing it, we in fact create reality. [43]

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… [44]

This dramatic conclusion is prompted by recent extremely delicate experimental investigations of the interaction of the observations being made and the nature of the resulting experimental outcomes.

But for Ellis any such considerations are a priori ruled out of the philosophical court. For him the views and opinions of authorities in the field of physical reality are worthless when it comes to what he considers to be the real non-reality revealing (in the sense of being 'agnostic') thought processes of crude sceptical philosophy:

> …authorities do not conclusively resolve arguments, simply because they can be wrong. There are many spectacular cases of authorities of the past turning out to be wrong, which I'm sure you're aware of. In this particular case, you quote a lot of authorities that all share the assumptions that I am questioning, which makes the whole enterprise rather a waste of energy on your part (for me, anyway). If I don't accept the assumptions your authorities are making, and you are citing them only because they share your assumptions, the justification they offer becomes circular. Of course, if you give the arguments of the authorities rather than just their conclusions, then you are just using them as a source of justifications that could potentially be correct regardless of where they come from… [45]

The authorities he is referring to is a fairly comprehensive set of modern physicists who clearly think that their work does tell us something significant about the nature of 'Reality'. Ellis considers that his list of sceptical points, most of which assume the irrelevance of physics at the outset, show that the views of such top-notch physicists are irrelevant in his 'Reality', which he seems to think lies metaphysically somewhere beyond the rainbow world of experience and the appearance of the 'material' realm.

It is quite clear from this fragment that Ellis considers that there exists a kind of Platonic philosophical realm, which he has dubbed as his 'correct' version of the 'Middle Way',

wherein pristine logical forms of argument have been established by a kind of divine logician and it is only the results of the application of the divinely ordained logical procedures (those Ellis has discovered) which can reveal the fact that we can never 'know' 'Reality'.

Ellis asks "How many previous theories in human history have been proved wrong - the vast majority." But, we are not concerned with the entirety of human history, we are concerned with physics, and strangely enough 'classical' physics took a pretty straight and undeviating course from the seventeenth century inception down to the end of the nineteenth century where upon the quantum revolution at the beginning of the twentieth century indicated a new level of reality had been reached, a level of reality with an astonishingly different mode of operation. Since then the fundamental features of the theory have remained stable, with a much greater knowledge of the detail accrued over time of course, plus the quantum interpretational problem, but that is a separate issue. The image of one scientific 'paradigm' being continuously overturned, trashed and replaced and so on is actually an overplayed myth, perpetrated in large measure due to academic over-proliferation in the quest for philosophy PhDs. The only major shift in paradigm within science since the inception of the modern scientific enterprise has been from 'classical' physics to quantum theory (relativity is a 'classical' level theory).

Furthermore, the notion that the history of physics is littered with a huge number of authorities being 'spectacularly' incorrect is simply wrong. The notion that Planck, Heisenberg, Schrodinger, Bohr, Born, de Broglie, Dirac, Bohm, Wheeler, Feynman ….. etc. etc. are all going to be 'spectacularly' incorrect en mass is, well, I won't use the f-word. Of course there will be some interpretative theories which turn out be unworkable. But the notion the entire quantum paradigm is going to be found fundamentally and spectacularly wrong? Einstein who was the real instigator of the theory thought it was 'incomplete', and currently Roger Penrose shares such a view.

According to Ellis:

> There is also no 'paradox of scepticism' whereby sceptics are making absolute claims about the non-absoluteness of human belief, so long as you understand the implications of scepticism to be agnostic rather than those of negative metaphysics. Scepticism merely observes that we cannot justify either the assertion or the denial of metaphysical beliefs: this is an observation that must be distinguished from the denial of any metaphysical belief, which would certainly over-reach the evidence available to our experience.[46]

However the fact of the demonstration of the impossibility of Cartesian style 'matter' is exactly such an assertion of "negative metaphysics" which has been clearly validated without over-reaching the evidence "available to our experience". In a previous quote Ellis asks "What proportion of the universe have we observed?," as if it were possible for somewhere on the outer limits of the universe which is unobservable to us for the apparently 'material' nature of reality to suddenly become 'really' material and made up of Cartesian type continuously solid matter or tiny Newtonian balls. Such would only be possible in an incoherent universe; and I am not even sure that this would be coherent in an incoherent universe.

At this point a committed sceptic, like Ellis, will perhaps be jumping up and down uttering something like "But read Hume, Hume on causality and induction"; so it is to this sceptical analysis we must turn our attention. Ultimately, of course, someone who is determined to

remain a staunch sceptic will do so, whatever arguments are marshalled in defence of the fundamental coherency of reality. It is surely very doubtful that there are knock-down arguments against someone who declaims "I know that I cannot know that my senses are not deceiving me, therefore I also know that there cannot be any certain knowledge."

When it comes to Hume, of course, the key issue is the problem of induction. According to the standard or 'traditional' presentation of Hume's viewpoint there is absolutely no way of absolutely grounding or validating any kind of knowledge which relies upon inductive reasoning, or to put it more generally *assumes that 'reality' is fundamentally coherent*, and this includes just about all, if not all, of the current theories of physics.

The sceptical position, crudely stated, is that it is entirely possible, for instance, that one day billiard balls will suddenly, instead of conforming to Newton's laws, melt into each other, jump off the billiard table and disappear into thin air. Now in one sense quantum theory has actually proved Hume correct, as quantum physicist Michio Kaku for instance tells us:

> I sometimes ask our PhD. students at the university simple questions such as, calculate the probability that they will suddenly dissolve and rematerialise on the other side of a brick wall. According to quantum theory there is a small but calculable probability that this could happen. Or, for that matter, that we will dissolve in our living room and wind up on Mars.[47]

According to quantum theory the quantum realm prior to 'measurement' contains a possibility for every conceivable event to occur, and each possible event has a probability for happening associated with it. So it would seem that it is entirely probable for billiard balls to behave in the bizarre way described above, and for scrambled eggs to unscramble themselves and so on, if, that is, by 'entirely probable' we mean that the event has some associated probability value. This value, however, would be so tiny that one would have to wait for the universe to end and the event would still, probably, not occur. It is precisely the fact that quantum theory can encompass and elucidate Hume's scepticism yet at the same time delimit its limits that surely proves the efficaciousness of the theory as an all-inclusive metaphysical account of 'Reality'. Quantum theory has given us the probabilities of Hume's improbabilities. Such a view can be derived from the application of the philosopher David Lewes's 'Principle Principle' concerning the 'credence' conformity of rational agents within a quantum chancy "Humean mosaic" of time advancing experienced 'actualities'. Crudely stated, any bizarre occurrence would simply become incorporated into the quantum probability configuration and thereby be comprehended within quantum theory![48]

Another feature of Hume's analysis is that it actually relies on a prior commitment to a metaphysical standpoint, which is the dualistic view that the 'real' world, so to speak, is 'out there' whilst the person doing the perceiving only has access to sense impressions 'in' their minds. According to Hume's account of knowledge any notions that we have concerning the nature and functioning of the world derives from contiguities and associations which somehow develop amongst these internal sense impressions. Now an immediate question which arises concerns the issue of the basis upon which such associations and so on develop. Any account which appeals to similarity and analogy and so on, as Hume's does, obviously imputes some activity to the mind in ordering the putative sense impressions, and this activity on the part of the mind must itself be part of reality itself, as we have argued previously. In fact Hume himself seems to anticipate Kant's later notion that causality is a necessary and natural category of reality, for Hume writes in his *Essay Concerning Human Understanding*

concerning this issue that causal inferences are "essential to the subsistence of all creatures," and:

> It is more comfortable to the ordinary wisdom of nature to secure so necessary an act of the mind, by some instinct or mechanical tendency, which may be infallible in its operations, may discover itself at the first appearance of life and thought, and may be independent of all the laboured deductions of the understanding. As nature has taught us the use of our limbs, without giving us the knowledge of the muscles and nerves by which they are actuated; so she has implanted in us an instinct, which carries forward the thought in a correspondent course to that which she has established among external objects; though we are ignorant of those powers and forces, on which this course and succession of objects depends.[49]

In other words "the ordinary wisdom of nature", or reality, might actually be more dependable than the "laboured deductions of the understanding." Note also the clear 'nondual-dualism' to use a term used by Stapp in his paper *Nondual Quantum Duality*, the clear implication being that the categories that the mind uses to comprehend what appears to be an external world are produced by the very same processes that produce the apparently external world. One might say that there must be a fundamental coherency in operation at some level even to be able to argue for incoherency, a fact that Hume was clearly aware of. The notion that this apparent duality is in reality a vicious unbridgeable ontological divide is itself a product of the "the laboured deductions of the understanding". Remarkably, however, now quantum theory indicates that both aspects of the apparent duality arise from the nondual quantum realm.

One of the features of quantum theory which makes it so remarkable, beside its continuous verification at an astonishing level of precision, is the fact that it was found to be true despite the fact that none of the scientists involved actually wanted it to be so. John Wheeler, for instance, said that:

> Quantum Theory appears to many as strange, unwelcome, and forced on physics as it were from outside against its will[50].

Hume suggested that all our knowledge was ultimately derived from 'sense impressions' of the external world. It is acknowledged, however, that the 'reality' suggested by quantum theory seems to correspond in no way to those of the everyday person but, rather, to the sense impressions of "mystics and madmen,"[51] as quantum physicist Nick Herbert says. According to Penrose:

> Quantum theory was not wished upon us by theorists. It was (for the most part) with great reluctance that they found themselves driven to this strange and, in many ways, philosophically unsatisfying view of the world.[52]

This is an important point to bear in mind because it lends great weight to the discoveries of quantum theory. The remarkable features of quantum functioning were not unearthed by physicists who set out to uncover them; quite the opposite. The American experimental physicist Robert Millikan, for instance, could not accept Einstein's picture of the light photon as both wave and particle and he therefore set out on a series of difficult experiments in order to prove that Einstein was wrong. The physicist and science writer John Gribben writes concerning this:

> … he only succeeded in proving that Einstein was right … In the best traditions of science, it was this experimental confirmation of Einstein's hypothesis (all the more

> impressive since it was obtained by a skeptic trying to prove the idea wrong) that established clearly, by about 1915, that there was something in the idea of light quanta.[53]

Towards the end of his life Millikan commented on this episode:

> I spent ten years of my life testing that 1905 equation of Einstein's and contrary to all my expectations, I was compelled in 1915 to its unambiguous verification in spite of its unreasonableness.[54]

So it is not the case that a deviant group of mad scientists got together sometime at the beginning of the twentieth century and decided that they were bored with the idea of a completely 'material' world, and would therefore like to concoct a more exciting version of reality; a numinous vision within which matter was asserted to be similar to an illusion generated in some strange fashion by the operation of mind or minds. Nor did they go to bed one evening and, because of some strange *Day of the Triffids*[55] (or, perhaps, Humean) like cosmic event, wake up next morning turned into incoherent rabid mystics. Quantum theory was proved by physicists in large part desperately trying to falsify it.

This observation moves us directly into the realm of the philosophy of science, an area of discourse which Ellis considers is central to his philosophical analysis which he claims is purely 'epistemological'; in this particular case of the notion of 'falsifiability' we are lead directly into the philosophical arms of Karl Popper who, according to the online *Stanford Encyclopedia of Philosophy*, is "generally regarded as one of the greatest philosophers of science of the 20th century." Popper's approach to the philosophy of science is particularly cogent in the present discussion because, like Ellis, Popper takes Hume's scepticism 'seriously.' Popper's theory requires that science operates according to an epistemological method of 'falsifiability', which was designed in order to avoid the problems associated with the idea that science requires the principle of 'induction', the notion that a large enough sequence of particular observations (the sun rising in the morning is often quoted as an example) can guarantee that the same observations will be made in the future.

Popper was impressed by the fact that theories such as Einstein's theory of relativity were 'risky' because they clearly were open to refutation by experimental evidence whereas, from Popper's evaluation, other spheres of investigation such as psychoanalysis could not be refuted by any particular test because they were formulated in a fashion which protected them from such testing. He came to the conclusion that only proposals which were falsifiable can be considered to be scientific. Furthermore it followed from this position that scientific theories which had not been falsified were only provisionally held as possible scientific 'truths' because they may be falsified at some point in the future. Stephen Thornton summarizes the view as follows:

> Popper, then, repudiates induction, and rejects the view that it is the characteristic method of scientific investigation and inference, and substitutes *falsifiability* in its place. It is easy, he argues, to obtain evidence in favour of virtually any theory, and he consequently holds that such 'corroboration', as he terms it, should count scientifically only if it is the positive result of a genuinely 'risky' prediction, which might conceivably have been false. For Popper a theory is scientific only if it is refutable by a conceivable event. Every genuine test of a scientific theory then, is logically an attempt to refute or to falsify it, and one genuine counter-instance falsifies the whole theory. In a critical sense, Popper's theory of demarcation is based upon his perception of the logical asymmetry which holds between verification and

> falsification: it is logically impossible to conclusively verify a universal proposition by reference to experience (as Hume saw clearly), but a single counter-instance conclusively falsifies the corresponding universal law. In a word, an exception far from 'proving' a rule, conclusively refutes it.[56]

On Popper's view, then, theories are weeded out by being falsified by experimental testing.

An interesting situation, then, would arise when after an amount of time we might be left with only two mutually exclusive and mutually exhaustive theories 'provisionally' accounting for some phenomenon. Presumably if one of these were to be falsified then the other would then have to lose it status of 'provisionality' and thus actually become the final and ultimate theory, there being no possible alternative. So, if we accept Popper's 'falsifiability' account of scientific knowledge, then the Mind-Matter metaphysical tussle for equality or supremacy within Western philosophy has indeed now been decided by the fact that quantum physics has shown 'matter' to be an illusory category of reality. Thus quantum physics would indeed, on Popper's philosophy of science, count as 'experimental metaphysics.'

Until the advent of quantum theory, the situation within the field of the metaphysical dimension of Western philosophy was that of a vying for absolute ontological position, or a dubious equality and interaction, between 'Mind' and 'Matter', ultimate concepts which have been the fundamental categories for ontological possibility since the time of Descartes. Descartes, of course, famously divided the ontology of reality into two 'substances': the 'extended substance' of 'matter' (*res extensa*) and the 'thinking substance of 'mind', or consciousness (*res cogitans*). It is important to note the use of the term 'substance' here is not the same as its use in the discussion of quantum field theory being insubstantial, which means that there is no *material* substance within the ground quantum field. The concept of 'substance' employed by Descartes was that of a unique aspect of reality which shared no qualities with any other substance, Cartesian 'substances' therefore are assumed ontologically foundational aspects of reality.

The significant basis which was established by Descartes for the subsequent metaphysical explorations of modern Western philosophy, down to the middle of the twentieth century (when in large measure Anglo-American philosophy gave up and retreated into mostly meaningless linguistic analysis, whilst Continental philosophy took up a more nuanced manner of analysis) was precisely the establishment of 'Matter' and 'Mind' as the two, mutually exclusive and exhaustive possible foundational 'substances'. Various possible views concerning possible dualistic perspectives within which these two 'substances' are considered to be equally foundational (Interactionism, Epiphenomenalism etc.) or, on the other hand, which of the two might be primary, were explored by Descartes himself, who posited interaction via the pineal gland, and philosophers at the time and afterwards.

The crucial, and actually insurmountable without intellectual deception, problem for any kind of Dualism is that the very definitions of the primary substances as set up by Descartes requires by definition that there cannot be any connection between the two if one accepts the reasonable philosophical principle which we might call the *Principle of the Incompatibily of Absolute Non-Identicals (*which we can shorten to the *'Principle of Absolute Incompatibility' (PAI)* with the implication that we are referring to absolute opposite or contrary natures*).* This principle is a natural corollary of the seventeenth century philosopher Leibnitz's *Principle of the Indiscernibility of Identicals (PII).* According to PII two things can only be identical if they share *all* their properties in common; PAI says that if two substances are absolutely

different and therefore share absolutely no common properties, qualities or aspects they cannot be related or connected in any way. Such absolutely different 'substances' can have no means of relationship or connection, they are, as Buddhist philosophy describes the situation 'concepts of mutual abandonment' which cannot interact in any way, unless we want to declare that 'deep darkness can give rise to tongues of flame.'

Popper, however, paradoxically maintained a dualist ontology and a form of an interactionist account of the capacities of mind and matter which veered towards a subtle monist materialism, thus apparently hedging his bets on the matter:

> …although Popper was a body-mind dualist, he did not think that the mind is a substance separate from the body: he thought that mental or psychological properties or aspects of people are distinct from physical ones.[57]

Remarkably Popper, the great philosopher of science, seems confused on these issues, for although he is scathing about the kind of hardcore 'eliminative materialism' preached by Paul and Patricia Churchland, referring to it as "promissory materialism" which relies on "prophecy about the future results of brain research"[58], he appears to be unaware of the strange inconsistent ambiguity which surrounds his own subtle 'non-eliminative' materialism. For, if we employ the usual notions of the 'physical' and 'mental' which come down to us from Descartes then 'physical' processes cannot by definition generate "mental or psychological properties or aspects" that are completely "*distinct from physical ones.*"

In his work with the Nobel prizewinning neurophysiologist Sir John C. Eccles, Popper (who was also a 'Sir') considered the possibility that quantum indeterminacy might underlie the possibility of free-will. Eccles had suggested that "critically poised neurons" might be influenced by the mind to assist in a decision, a view which anticipated Penrose and Hameroff's later suggestions. At this point, however, Popper criticized the idea of amplified quantum events affecting the decision. But in the 1977 book with John Eccles, *The Self and its Brain*, Popper finally formulated a two-stage model of mind-brain interaction involving quantum physics; he compares free will to Darwinian evolution and natural selection:

> New ideas have a striking similarity to genetic mutations. Now, let us look for a moment at genetic mutations. Mutations are, it seems, brought about by quantum theoretical indeterminacy (including radiation effects). Accordingly, they are also probabilistic and not in themselves originally selected or adequate, but on them there subsequently operates natural selection which eliminates inappropriate mutations. Now we could conceive of a similar process with respect to new ideas and to free-will decisions, and similar things. "That is to say, a range of possibilities is brought about by a probabilistic and quantum mechanically characterized set of proposals, as it were - of possibilities brought forward by the brain. On these there then operates a kind of selective procedure which eliminates those proposals and those possibilities which are not acceptable to the mind."[59]

In this observation it is clear that Popper's account clearly requires that the mind must have an effect at the quantum level of functioning; which is a view that, by the Principle of Absolute Incompatibility, must mean that the quantum level has mind-like qualities (for if it did not there could not be an interaction of the kind suggested by Popper). This requirement actually undermines Popper's subtle materialist monist dualism. The resemblance of the Popper-Eccles proposal to that of Stapp in his *Nondual Quantum Duality* paper is quite clear. As Stapp says:

> …quantum mechanics is thus dualistic in the pragmatic and operational sense that it involves aspects of nature that are described in physical terms and also aspects of nature that are described in psychological terms… This is all in close accord with classic Cartesian dualism. On the other hand, in contrast to the application to classical mechanics, in which the physically described aspect is ontologically matterlike, not mindlike, in quantum mechanics the physically described part is mindlike. Thus quantum mechanics conforms at the *pragmatic/operational* level to the precepts of Cartesian duality, but reduces at a deep *ontological* level to a fundamentally mindlike nondual monism.[60]

But Eccles and Popper seemed to baulk at going as far as asserting the "mindlike" nature of reality. As Donald E. Watson and Bernard O. Williams point out:

> As a young medical student, Sir John Eccles could not accept the "irreligious philosophy of monist-materialism." He turned to Descartes' dualism because separating res extensa and res cogitans "gave a secure status to the human soul or self." Though Eccles was motivated partly from his religious beliefs, it is clear from context that his concept of spirit was not confined to any particular religious or philosophical doctrine. That is, he equated the terms spiritual and nonmaterial, which disengaged his thinking from Cartesian dualism and placed it in the path of modern science. Given this insight, if he had not persistently returned to dualist-interactionism or any other philosophical model of mind, he would have been free to develop a scientific theory of the self and its relation to the brain.[61]

In other words (and replacing the word 'self' with the more appropriate term 'mind' in the above quote) if Eccles and Popper has not felt compelled to leave at least a subtle form of matter lying around at the foundations of reality they might have come to the conclusion, which is clearly required by Popper's falsifiability thesis and the evidence of quantum theory, that matter had dematerialized into an insubstantial mindlike quantum field of potentiality.

The seventeenth century philosopher John Locke wrote concerning the notion of material substance:

> The idea then we have, to which we give the general name substance, being nothing but the supposed, but unknown support of those qualities, we find existing which we imagine cannot subsist, *sine re substante,* without something to support them, we call that support *substantia,* which, according to the true import of the word, is in plain English, standing under or upholding.[62]

A few pages later Locke compared the idea of 'substance' to the notion that the world rests on an elephant, which in turn rests upon a turtle and so on, the point being that we can never actually know the actual nature of any such putative substratum of reality because we only ever encounter properties, qualities and characteristics, rather than the naked substantiality itself. It seems then that Locke, in a very minimalist sense, anticipated quantum field theory!

Although Locke seemed to adopt an atomist point of view concerning foundational reality, he also pointed out that "It is impossible to conceive that pure incogitative matter should produce a thinking intelligent being…" [63]. The following passage from Locke is "what he considered a sound *a priori* argument that Mind must come first, must be the original Cause, not merely an Effect:"[64]

> If, then, there must be something eternal, let us see what sort of Being it must be. And to that it is very obvious to Reason, that it must necessarily be a cogitative

> Being. For it is as impossible to conceive that ever bare incogitative Matter should produce a thinking intelligent Being, as that nothing should of itself produce Matter. Let us suppose any parcel of Matter eternal, great or small, we shall find it, in itself, able to produce nothing. . . . . Matter then, by its own strength, cannot produce in itself so much as Motion: the Motion it has, must also be from Eternity, or else be produced, and added to Matter by some other Being more powerful than Matter. . . . But let us suppose Motion eternal too: yet Matter, incogitative Matter and Motion, whatever changes it might produce of Figure and Bulk, could never produce Thought: Knowledge will still be as far beyond the power of Motion and Matter to produce, as Matter is beyond the power of nothing or nonentity to produce. And I appeal to everyone's own thoughts, whether he cannot as easily conceive Matter produced by nothing, as Thought produced by pure Matter, when before there was no such thing as Thought, or an intelligent Being existing. . . . So if we will suppose nothing first, or eternal: Matter can never begin to be: If we suppose bare Matter, without Motion, eternal: Motion can never being to be: If we suppose only Matter and Motion first, or eternal: Thought can never begin to be. For it is impossible to conceive that Matter either with or without Motion could have originally in and from itself Sense, Perception and Knowledge, as is evident from hence, that then Sense, Perception, and Knowledge must be a property eternally inseparable from Matter and every particle of it.[65]

So Locke clearly considered the field of (non-individuated) Mind to be, as quantum physicist and the unwittingly inadvertent instigator of the quantum revolution Max Planck (Einstein was the physicist who actually wittingly promoted the idea of the quantum nature of reality) put it the 'matrix of matter':

> 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.[66]

It is quite remarkable just how the cogent argument on the part of Locke actually produces a conclusion that is spectacularly validated three centuries later with the advent of quantum theory and the insubstantiality of quantum field theory wherein only properties without property holders are posited.

This example indicates the possibility of clear and coherent philosophical reflection leading to metaphysical insight of the first order. It is perhaps even more remarkable that Popper's falsifiability philosophy of science, which Popper originally thought would be an antidote to metaphysics, can, when applied in the context of the clear findings of quantum physics, be employed to validate Locke's viewpoint; and, furthermore, that Popper ended up developing a metaphysical perspective which took its basic demeanour from an acceptance of quantum physics as a foundational description of the nature of reality.

Popper shared Einstein's worries concerning the counter intuitive implication that apparently separated elements of 'reality' seem to have a mysterious interconnection between them, a aspect of the nature of 'Reality' we shall look at very shortly, and because of this worry about the phenomenon of 'quantum entanglement' Popper tried to design a quantum experiment to resolve the issue.[67] However, as we shall see shortly, physicist Giancarlo Ghirardi, is actually quite scathing about Popper's understanding of the subtle aspects of quantum theory involved. But, nevertheless, it is quite clear that Popper clearly considered his falsifiability methodology to operate within science and was not an argument to claim, as Ellis does, that

physics can tell us nothing about 'Reality'; Popper clearly thought that quantum theory had a great deal to contribute in this ultimate arena of knowledge.

Popper's later development of his 'Three Worlds' proposal, outlined in his 1978 Tanner Lectures on Human Values, is highly metaphysical in tenor:

> In this lecture I intend to challenge those who uphold a monist or even a dualist view of the universe; and I will propose, instead, a pluralist view. I will propose a view of the universe that recognizes at least three different but interacting sub-universes.[68]

The three worlds (figure 1) proposed as being 'real' by Popper are those of the 'physical' world (World 1) the 'mental' world (World 2) and the 'cultural' world (World 3); the world of culture is also the world of 'objective' knowledge; these worlds were conceived of by Popper as interacting through various feedback mechanisms. This 'three worlds' perspective was later adapted by Roger Penrose as we shall later see. It would seem then that, not only did Popper consider that quantum theory was, contrary to Ellis's viewpoint, capable of providing evidence about the universe, he also decided at some point that, even despite his falsifiability thesis, metaphysics was a worthwhile pursuit.

In his 'Three Worlds' lectures Popper gave the following account of what he considers should count as being 'real':

> I suggest that all of us are most certain of the existence or reality of physical bodies of medium size: of a size such that we can easily handle them, turn them round, and drop them. Such things are 'real' in the most primitive sense of the word, I conjecture that a baby learns to distinguish such things; and I suppose that those things are most convincingly real to the baby that he or she can handle and drop, and can put into his or her mouth. Resistance to touch also seems to be important; and some degree of temporal persistence. Starting from a primitive idea of real things like this, the physicalist extends the idea by generalizing it. I suggest that the materialist's or physicalist's idea of real physical existence is obtained by including very big things and very small things, and things that do not persist through any length of time; and also by including whatever can causally act upon things, such as magnetic and electrical attraction and repulsion, and fields of forces; and radiation, for example X-rays, because they can causally act upon bodies, say, upon photographic plates. We are thus led to the following idea: what is real or what exists is whatever may, directly or indirectly, have a causal effect upon physical things, and especially upon those primitive physical things that can be easily handled.[69]

The first point we should note is that the first sentence of Popper's statement is just false; if that is, by 'real' we mean completely independent of observing minds. Ordinary human beings may be 'certain' in a 'primitive' manner of the 'reality' of the objects of the everyday world as independent self-enclosed entities, but quantum theory clearly shows this certainly is mistaken. In this analysis Popper suggests that all the attributions of reality that are made, both within science but also in life in general, are based, at root, in the immediacy of our *experiences* of the "physical bodies of medium size", and it to these objects of direct experience that we attribute the most 'primitive' notion of reality. It is upon the base of such directly experienced 'physical' objects that the notion of 'reality' is generalised upon the basis of 'causal effects'.

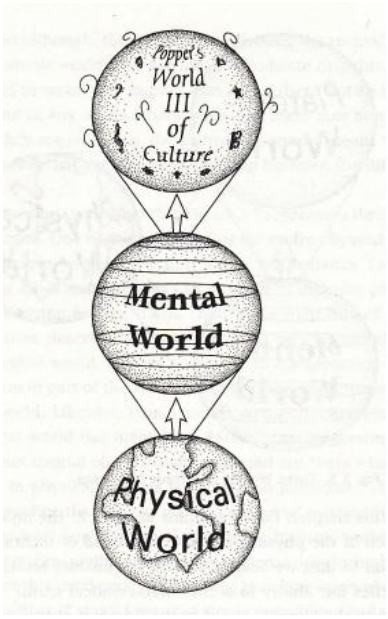


Figure 1 – Popper's three worlds as depicted by Penrose.[70]

Now, although Popper speaks of the 'physical' world as in some sense looking as the foundational level, a proper consideration of the overall viewpoint, taking into account that fact that it actually bases its viewpoint upon the *experiential* aspect of our awareness of the 'physical' world, requires that that the 'three words' proposal is most appropriately contained within a overall pan-experiential perspective. It may be objected that the dualist-interactive perspective proposed by Popper in *The Self and Its Brain: An Argument for Interactionism*,, argues against such a pan-experientialist perspective, but, as has been already argued above, if we are using the terms 'matter' and 'mind' in a traditional manner such an interaction is impossible. The kind of interactionism proposed by Popper appeals to an interaction at the quantum level, a level at which traditional 'matter' no longer 'exists', to re-quote Stapp.

In the context of the current discussion regarding Ellis's claim as to the ultimate unknowability of 'Reality', which Ellis considers established by Popper's falsifiability principle, the significant point is that within Popper's worldview 'Reality' is clearly not some structure or process which is absolutely beyond all possible knowledge. For Popper, rather, 'Reality' reveals itself through the "feedback mechanisms" within a pan-experiential metaphysical process. Such a view directly undermines the kind of dogmatic claims presented by Ellis:

> In the Western tradition of philosophy there have been many false assumptions about the implications of scepticism. One of these is that if we take it seriously it stops us from holding beliefs or making claims altogether. This is not an implication of scepticism, because all it undermines is claims about reality. It does not prevent us from making statements about our experience, nor does it prevent us making justifiable provisional statements about what appears to be the case based on that experience.[71]

When we understand that 'Reality' is not and cannot be completely and absolutely beyond and antithetical to our experience, statements regarding scepticism like this – "*all it undermines is claims about reality*" - seem grotesquely overblown.

In his final summing up of his 'Three Worlds' metaphysics Popper says:

> To sum up, we arrive at the following picture of the universe. There is the physical universe, world 1, with its most important sub-universe, that of the living organisms. World 2, the world of conscious experience, emerges as an evolutionary product from the world of organisms. World 3, the world of the products of the human mind, emerges as an evolutionary product from world 2. In each of these cases, the emerging product has a tremendous feedback effect upon the world from which it emerged. For example, the physico-chemical composition of our atmosphere which contains so much oxygen is a product of life - a feedback effect of the life of plants. And, especially, the emergence of world 3 has a tremendous feedback effect upon world 2 and, through its intervention, upon world 1. The feedback effect between world 3 and world 2 is of particular importance. Our minds are the creators of world 3; but world 3 in its turn not only informs our minds, but largely creates them. The very idea of a self depends on world 3 theories, especially upon a theory of time which underlies the identity of the self, the self of yesterday, of today, and of tomorrow. The learning of a language, which is a world 3 object, is itself partly a creative act and partly a feedback effect; and the full consciousness of self is anchored in our human language. Our relationship to our work is a feedback relationship: our work grows through us, and we grow through our work. This growth, this self-transcendence, has a rational side and a non-rational side. The creation of new ideas, of new theories, is partly non-rational. It is a matter of what is called 'intuition' or 'imagination'. But intuition is fallible, as is everything human. Intuition must be controlled through rational criticism, which is the most important product of human language. This control through criticism is the rational aspect of the growth of knowledge and of our personal growth. It is one of the three most important things that make us human. The other two are compassion, and the consciousness of our fallibility.[72]

But the "consciousness of our fallibility" referred to by Popper is not the absolutized and metaphysically foundational 'fallibility' as to the possibility of any 'real' knowledge of 'Reality' asserted by Ellis; it is, rather, the awareness that "intuition is fallible" unless it is guided by "rational criticism."

In relation to this it is worth revisiting the quote from Hume already cited:

> As nature has taught us the use of our limbs, without giving us the knowledge of the muscles and nerves by which they are actuated; so she has implanted in us an instinct, which carries forward the thought in a correspondent course to that which she has established among external objects…[73]

The fact that human bodies and their experiential continuums and mental faculties are all part of 'Reality' and embedded within it is sufficient rational reason to adopt at the outset, in contrast to the metaphysical nihilism which seems to lie at the core of Ellis's vision, a positive attitude to the possibilities of intuitive metaphysical insight, as long, of course, as it is guided by the rigorous employment of "rational criticism."

The example of mathematics is very relevant in this context. The physicist Eugene Wigner once referred to:

> The unreasonable effectiveness of mathematics in the physical sciences.[74]

Penrose to a large extent concurs with Wigner about the 'mystery' of it can possibly come to pass that mathematics has the remarkable capacity to describe with such great precision the processes and operations of the 'physical' world, a world which generally is considered as being absolutely distinct from the realm of the 'mental.' Hence Penrose, with regard to mathematics and his reworking of Popper's 'three worlds' (see figure 2) asks:

> …what underlies our ability to access mathematical truth? When I referred to the Platonic world … I was primarily talking about mathematics and the mathematical concepts one has to call upon to describe the physical world. One has the feeling that the mathematics needed to describe these things is out there. There is also, however, the common feeling that these mathematical constructions are products of our mentality, that is, mathematics is a product of the human mind. One can look at things in this way but it is not really the mathematician's way of looking at mathematical truth; nor is it my way of looking at it either. So although, there is an arrow joining the mental world and the Platonic world, I do not mean to indicate that this, or indeed any of these arrows, implies that any of these worlds simply emerges out of any of the others. Although there may be a sense in which they are emerging, the arrows are simply meant to represent the fact that there is a relationship between the different worlds.

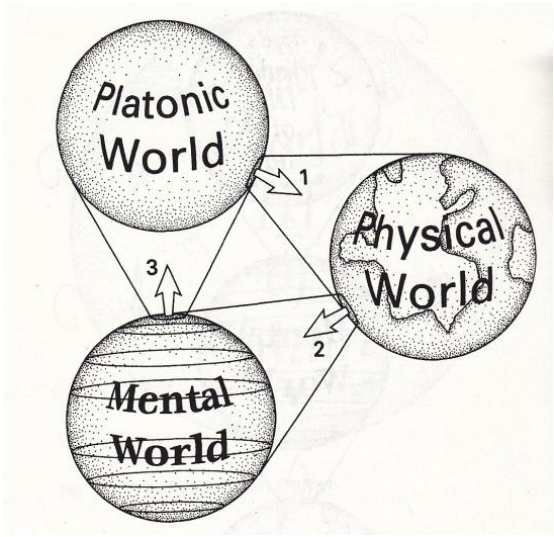


Figure 2 – Penrose's three worlds

But mathematics obviously is, indeed, a product of the human mind, so how come the astonishing 'objectivity' which comes about, an apparent objectivity which is so profound that it is able to describe in great detail the lineaments of the physical world and also leads those of Penrose' disposition to speculate about the existence of a 'Platonic World'. Surely the answer is likely to be that both mind and the physical world have their source in the same process of 'Reality' and are both aspects of that 'Reality'. The reason that the mathematical patterns of thought which have been 'incrementally' discovered or accessed as if from a 'Platonic' realm over the centuries describe the functioning of the physical world is simply that they both have a common source and the human mind, to various degrees, has an intuitive capacity to discover and understand such mathematical patterns. The quantum physicist David Bohm described such a common source, which is actually suggested by quantum physics, as the 'implicate order':

> 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.[75]

In this case it would be more appropriate to graphically represent the three worlds as shown in figure 3. One intriguing aspect of this viewpoint is provided by the implication of the famous Gödel incompleteness theorem which indicates that any complex mathematics capable of describing the physical world cannot supply a validation for its own validity, it is in a sense logically groundless and yet it functions with a remarkable logically crystalline precision. A mathematician of Ellis's profoundly sceptical disposition would surely lament: "We can never, ever know anything about Mathematics! For its own nature hides the source of its effectiveness from us." But this is not correct for, as Penrose has cogently argued, Gödel's incompleteness theorems indicate the dramatic power of human intuitional insight.

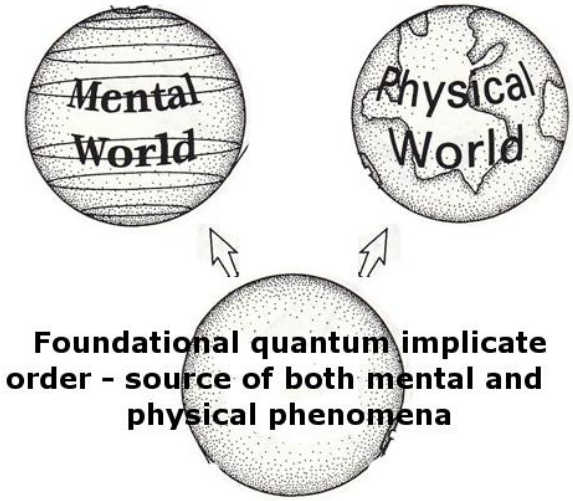


Figure 3 – common quantum implicate source.

The above analysis of the 'three worlds' began from consideration of Popper's metaphysical configuration of his three worlds. Ellis, however, seems to prefer to ignore these aspects of Popper's work, although he considers Popper to be one of his inspirations:

> The concept of falsification is a vital one for the testing of our beliefs. Without it the search for objectivity is in vain, because we can have no clear indication that we are moving beyond the limitations of one view and into a more adequate one. The possibility of our beliefs being shown to be wrong is a crucial indicator that we are avoiding metaphysical dogma and gaining objectivity in our beliefs. However, at the same time, because a metaphysical justification for the process cannot be sought within an experiential framework of objectivity. Central to Middle Way philosophy is the claim that falsification can be decisive and objective without being absolute.[76]

Here again we find Ellis proclaiming the impossibility of true knowledge. Even with the cherished principle of falsification in place "there can be no absolute falsification" because

the principle itself is beyond 'justification' within our "experiential framework of objectivity." This would mean, of course, that the principle of falsification is itself unfalsifiable; which further means that, by Ellis's own proclamations, the principle itself, as employed within Ellis's perspective, becomes *dogmatic* metaphysics.

Ellis's appropriation of the notion of 'falsification' does not seem to conform to Popper's use of it. Ellis would no doubt want to claim that one can only apply the notion of 'metaphysics' to assertions *about* 'Reality', rather than assertions concerning the method for finding, or not finding, out about 'Reality'. Such an unfalsifiable assertion, however, will not wash; for the assertion that 'Reality' is absolutely unknowable is clearly an assertion about 'Reality'. According to Ellis:

> Popper's approach also provides one of the primary ways of recognising metaphysical beliefs: metaphysical beliefs are unfalsifiable beliefs, that is, beliefs that can be maintained regardless of the evidence offered by experience. A metaphysical belief can always be maintained no matter what our experience, because it is sufficiently abstracted from all possible experience to be reinterpreted to fit any possible experience.[77]

If this were to be the case then it clearly applies to Ellis's own assertions, and *this can be seen by applying his own assertions to those very assertions!*

But Ellis's notion of what metaphysics is simply does not conform to most philosophers notion of metaphysics, although it does conform to the use of the term as intellectual abuse as was employed within the dogmatic scientism of the logical positivists. However, during the course of 'traditional' Western philosophy, which Ellis calls 'representational' philosophy, the concern with discovering what the ultimate ontological lineaments of 'Reality' consisted of was central; thus Leibniz wrote:

> I consider the notion of substance to be the keys to the true philosophy.

Brandon C. Look, in his online *Stanford Encyclopedia of Philosophy* entry for Leibniz points out concerning this:

> For Leibniz, the fundamental questions of metaphysics were reducible to questions of ontology: What is out there? What are the most basic components of reality?[78]

And this concern regarding the ultimate nature of the phenomena experienced by sentient, or at least human, beings was also a central, and 'metaphysical', knowledge target for most philosophers down even to Daniel Dennett who, against all the evidence, still maintains an unjustifiable materialist standpoint. And indeed in Dennett's case it is true that he holds a "metaphysical belief" that is "maintained no matter what our experience", to re-quote Ellis. But the reason that Dennett is clearly mistaken is not because, as Ellis thinks:

> …no claim can more than approximately represent truth, and truth can be no more than a regulative idea … . Justification needs to be separated from any reliance on truth claims, and based instead on integration and objectivity. Justification is always incremental and never absolute.

It is, rather because the metaphysical belief in the existence of independent and solid Cartesian type 'matter' has been shown, admittedly in a scientifically 'incremental' manner, within our own experience to be completely false. Ellis claims that:

> A falsifiable belief is of no relevance to us if it does not accord with our experience, and a merely coherent belief that seems to accord with our experience is merely dogmatic if it is not provisional, recognising its own fallibility.

But the falsification of Cartesian type matter is not 'provisional' it is actually final. As quantum physicist Henry Stapp expresses this finality:

> 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.[79]

And, as we shall see, this conclusion, or one like it, is necessarily established by the fact that the precise analysis of our experience indicates that, whatever 'Reality' might be, *it cannot be* made up of "those tiny bits of matter that Newton imagined the universe to be made of," as Stapp puts it.

The very nature of our experience rules this out, unless, that is the fundamental scientific method, including Popper's notion of 'falsifiability', is completely and desperately incorrect, no not even incorrect, the method would have to be desperately and degenerately misleading, or, perhaps, 'Reality' would have to be determinedly and incoherently perverse, having the means at its disposal so to speak to be not just subtly paradoxical but to be utterly, absolutely and unremittingly incoherent and contradictory (it was thought of course that quantum wave and particle were contradictory, but this turns out not to be so – 'particles' are transformations though experience of the fundamental quantum wave-nature).

If 'Reality' were to be made up of tiny 'solid bits of matter', then it simply could not exhibit the phenomenon of quantum entanglement, an issue we now need to investigate in a little detail. And, after we have done so we shall find that Ellis's claim that:

> We do not ultimately know whether or not the world is actually made up of absolute *things* that either exist or don't exist,…[80]

…is actually false. In a recent work the science writer Michio Kaku tells us that:

> The reason why molecules are stable and the universe does not disintegrate is that electrons can be in many places at the same time. ….electrons can exist in parallel states hovering between existence and non-existence.[81]

And, as quantum physicist Lee Smolin says:

> Quantum physics tells us, no it screams at us, that reality is not composed of things. It is made up of processes…[82]

The fact that the 'ultimate' nature of quantum reality, which is the most precise description of the nature of our collective experience available to us, a description which *must* be indicative *in some degree* of the nature of 'Reality', has turned out to be a realm of potentiality which 'hovers' between existence and non existence until it is measured had implications which the physicists Einstein, Boris Podolski and Nathan Rosen (EPR) found detrimental to what they considered what 'Reality' should be like. In 1935 Einstein, Podolsky and Rosen published a paper with the title "Can Quantum- Mechanical Description of Physical Reality Be Considered Complete?"[83] In this paper, known as the EPR paper, EP & R show that quantum physics indicates that there must be a mysterious interconnectedness between distant

quantum aspects of reality, an interconnection completely at variance with anything expected in the 'classical' everyday level. In particular quantum physics requires that quantum 'particles' that have interacted and then separate, even to large distances, are interconnected in a manner such that a measurement of one of them will instantaneously change the state of the other.

In particular this rules out that notion that there are ultimate 'things', 'things' which are conceived of as self-enclosed independent entities which have an 'existence' independent of all other equally independent 'things'. The actual term used by EPR for 'thing' was 'element of reality'. In the EPR paper it was argued that the following should suffice as a definition of an 'element of reality':

> If, without in anyway disturbing a system, we can predict with certainty (i.e., with probability equal to 1) the value of a physical quantity, then there exists an objective element of physical reality corresponding to this physical quantity.[84]

The phenomenon at the heart of this debate is that of quantum entanglement. Quantum 'particles' are said to be 'entangled' when they interact, or are produced, at the quantum level in a manner so that they share a common quantum state which is 'hovering between existence and non-existence'. Whilst they remain in this state neither 'particle' have any determinate characteristics, they only have a multitude of possible characteristics. In fact even to use the term 'particles' is in a sense misleading because until a measurement is performed there is only an interconnected field of potentiality for the 'particles' to come into being when a 'measurement is performed by an 'observer'.

For example consider the case of the polarization of quantum entangled photons ('particles' of light). Two entangled photons are created from a source, one of them moves to the left and the other to the right (figure 4); at this point the photons do not have any explicit polarization although they may become, when measured, polarized in any direction, the actual direction appears to be random. However, the way in which the quantum world works is that if the right photon is 'measured' by an observation to have vertical polarization the left photon will immediately also become vertically polarized. It seems as if there is a 'spooky', to employ the word used by Einstein, instantaneous connection which can operate over any distance.

It is essential to understand the mysterious nature or 'spookiness' of this instantaneous connection in order to appreciate the significance of what is to follow. It is not the case that the photons have a definite polarization that we do not know about; this is the significance of the use of the term 'nonepistemic' by Ghirardi in his explanations. Prior to measurement there is a multitude of potential polarization possibilities but no actual polarization, the state is that of a quantum 'superposition', which is combination of a multitude of potentialities.

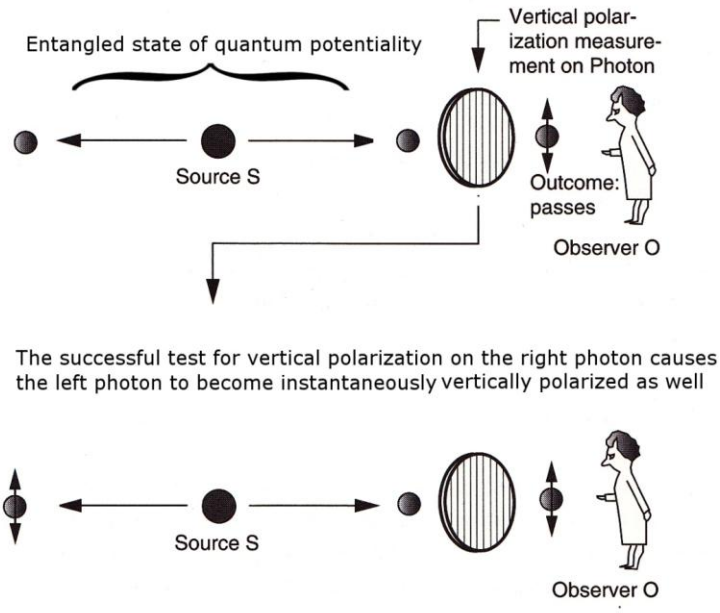


Figure 4 (*taken- with modification - from Ghirardi's book Sneaking a Look at God's Cards*)

John Bell humorously described the mistaken way to view the situation of quantum entanglement in the context of quantum particle 'spin' in which the two particles will adopt opposite spin directions when one is measured, by referring to his cartoon of 'Dr Bertlmann' (figure 5):

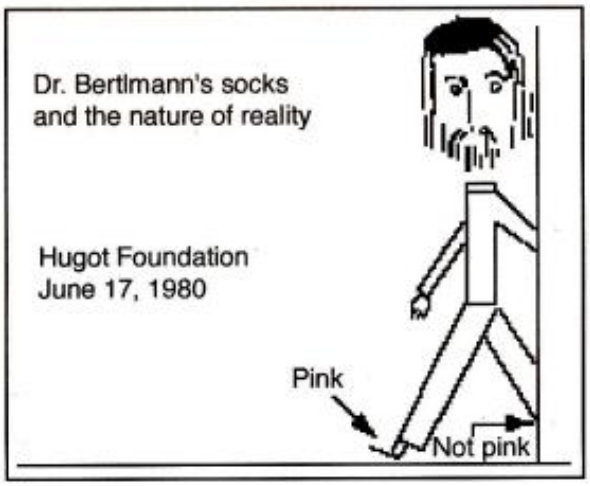


Figure 5

> The philosopher in the street, who has not suffered a course in quantum mechanics, is quite unimpressed by Einstein-Podolsky-Rosen correlations. He can point to many examples of similar correlations in everyday life. The case of Dr Bertlmann's socks is often cited. Dr. Bertlmann likes to wear two socks of different colours. Which colour he will have on a given foot on a given day is quite unpredictable. But when you see that the first sock is pink, you can be already sure that the second sock will

> not be pink. Observation of the first, and experience of Bertlmann, gives immediate information about the second . . . and is not the EPR business just the same?[85]

The point that Bell, is making, of course, is that the situation with the quantum entanglement situation which is addressed in the EPR context as to just what an 'element of reality' consists of is not at all analogous to the Dr. Bertlmann socks example:

> It is in the in the context of ideas like these that one must envisage the discussion of the Einstein-Podolsky-Rosen correlations. Then it is a little less unintelligible that the EPR paper caused such a fuss, and that the dust has not settled even now. It is as if we had come to deny the reality of Bertlmann's socks, or at least their colours, when not looked at. And as if a child has asked, How come they always choose different colours when they are looked at? How does the second sock know what the first has done? Paradox indeed![86]

The point is that if Dr. Bertlmann's socks were quantum socks then they would have no specific colours until an observation is made and when we observe the first the second would somehow 'know' that the first had adopted a colour and would instantaneously adopt a different colour.

But Bell is not revelling in the apparent paradox. At this point in his thinking Bell considered that there was something incomplete and unsatisfactory with the theory:

> Paradox indeed! But for the others, not for EPR. EPR did not use the word "paradox." They were with the man on the street in this business. For them, these correlations simply showed that the quantum theorists had been hasty in dismissing the reality of the microscopic world. In particular Jordan had been wrong in supposing that nothing was real or fixed in that world before observation.[87]

Pascal Jordan was a physicist who had wholeheartedly embraced the notion that the act of observation in some way produces or creates the transition for the realm of quantum potentiality to experienced actuality. This was an adumbration of the now increasingly unavoidable conclusion that in some measure consciousness is creative in the quantum measurement process. At the time that Bell was writing the above analysis, however, Bell was sceptical about such conclusions and was on the side of Einstein-Podolsky-Rosen view that the fact that the left hand photon in the above example adopts a definite polarization when the right one is measured must mean that "there exists an objective element of physical reality" which exists independently of the observation. The notion that the observation of the right hand photon 'created' the polarization of the left hand one was just too 'spooky'.

At this point the physicist David Bohm, who had had lengthy discussions on this issue with Einstein, came up with a 'hidden variables' theory which reproduced all the phenomena of quantum physics in a manner which did not require an 'unreal' or semi-real quantum realm of potentiality but assumed that the positions of 'particles' were hidden and were guided by a quantum 'pilot wave'. There is no need to investigate the de Broglie-Bohm theorem; the point is that such a theory, if correct, would mean that the particles in the polarization experiments we have been considering would have hidden 'on board' local bits of information regarding their inner states (figure 6). Bell greeted this approach with enthusiasm:

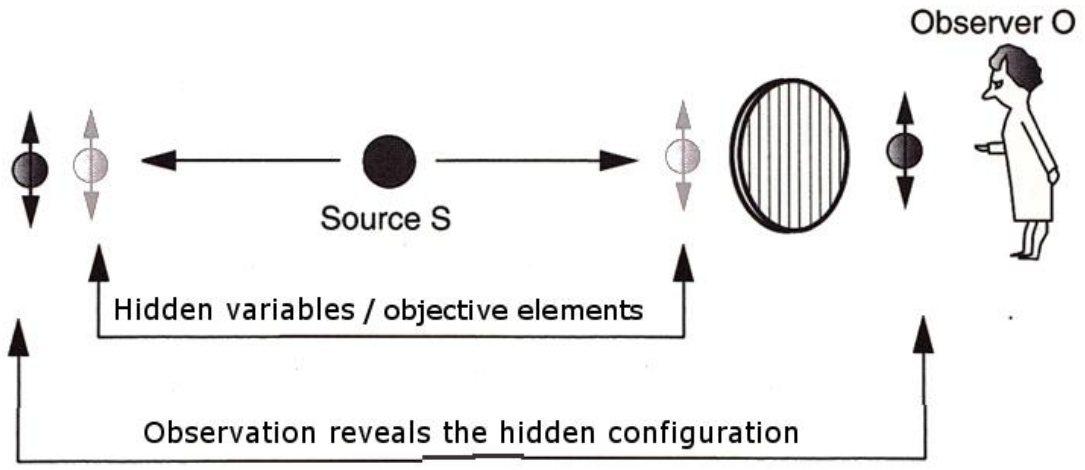


Figure 6

> This theory is equivalent experimentally to ordinary, nonrelativistic quantum mechanics-and it is rational, it is clear, and it's exact, and it agrees with experiment and I think it's a scandal that students are not told about it. Why are they' not told about it? I have to guess here that there are mainly historical reasons, but one of the reasons is surely that this theory takes almost all the romance out of quantum mechanics. This scheme is a living counter-example to most of the things that we tell the public on the great lessons of twentieth century science: things like the uncertainty principle - that particles do not have velocities as well as positions; things like the necessary role of the observer in modern physics - there just isn't any; things like the necessary appearance of hazard, or pure chance, in modern physics; this theory is deterministic and it accounts for all the quantum phenomena fully. So what's wrong with it?

These observations by Bell are crucial and it is necessary to comprehend in their full significance. *Bell at this time was a thoroughgoing realist who would have no truck with what he considered to be 'romantic' notions of uncertainty and the necessary role of the observer in modern physics; according to Bell writing at this time "**there just isn't any**.*" Ghirardi remarks regarding this aspect of Bell's viewpoint at this time that he:

> …pointed out that EPR did not intend to reveal a paradox, but to draw extreme conclusions from the conceptual structure of the theory, and show its incompleteness.[88]

In other words it was not Bell's intention to prove that 'Reality' was in anyway mysterious or paradoxical, quite the opposite, he thought there was something lacking in quantum theory. But, as the quantum physicist Anton Zeilinger points out, in Bell's 1964 paper 'On the Einstein-Podolsky-Rosen Paradox'[89]:

> Bell showed that it is not possible to understand the phenomenon of entangled systems if one starts from rather "reasonable" assumptions about how the world should work, assumptions that one might even be tempted to call self-evident.[90]

It is at this point in his discussion of Bell's work that Ghirardi indicates Karl Popper's deficient understanding of quantum theory, which is worth examining in the light of the fact that Dr. Ellis seems to think that philosophers of science are more authoritative concerning

'Reality' than quantum physicists.. According to Ghirardi, Popper had made the "philosopher on the street" Dr. Bertlmann socks mistake; Ghirardi writes regarding this:

> A similar misunderstanding was shown by the great philosopher of science, Sir Karl Popper. In a book of some of this collected writings, *Quantum Theory and the Schism in Physics*, Popper presents his own criticisms of the orthodox interpretation, attacking the traditional position about the reduction of the wave packet, saying, "No doubt, the reduction of the wave-packet can happen very sudden; even with super-luminal velocity, as I explained in section 75 of *The Logic of Scientific Discovery*; for it simply is not a physical event - it is the result of the free choice of new initial conditions." It should be noted that this wording, with its explicit reference to superluminal events, suggests a position like that of … the socks on Dr. Bertlmann. Just how these new initial conditions, defined as an action that takes place at A, can, to use the language of Popper, render immediately actual some potentialities and not others present in B at the moment of measurement, does not seem to interest him. This work dates from the 1950s.[91]

Ghirardi then recounts how "just few years after writing the preface of that book, Popper fell into an opposite, and equally serious, error about an 'EPR situation.'" In this case Popper suggests his variant of the EPR experiment and argues for the possibility of sending signals faster than the speed of light, a view which Ghirardi indicates is "fundamentally erroneous and arises from an incorrect use of quantum formalism". Ghirardi then continues:

> I recall a spirited discussion I once had with Popper at the International Center for Theoretical Physics at Miramare in 1983. Professor Abdus Salam informed me that on the occasion of Popper's visit (for delivering a lecture on the foundations of quantum mechanics), he would be very pleased if the Center would have on hand some competent person in the field, and asked me to take part in the discussion. I knew Popper's work well and told Professor Salam that my intervention could be critical. Salam's reply was simple: "I have full confidence in you, and if you think you are right, you should explain your position without any fear." Popper presented his thought experiment (a variant of the EPR argument, which, according to him, left us with only two alternatives: either the orthodox interpretation was correct, and it would then be possible to send signals faster than the speed of light, or there would not be any action at a distance and the experiment would constitute a falsification of quantum theory. At the end of the conference I explained to him in simple, but mathematically precise terms, the reasons why his point of departure was erroneous: he had not correctly applied the rules of the theory and in fact, the *impossibility* of sending superluminal signals would confirm the theory rather than falsify it - the exact opposite of what he maintained. At the end of my intervention he only said that he could not answer my objection since he did not have a mastery of the mathematics of the formalism, but was still convinced that the theory implied the possibility of superluminal signals.[92]

The 'orthodox interpretation' refers to the usual interpretation of the 'Copenhagen' viewpoint that in the situation of entanglement described above there is an immediate and inherent connection between distant points of the quantum entanglement. This viewpoint has a radically 'subjectivist' slant in that it would mean that an observation performed at one point would have an immediate effect at the quantum level, possibly across immense distances. Popper considered that the experiment which he proposed, the details of which need not detain us – there is some controversy about its significance[93], would either falsify the Copenhagen view or indicate the 'objective' existence of faster than light signalling. In his

book Ghirardi is carries out a detailed analysis of Popper's views concerning the experiment and concludes that:

> It would be difficult to imagine a more radical misunderstanding of the effects of nonlocality, or a more erroneous use of the formulism.[94]

It would seem, then, Popper considered that his profession as philosopher of science enabled him to contradict established and respected quantum physicists as to the implications of the quantum formulism, even though admitting not being fully conversant with it. And, as we know, Ellis also feels content to make his claims about the impossibility of knowledge without knowing too much about it.

Ghirardi is not the only quantum physicist with a less than positive view of highly lauded philosophers of science. Abner Shimony, who is not only a physicist but is also a highly regarded philosopher of physics, in an interview with Joan Lisa Bromberg conducted in 2002, has some fairly uncompromising things to say about some notions of Thomas Kuhn and Paul Feyerabend concerning the methodology of science. The following remarks were made during Shimony's description of the events surrounding the early testing of Bell's inequality, a mathematical inequality which was given a more testable form by Shimony and others, and an inequality which, as we shall see, if shown to be violated by experiment, indicates that 'Reality' really is mysteriously interconnected in the 'spooky' manner suggested by quantum entanglement. Shimony is talking about the early experimental tests he was involved with; the Freedman-Clauser experiment was the first such experimental test of Bell's inequality:

> Fortunately for Mike and me, Clauser very much wanted his hands on the first experiment, the first test of Bell's Inequality, because he was absolutely convinced that the experiment was going to come out for the local hidden variable theory and against quantum mechanics, and it was going to be an epoch-making experiment and he wanted to have his hands on it.[95]

So Clauser was completely convinced that the 'spooky' aspect of quantum theory couldn't be true and he wanted to test Bell's inequality precisely because he was sure that quantum theory would be shown to be faulty. Clauser, then, fully expected to find that there must be 'local hidden variables', hidden bits of information, 'local', or 'on board' so to speak, to the entities involved, which determined the observed behaviour. Shimony goes on to say that:

> There's another little detail that I want to put in because I really dislike the idea that experimental results are theory laden, that somehow experimenters see what they want to see. Clauser is a very ebullient man, enthusiastic and so forth. So he thought he was certainly going to find local hidden variable results, and that this was going to be revolutionary. He had bets of quite large amounts of money on the outcome, I think of the order of $500, but you'll have to get from him how much it was. His experiment with Freedman came out for quantum mechanics, unequivocally. Holt didn't make, as far as I know, any bets, but he once told me, "My experiment better come out for quantum mechanics. If it comes out for local hidden variable theories, well, I've got the Nobel Prize, but Harvard is not going to give me a doctorate." How did his experiment come out? Well, it was an odd kind of borderline result. It did barely agree with Bell's inequality. It was sort of at the Bell limits, you know, the sum of those expectation values has to be between minus two and plus two. It was just at two. And it disagreed pretty sharply with quantum mechanics. So his experiment came out certainly clearly against quantum mechanics, even though he anticipated, and his theory said it would be quantum mechanical. So here, you have a

> case in which the two main experimental players in the game each got the result that the other anticipated. So much for theory ladenness of observation. Phooey.[96]

When reading the philosophies of science as presented by Kuhn and Feyerabend, it is very easy to come away with the notion that, firstly, reality, as understood by physics, can be viewed through just about any conceptual, theory-laden, framework that the human imagination can come up with and, secondly, the 'progress' of science is a process of dramatic 'revolutions' through which one 'paradigm' is wholly replaced by another 'incommensurate' paradigm:

> Kuhn claimed that science guided by one paradigm would be 'incommensurable' with science developed under a different paradigm, by which is meant that there is no common measure for assessing the different scientific theories. This thesis of incommensurability, developed at the same time by Feyerabend, rules out certain kinds of comparison of the two theories and consequently rejects some traditional views of scientific development, such as the view that later science builds on the knowledge contained within earlier theories, or the view that later theories are closer approximations to the truth than earlier theories.[97]

For Kuhn scientists operating in differing paradigms live in different worlds:

> …the proponents of competing paradigms practice their trades in different worlds. One contains constrained bodies that fall slowly, the other pendulums that repeat their motions again and again. In one, solutions are compounds, in the other mixtures. One is embedded in a flat, the other in a curved, matrix of space. Practicing in different worlds, the two groups of scientists see different things when they look from the same point in the same direction.[98]

It is quite clear that Kuhn emphasizes the discontinuities within changes in scientific perspectives and new developments. Thus in *The Structure of Scientific Revolutions* Kuhn says that:

> ... the physical referents of these Einsteinian concepts are by no means identical with those of the Newtonian concepts that bear the same name. (Newtonian mass is conserved; Einsteinian is convertible with energy. Only at low relative velocities may the two be measured in the same way, and even then they must not be conceived to be the same.)[99]

Such notions, however, are overstated, perhaps for academic effect. An investigation of the concept of 'mass' for instance reveals that its origins are clearly in simple human experience of pushing around 'massive' objects and this fundamental and primal aspect of the meaning of the term still operates within the various much more rarefied conceptual surroundings of physics. Concepts generally evolve through sequences of accumulating differences accruing upon a basic similarity.

Perhaps the most significant, probably the only, major paradigm shift within physics since the seventeenth century has been that of the 'classical' to 'quantum'. As Nick Herbert has said:

> Nothing exposes the perplexity at the heart of physics more starkly than certain preposterous claims a few outspoken physicists are making concerning how the world really works. If we take these claims at face value, the stories physicists tell resemble the tales of mystics and madmen.[100]

This really was a seismic change in our understanding of the 'physical' world, but we are not faced with a bunch of 'classical' physicists completely unable to comprehend another bunch

of 'quantum' based physicists and vice-versa. Physicists today comprehend the nature of both theories; it is the puzzle of how they fit together which is the crucial issue. Within this astonishing paradigm shift, which was prompted by the discovery of serious 'anomalies' - to use a term employed by Kuhn - in the 'classical' paradigm there was most certainly a need to forge new concepts to cope with the new quantum context. As Shimony says:

> Bohr believed that the apparent anomalies of quantum mechanics are consequences of misinterpretation, resulting from the use of theoretical concepts without detailed attention to the experimental arrangement and from neglect of the fact that the arrangement must be described in the language of classical physics. The use of expressions like "creation of physical attributes of objects by observation" are manifestations of such misinterpretation, … It is essential to Bohr's theory of knowledge that the ordinary human elements in experience be accepted without challenge or revision; he wrote "we must not forget that, in spite of their limitation, we can by no means dispense with those forms of perception which colour our whole language, and it terms of which all experience must ultimately be expressed.[101]

Bohr, however, was to a large extent extremely conservative in what he was able to visualize and as Shimony remarks "the theme of renunciation and submission to the unavoidable limitations of the human condition is recurrent in Bohr's writings."[102] Such a viewpoint is understandable at the time when the 'reality' of the everyday word was hardly questionable for most people, even physicists. Bohr clearly wanted to 'save the appearances' of the everyday 'classical' world, and to this end tried to demote the 'reality' of the quantum realm.

Today, however, scanning tunnelling microscopes provide pictures of waves of quantum probability (fig. 7). As Jim Al-Khalili says 'this is the closest physicists have got to actually seeing the quantum wavefunction'[103]. Furthermore the necessary concepts have been developed, upon the basis of former 'classical' notions, to comprehend the quantum situation. In passing it is worth mentioning that, in the light of such STM images Ellis's assertion that quantum theory tells us nothing about the universe seems overblown to the point of bursting!

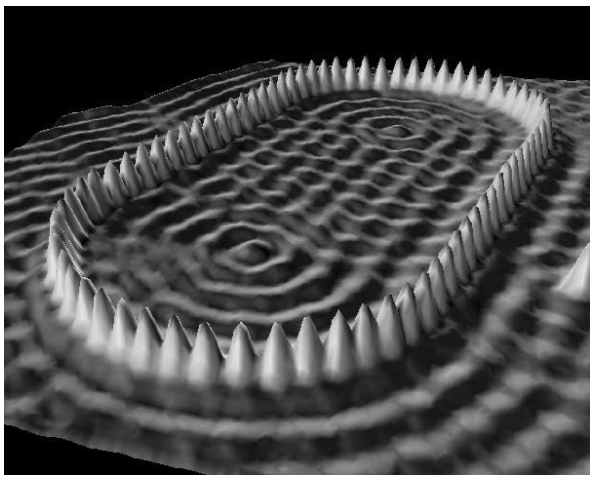


Figure 7

It is not the case that the notion of 'paradigm-shifts' has no relevance, it is just generally overplayed, as is the notion of 'theory-ladenness'. Feyerabend gave a paper entitled 'On the Quantum Theory of Measurement" to the 1957 Colston Research Symposium in which he

introduced a major component of his philosophy of science, the notion that there is no independent neutral 'observation-language' or 'everyday language' against which the theoretical statements can be tested. Quantum physicist and philosopher Bernard d'Espagnat is in no doubt that Feyerabend exhibits a "faulty" understanding of quantum implications, as Feyerabend considers that macro-objects can be taken as being ontologically distinct from their quantum basis[104], which is a misinterpretation of Bohr's position. But Feyerabend's central concern is the issue of the nature of theoretical conceptuality:

> …the everyday level is part of the theoretical rather than something self contained and independent.[105]

And:

> …the interpretation of an observation-language is determined by the theories which we use to explain what we observe, and it changes as soon as those theories change.[106]

Such notions of helpless entrapment within language and theory are appropriate only within limits. It also essential to understand that our experience that gives rise to any language and theory is guided by a 'Reality' within which our experience is enmeshed The notion of paradigm entrapment can become, when absolutized, as is the case with Ellis, a full blown metaphysical scepticism, or, on the other hand, a claim for an absurd thoroughgoing relativism, as if 'Reality' had nothing to say on the matter.

What quantum physics and correct philosophical analysis does provide, however, is a *constrained metaphysical relativism* (CMR). This is the metaphysical position that it is the very nature of 'Reality', not to be unknowable, as Ellis maintains, but to be knowable in various manners which are consistent with, and constrained by, its inner nature. Furthermore the inner, or absolute nature of reality, is indicated by the overlap between various different aspects which are consistent with appropriate experience.

This metaphysical position is basically the one advanced by Stephen in their recent book *The Grand Design*:

> Model-dependent realism short circuits all this argument and discussion between the realist and anti-realist schools of thought. According to model-dependent realism, it is pointless to ask whether a model is real, only whether it agrees with observation. If there are two models that both agree with observation … then one cannot say that one is more real than another. One can use whichever model is more convenient in the situation under consideration.[107]

This view, if hastily perused, might look similar to Ellis's scepticism, but it is not. This is quite clear from the fact that model-dependent realism (MDR) accepts that models can be ruled out, thus final negative metaphysical decisions are possible. In Hawking and Mlodinow's formulation the terms 'realist' and 'anti-realist' are used quite loosely for, in fact, MDR necessarily will have to impute unreality to models, such as the existence of ultimate little balls of 'matter', which are clearly ruled out by observation. And, on the other hand, 'reality', or at least a 'provisional' reality, would have to be accorded to those models which are in accord with observation.

But this, it might be thought, is little better than Ellis's universal metaphysical scepticism, it still only gives us a set of 'provisional' realities. But, again this is mistaken on two counts.

Firstly CMR (constrained metaphysical relativism) asserts that it is the *very nature of reality to reveal itself in various constrained guises*. Secondly, as Hawking and Mlodinow point out:

> … situations in which … very different theories accurately describe the same phenomenon-are consistent with model-dependent realism. Each theory can describe and explain certain properties and neither theory can be said to be better or more real than the other. Regarding the laws that govern the universe what we can say is this: there seems to be no single mathematical model or theory that can describe every aspect of the universe. Instead … there seems to be the network of theories called M-theory. Each theory in the M-theory network is good at describing phenomena within a certain range. Wherever their ranges overlap, the various theories in the network agree, so they can all be said to be parts of the same theory.[108]

And it is within the overlapping of the ranges, in particular the point at which all ranges overlap, that we can find a clue to the 'ultimate' metaphysical nature of reality. Furthermore, as will be argued in other articles, because the ultimate nature of reality is mind-like or 'Mindnature', it is entirely possible that there are advanced techniques of training and meditation which enable one to directly experience the deep non-dual nature of 'ultimate' reality.

It is time to start Bell's theorem tolling for the end of dogmatic sceptical metaphysical agnosticism. The experiment we are going to consider is considerably simplified for purposes of exposition but will contain all the elements necessary to understand the remarkable quantum phenomenon of the non-local interconnection of quantum entanglement. The experimental set up is shown in figure 8. The two experimenters are traditionally called Alice and Bob, each has control of a polarizing filter which can be rotated into three positions: 1, 2 and 3. They choose which position at random as entangled 'particles' are sent from a source towards the polarizing filters as shown. Sometimes the 'particles' will be transmitted through the filter and sometimes they fail to transmit, which occurs seems to be a random event. Quantum theory gives us the precise probabilities for transmission and failure but the actual values need not concern us. All we need to know for the moment is that there are three possible positions for the polarizing filters 1, 2, and 3, and, furthermore, for each position the photon will either pass through, which we register as YES, or fail to pass, which we register as a NO.

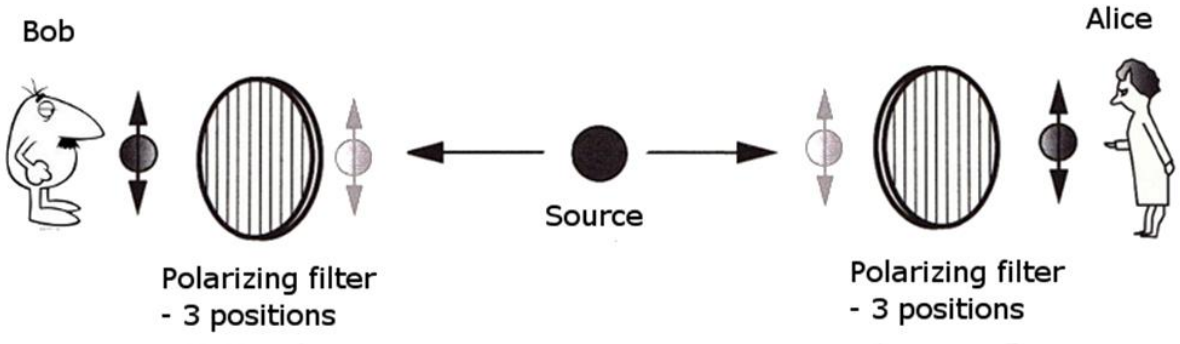


Figure 8

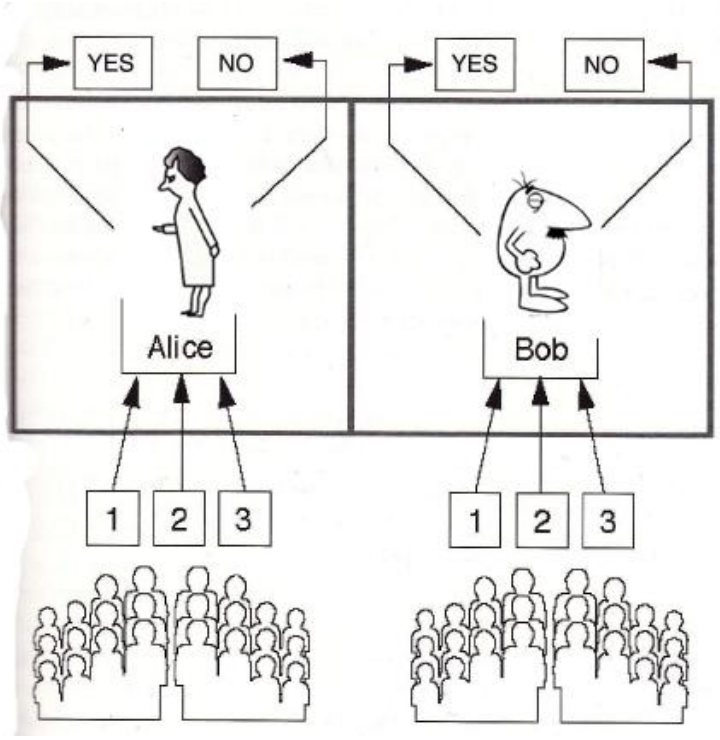


Figure 9

The following discussion is taken from Ghirardi's brilliant book on quantum physics *Sneaking a Look at God's Cards*, in a section entitled 'Telepathy or a Cheap Trick'. Alice and Bob are putting on a music hall performance (figure 9). There are two section of the audience one of which continuously and randomly feed Alice cards with a 1,2 or 3 on each of them; the other does the same for Bob. Both Alice and Bob write either a 'YES' or a 'NO' on each card they are given, this response is random but 50% of the time the response will be 'YES' and 50% 'NO'. The performance is set up so that it appears that Alice and Bob have no idea about the numbers on the other's cards, or the other's responses. However, amazingly, whenever Alice and Bob are, randomly, given the same number they always, apparently also randomly, give the same response, they both either write 'YES' or both write 'NO'. It appears to be an astounding feat of telepathy!

However, there are sceptics who suggest that such telepathy is simply impossible, the performance must involve a cheap trick, it is obvious, they say, that Alice and Bob must come to a prior agreement of some kind which enables them to produce the illusion of telepathy, there must be some 'hidden variables' somewhere in the performance. The only way this could be done is to agree to patterns of responses before the show. For example, they could decide that for the first set of cards they might agree to the pattern:

1	2	3
YES	NO	NO

and for the second:

1	2	3
YES	NO	YES

And so on. They would have to remember a great many patterns but we assume they can do this. They must also make sure that the patterns they use are such that the overall 'YES' – 'NO' responses are split 50%-50%.

This imaginary music hall performance actually corresponds to the experiment shown in figure 8. Alice and Bob are choosing the setting of the polarizing filters to one of the three positions at random - the experiment has been set up so that they are completely isolated from each other. Furthermore what happens in the experiment, which has been repeated on many occasions to a fine level of precision, is exactly as described in the music hall example. Whenever Alice and Bob set the filters to the same position the result – PASS = 'YES' or FAIL = 'NO' is always the same. When the positions are different, however, the results seem pretty random. The question which arises, of course, is how do the photons manage to coordinate? This is the issue of whether or not there are 'hidden variables'' operating at the quantum level that we have not spotted. By the way, the distance over which such experiments have been carried out is more than 10 kilometers[109], and yet it appears that the photons respond instantaneously. How?

In the case of the music hall scenario Ghirardi shows that it is possible to demonstrate that by examining the configuration of the pairs of results in which there are mismatches of numbers that it is impossible for Alice and Bob to have a pre-arranged 'hidden-variable' system. A shrewd group of researchers, whom Ghirardi likens to Bell, do some further investigation and discover that over time the number of disagreements and agreements between the cards given to Alice and Bob is equal. They then look into what the situation would be in the case of using pre-arranged tabled. First they note that the possibilities for the two cards given to Alice and Bob at any one time is as follows:

1,1 1,2 1,3 2,1 2,2 2,3 3,1 3,2 3,3

Now consider what happens when Alice and Bob apply the first table above (using 'Y' for YES, 'N' for NO) and we note the number of agreements and disagreements:

1,1	1,2	1,3	2,1	2,2	2,3	3,1	3,2	3,3
YY	YN	YN	NY	NN	NN	NY	NN	NN
agree	disagree	disagree	disagree	agree	agree	disagree	agree	agree

This gives 5 agreements and 4 disagreements

What about the second table?

1,1	1,2	1,3	2,1	2,2	2,3	3,1	3,2	3,3
YY	YN	YY	NY	NN	NY	YY	YN	YY
agree	disagree	agree	disagree	agree	disagree	agree	disagree	agree

This gives 5 agreements and 4 disagreements.

As long as we use tables with one YES and two NOs or one NO and two YESs the pattern we choose is irrelevant, we will always get a ratio of 5 agreements to 4 disagreements; if we use all YESs or all NOs we will get 9 agreements of course. So we can conclude with certainly that using tables in this way would mean that:

Number of agreements – Number of disagreements ≥ 1 ('$\geq$' means greater or equal to)

This is a Bell-type inequality.

But our investigators have already discovered that the number of agreements and disagreements which actually occur is equal, so the difference between them is zero. The only conclusion that can be drawn is that it is impossible for prearranged tables to be being used. If pre-arranged tables were being used then the difference between the number of agreements and the number of disagreements *must* be greater or equal to one. But in actuality the difference is zero. Hence tables cannot be in use; it therefore must be a case of telepathy. This is an example of the use of a Bell-type inequality; and the significant point to grasp is the fact that *the violation of the inequality proves without doubt that no cheap tricks, no pre-arranged tables, or no 'hidden variables' can possibly be involved in the phenomenon. We are in the presence of telepathy!*

In his book *The Dance of the Photons* Professor Anton Zeilinger, a quantum experimenter who has conducted many of the precise experiments of the type we are discussing gives a fairly accessible derivation of *Bell's inequality for polarization of entangled photons*. This presentation derives from a paper by Eugene Wigner[110] which was expanded by d'Espagnat[111] In order to make the derivation more approachable we consider pairs of identical human twins, instead of entangled quantum 'particles.' The three polarization measurements (1, 2, or 3) correspond to the observation of three features of the twins, their height, hair color, and eye color, and we set this up so that we use two valued features: tall or short (we can set a height to divide our sample into two groups), blue eyes or brown eyes, blond hair or brunet hair. Because the twins are identical we know that if one of the twins is tall, blue-eyed, and brunet, we know that the other twin will also be tall, blue eyed, and brunet. From the perspective of Einstein, Podolsky, and Rosen, these three properties - height, eye color, and hair color - are 'elements of reality' that we predict with certainty for the second twin upon obser-vation of the first twin. We also assume that the reason for these correlations is that the twins carry the same genes. These genes correspond to the 'local hidden variables' we postulate might be operational in the quantum situation.

We can now look at all the possible combinations in a large sample of these twins:

- Tall, blue-eyed, brunet
- Tall, blue-eyed, blond
- Tall, brown-eyed, brunet
- Tall, brown-eyed, blond
- Short, blue-eyed, brunet
- Short, blue-eyed, blond
- Short, brown-eyed, brunet
- Short, brown-eyed, blond

Now we can make some very simple and obvious statements amount the numbers involved. For instance:

$$\begin{pmatrix}\text{Number of tall}\\ \text{pairs of twins}\\ \text{with blue eyes}\end{pmatrix} = \begin{pmatrix}\text{Number of tall}\\ \text{pairs of twins}\\ \text{with blue eyes}\\ \text{and brunet hair}\end{pmatrix} + \begin{pmatrix}\text{Number of tall}\\ \text{pairs of twins}\\ \text{with blue eyes}\\ \text{and blond hair}\end{pmatrix} \quad \textbf{[Exp 1]}$$

The equality (**Exp**ression **1**) should be obvious, as the hair colours blond and brunet cover all the twins there cannot be any tall, blue-eyed twins with another hair colour. From this equation we can derive the following inequality, the symbol '≤' means that the number on the left hand side is less than or equal to the number on the right hand side:

(Number of tall pairs of twins with blue eyes) ≤ (Number of tall pairs of twins with brunet hair) + (Number of blond pairs of twins with blue eyes)

[Exp 2]

The reason that this inequality must be true is because:

(Number of tall pairs of twins with blue eyes) = (Number of tall pairs of twins with blue eyes and brunet hair) + (Number of tall pairs of twins with blue eyes and blond hair)

(Number of tall pairs of twins with brunet hair)

This number must be larger than the top number because we know there are tall, brunet pairs with brown eyes which we have added to this set.

Both of the bracketed sets on the left hand side of **Exp 2** must be larger than the corresponding bracketed sets in **Exp 1** because extra pairs of twins are added in. In the case of the first bracket on the right hand side, pairs of twins who are tall, brunet with brown eyes are added in; and in the case of the second bracketed set on the right hand side we have added in pairs of twins with blue eyes, blond hair and are short.

Now we suppose that we can only observe one property on each twin, we can write down **Exp 2** as follows:

(Number of pairs of twins where one is tall and the other has blue eyes) ≤ (Number of pairs of twins where one is tall and the other has brunet hair) + (Number of pairs of twins where one has blond hair and the other has blue eyes)

[Exp 3]

Why does this work? Consider the set on the left hand side. The number of pairs of twins where one is tall and the other is blue eyed must be the same as the number of tall twins with

blue eyes because they are twins. If the twin of a tall twin has blue eyes then the tall twin must have blue eyes also because they are twins. The same reasoning applies to the sets on the right hand side; so **Exp 3** is equivalent to **Exp 2** but expressed in a different form. **Exp 3** is *Bell's Inequality for Twins*.

The point of this inequality is that it must be satisfied by a 'Reality' which conforms to our everyday notions concerning reality, which is that 'Reality' is made up of individual, separately existing things which have their features inherently attached to them independently of observations. Zeilinger comments upon Bell's achievement with devising this possibility for performing 'experimental metaphysics':

> How is it possible that a statement as simple as Bell's inequality might not hold in nature? The problem we have is that the considerations that led us to Bell's inequality were extremely simple. I would argue that they are so simple that the Greek philosopher Aristotle could already have derived Bell's inequality had he known that this was an interesting and nontrivial problem. We did not have to use quantum mechanics for its derivation. But Aristotle would never have expected that this could be an interesting problem. In contrast, he probably would have said that this is quite uninteresting, because nature obviously has to behave in a way so as not to violate the inequality.

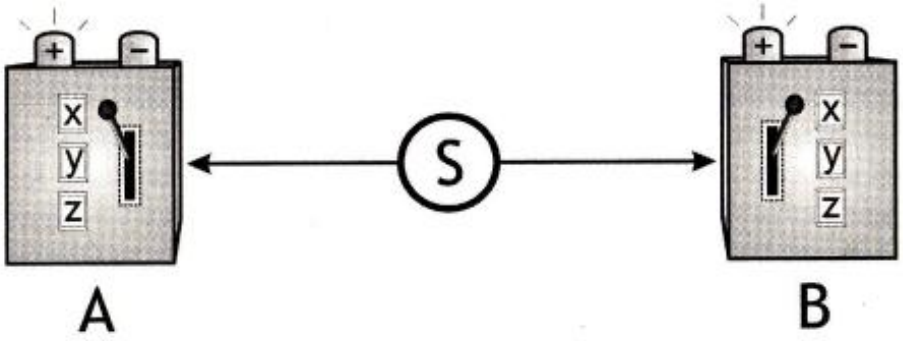
As Daniel Greenberger commented, to think that nature could possibly function in a manner to violate Bell's inequality is surely "crazy".[112]

In order to translate this from the terms of human twins, also taking into account Ghirardi's discussion outlined above, we use the following translation. In Zeilinger's discussion he refers to the diagram shown in figure 10. We had three different features which were determined by the setting of the polarization filters, these features were labelled 1, 2 and 3, in order to accord with Zeilinger's exposition we shall now label them x, y and z. There were two possible results: 'YES' 'NO', which now are labelled + or –, Alice and Bob become 'apparatus A' and 'apparatus B'. We need to recall that the + and – results are always perfectly correlated (+ + or – –) whenever the same feature was tested at apparatus A and apparatus B. Zeilinger gives the following explanation, the expressions in square brackets indicates Ghirardi's schema:

- The size corresponds to the property x [1]: tall is translated into the result + [YES]; short translated into the result – [NO].
- Eye colour corresponds to the property y [2]: blue is translated into the result + [YES]; brown translated into the result – [NO].
- Hair colour corresponds to the property z [3]: brunet is translated into the result + [YES]; blond translated into the result – [NO].

And we now have *Bell' inequality for pairs of entangled quantum particles*:

$$\begin{pmatrix}\text{Number of} \\ ++ \text{ results with} \\ \text{apparatus A on } x \\ \text{and apparatus} \\ \text{B on } y\end{pmatrix} \leq \begin{pmatrix}\text{Number of} \\ ++ \text{ results with} \\ \text{apparatus A on } x \\ \text{and apparatus} \\ \text{B on } z\end{pmatrix} + \begin{pmatrix}\text{Number of} \\ +- \text{ results with} \\ \text{apparatus A on } y \\ \text{and apparatus} \\ \text{B on } z\end{pmatrix}$$



Arrangement for the experimental observation of entanglement. A source S emits pairs of particles. One particle is registered by measurement station A, the other particle by measurement station B. Using a switch at each measurement station, the experimentalist can decide which kind of measurement, *x*, *y*, or *z*, is performed on the respective particles. The measurement result for each of the positions of the switches has only two possibilities, + or −.

Figure 10 (Taken from *The Dance of the Photons*)

Zeilinger goes on to describe a slightly more complicated experiment which need not concern us. The results apply equally to the inequality displayed above. The point is that Bell's inequality must be satisfied for a 'locally real' 'Reality' to be functioning, which is a 'Reality' with 'real' individuated and separate 'things', or 'elements of reality', to ultimately exist independently of observations, and independently of all other apparent 'things'. *Quantum theory predicts that that Bell's inequality must be violated; and it turns out that in all experiments (except an early one which certainly was defective) quantum physics has been validated and Bell's theorem violated.*

In the final paragraph of his section 'Telepathy or Cheap Trick' Ghirardi writes:

> I would like to conclude this section with a quotation from Einstein that is particularly apt for the example just discussed, and shows how lucidly he intuited (even while refusing to accept) the deepest implications of the theory, long before Bell's own analysis: "It seems hard to sneak a look at God's cards. But that He plays dice and uses 'telepathic' methods (as present quantum theory requires of Him) is something that I cannot believe for a single moment."[113]

Indeed, it seems remarkable that Einstein, who was the first to take the notion that 'Reality' at its deepest physical level was quantum in nature, when he used the idea to solve the puzzle of the photoelectric effect, and was the person, of course, who overturned notions of absolute

space and time with his relativity theories, simply could not, would not, accept that independent and completely separate 'elements of reality' ultimately do not exist.

Ghirardi, however, tells us that the evidence tells us that "the photons themselves must be telepathic."[114] Experiments of extraordinary delicacy and precision have been carried out to probe the phenomenon of the telepathic nature of quantum entanglement. Ghirardi describes one carried out by Alain Aspect, who carried out one of the first precise demonstrations of the violation of Bell's inequality, and collaborators that involved a system which precluded any form of hidden message being transmitted at the speed of light and he concludes:

> Personally, I take the experiment of Aspect and his collaborators as conclusive: photons really are telepathic, or to use more scientific terminology they cannot be considered as possessing any local characteristics that determine whether or not they will pass the test before the test is carried out. Nevertheless, they still react the same way for the same test.[115]

Anton Zeilinger concludes that:

> Quantum particles do not behave like identical twins. Even though they always show the same results when they are measured for the same property, we are not allowed to explain this by saying that they carried that property before and independently of observations.[116]

Zeilinger analyses what he considers to be the implications of the quantum physical violation of Bell's inequality in his final section 'What Could That Mean?". He begins by asserting that at least one of the assumptions about "Reality" which were used to derive Bell's inequality must be wrong. These assumptions he lists as follows:

1) **Realism**: This is the idea that an experimental result reflects in some way the features of the particles that we measure.
2) **Locality hypothesis**: the assumption that the real physical situation of the measurement at apparatus B including particle b must be independent of the kind of measurement done at the same time to the distant particle a using measurement apparatus A.
3) **Counterfactual nature of reality**: Zeilinger writes: "There is a third assumption, which we used implicitly but did not express in detail. It is the assumption that it makes sense to consider what kind of experimental result would have been obtained if one had measured a different than the one than the one that was actually measured. For the case of twins the assumption means that it makes sense to assume that, for example, blue-eyed blond twins must be either tall or short, even if we do not check their height.

Zeilinger then writes that:

> We now discuss some of the possible conceptual consequences of the breakdown of local realism. One possibility is that the reality assumption is not correct. This would mean in principle that the property of a particle observed in a specific experiment is not an element of physical reality before the measurement is performed. In the end, this means that the reality depends on the decision of the observer-of the experimentalist-about which measurement to perform. The breakdown of realism would mean that the measured result does not reflect any kind of property that existed before and independently of observation.
>
> Another possibility would be that the locality hypothesis is not correct. Such a breakdown of locality could, for example, mean that something is wrong with our

> picture of space and time. A quantum system that consists of two or more entangled particles remains an unseparated entity regardless of how far the individual components of the system are separated from each other.
>
> A breakdown of the third assumption would mean that one is only allowed to talk about the properties of systems when these properties are indeed measured. Expressed very simply, the question "What if?" would be illegal. This would certainly contradict our everyday experience. We always consider different possible alternatives, and we base decisions on the possible consequences of these alternatives. For example, to know what will happen if we cross a superhighway during rush hour with our eyes closed, it is not really necessary for us to perform that experiment.
>
> At present, there is no agreement in the scientific community as to what the philosophical consequences of the violation of Bell's inequality really are. And there is even less agreement about what position one has to assume now. Nearly all physicists agree that the experiments have shown that local realism is an untenable position. The viewpoint of most physicists is that the violation of Bell's inequality shows us that quantum mechanics is nonlocal. This nonlocality is exactly what Albert Einstein called "spooky"; it seems eerie that the act of measuring one particle could instantly influence the other one.
>
> The other possibility would be for us to give up the picture of a world that exists in all its properties independent of us. That would mean that we have a very essential influence on reality just by deciding which measurement to perform. There are indeed hints that this might be the message we have to accept.[117]

Nowhere in his summary, however, does he mention the possibility that 'Reality' can be made up of independent, completely solid and self-contained units of 'matter'. Such a metaphysical position has been, completely ruled out, if, that is, we accept that 'Reality' is essentially coherent. But isn't the assumption of a completely and radically incoherent universe, well, incoherent?

Although in the above quote Zeilinger says that "there is no agreement in the scientific community as to what the philosophical consequences of the violation of Bell's inequality really are," this does not mean that there are not some possibilities that are definitely ruled out by the results of the demonstration of the violation Bell's inequality. This is why Zeilinger writes in a collection of essays dedicated to the work of the famous twentieth century physicist John Wheeler of Wheeler's:

> …realization 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.[118]

Which is an observation which clearly suggests that there can be no 'Reality' which is completely cut off and 'independent' from sentient observation of some sort; in some manner all sentient beings are somehow 'entangled' with the world of apparent materiality. As Wheeler expressed this quantum insight:

> 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.[119]

Although some may find Wheeler's pan-psychic cosmic vision overly 'mystical', it remains the case that any kind of naïve realism about 'matter' being composed of solid independent 'stuff' which has no connection to the minds of observers is ruled out as a metaphysical possibility by the violation of Bell's inequality. Such an ontological structure of reality would be completely and absolutely at variance with our collective experience as revealed by physics.

The recent publication of the book *Elegance and Enigma: The Quantum Interviews* enables us to get some idea of what some significant physicists of the 'scientific community' think about the implications of the violation of Bell's inequalities as the subject was one of the questions posed to a group of quantum physicists by the editor Maximilian Schlosshauer. The following are brief excerpts from the answers given[120]:

Guido Bacciagaluppi: …what can safely be said is that … distant correlations present in nature cannot be understood in what seem to be quite general forms of local models. … I am happy to call that nonlocality.

Caslav Brukner: Bell's theorem … states that no 'local causal' or 'local realistic' theories can ever reproduce all of the predictions of quantum theory … (and) requires a radical revision of the ruling philosophical view among most scientists and is in sharp contrast to our everyday experience.

Jeffrey Bub: …the experimentally observed violations of Bell's inequalities tell us that we live in a world in which there are nonlocal correlations which are inconsistent with any explanation in terms of common causes.

Christopher Fuchs: … our actions matter indelibly for the rest of the universe (pluriverse). … With every quantum measurement set by an experimenters free will, the world is shaped just a little as it participates in a kind of moment of birth.

Daniel Greenberger: Bell's theorem is based on the idea that there exist sets of instructions that determine future events as consequences of past events. The violations of Bell's theorem tells us that there exist situations that do not follow from such sets of instructions. This relates directly to our ideas of classical causality, which are based on the future being determined by specific conditions in the past. Instead, in quantum theory we have entangled states, where neither state is determined until it is measured.

Tim Maudlin: … we can conclude that nature is nonlocal.

Lee Smolin: The observed violations of the Bell inequalities imply that there are real physical nonlocal correlations in nature.

Antonio Valentini: The observed violations of Bell's inequality tell us that locality it violated – if we assume that there is no backward causation and that there are non many worlds.

Wojciech Zurek: The basic message is that our universe is quantum.

According to d'Espagnat an important implication of Bell's theorem is the correctness of quantum field theory as the most fundamental *physical and metaphysical* account of 'Reality'. He writes:

> …what, from a philosophical standpoint, is by far the most remarkable feature of quantum field theory is that it reduces the (scientifically unmanageable) notion "creation" [of particles] to the (scientifically tractable) notion "state change." And the point that is relevant to the here considered issue is that it succeeds in doing so

> by making primary some concepts of a general nature-such as fields associated with types of particles-and secondary the concept of individualized particles. Consequently, if we are on the lookout for some concept, or "mathematical algorithm," that this theory could be identified as referring to the "basic stuff," we can find none except, conceivably, the element the state of which changes when a particle gets "created" or "annihilated". … Now, in the theory, there are not myriads and myriads of such elements. Indeed there is just one! Which means that, conceptually speaking, the theory is as far from atomism as it is conceivably possible for a theory to be.[121]

On the other hand, however, I guess that if we are still in the mood to humour an extreme Humean scepticism, it could all conceivably be being orchestrated by Noddy and Big Ears pulling wooden levers at the edge of the universe, could it?

It might be thought that such a lampoon is going too far, being too unkind. But it must be fully appreciated that Ellis is asserting that human beings can reach *absolutely no certain knowledge* about the metaphysical nature of reality, either positively or negatively. Yes, one might say, but he obviously would not claim that fictional characters from children's books could be viable metaphysical agents. Maybe not, however, the point is that, in the light of the quantum violation of Bell's theorem, Cartesian-Newtonian type 'matter' is equally, although not so obviously, fictional; which is why quantum physicist Henry Stapp tells us that:

> One might try to interpret the 'matter' occurring in this formula as the 'matter' that occurs in classical physics. But this kind of 'matter' does not exist in nature.[122]

And which is also why Paul Davies and John Gribben, in their book about 'the death of materialism', which is the title of their first chapter, *The Matter Myth*[123].

In a talk entitled 'Science, Values, and the Nature of the Human Person'[124] Henry Stapp referred to the necessity for a new idea of 'matter':

> By this new idea of "matter" I mean the new idea of the "stuff" out of which the physical universe is made. The properties of this stuff are radically different from the properties of matter postulated by Isaac Newton and his successors. The properties of "quantum matter" lie "mid-way" between those of classical matter and mind:"matter" has moved toward "mind".

The problem with the notion of adopting a new concept of 'matter', however, lies precisely in its Cartesian-Newtonian origin which has permeated the Western scientific, philosophical and academic ethos to the point of no return. As we have seen, when we have two possible ontological absolutes, 'Mind' and 'Matter', and one of them, in this case 'Matter' is in true Popperian fashion 'falsified', then that must clearly leave us with the only possible conclusion, the ultimate nature of 'Reality' is Mind-like.

It would seem that the most obvious conclusion is precisely that which is indicated by quantum field theory conjoined with the obvious conclusion that the ultimate quantum field must have mind-like qualitative features; otherwise none of us would have minds. The violation of Bell's theorem, which has been experimentally verified over and over with astonishing degrees of precision, indicates that the realm of what was once thought be independent 'matter' and the realm of mind are not separate but interpenetrate in a nonlocal quantum field of potentiality which bears a significant resemblance to what Buddhist

Dzogchen philosophy calls 'Mindnature' – an energetic realm of potentiality which is activated by an internal 'excitatory intelligence'.

The Tibetan Dzogchen term *sems nyid* is translated by Anne Carolyn Klein and Geshe Tenzin Wangyal Rinpoche in their book *Unbounded Wholeness: Dzogchen, Bon, and the Logic and the Nonconceptual* as 'Mindnature' may be a possible description of the ultimate nature. As the *Expansive Sky Tantra* says:

> Prior to Buddhas or ordinary beings,
> Our primordial ancestor, the quintessential heart essence base
> Dwells as just that unbounded sun heart essence
> Because it is one with, being everywhere suffused by,
> The dynamic display of the [creative and unmanifested] dimension,
> My own mind, just that greatness, vast and whole
> Dwells primordially uncoarsened by any external element.

A1so the *Authentic Scripture* says:

> Prior to all Buddhas and sentient beings
> When even their names do not exist
> Is ancestral wholeness, mindnature.

Furthermore the *Profound Great Bliss Sutra* says:

> Mind of mine, dwelling in the present
> Uncontrived, uncoarsened, and untouched
> Heart essence of all that is
> Dwells solely as wholeness unbounded.[125]

So it looks as if we can say that quantum Mindnature dwells solely as quantum non-locality unbounded!

Sources:

Allday, Jonathan (2009). *Quantum Reality: Theory and Philosophy.* CRC Press.

Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004). *Science and Ultimate Reality*. Cambridge University Press.

Brunnhölzl, Karl (2004) *Center of the Sunlit Sky: Madhyamaka in the Kargyu Tradition.* Ithaca: Snow Lion Publications.

Brunnhölzl, Karl (2010). *Gone Beyond: Volume 1: The Prajnaparamitra Sutras, The Ornament of Clear Realization, and Its Commentaries in the Tibetan Kagyu Tradition.* Ithaca: Snow Lion Publications (Tsadra Foundation).

Bohm, D (2002) *Wholeness and the Implicate Order* (First published: Routledge & Kegan Paul, 1980; Routledge Classics, 2002)

Chandrakirti and Jamgon Mipham (2002). *Introduction to the Middle Way: Chandrakirti's* Madhyamakavatara *with Commentary by Jamgon Mipham.* Translated by the Padmakara Translation Group. Boston: Shambhala Publications.

d' Espagnat, B (2003). *Veiled Reality: An Analysis of Present-Day Quantum Mechanical Concepts*, Westview Press.

Dolling, L.M.; Gianelli, A. F. & Statile, G. N. (eds) (2003). *The Tests of Time: Readings in the Development of Physical Theory*. Princeton University Press.

Eccles, John C. and Karl Popper (1984). *The Self and Its Brain: An Argument for Interactionism*, Routledge - (http://en.wikipedia.org/wiki/Karl_Popper)

Ellis, R. M. (2008). *The Trouble with Buddhism: How the Buddhist tradition has betrayed its own insights*. UK: Robert M. Ellis; Lulu.com.

Feynman, Richard (1988). *QED: The Strange Theory of Light and Matter*. Princeton University Press

Ghirardi, G (1997). *Sneaking a Look at God's Cards: Unraveling the Mysteries of Quantum Mechanics*, Princeton University Press.

Gribben, John (2009). *Science: A History*. Penguin Books.

Hawking, Stephen & Mlodinow, Leonard (2010). *The Grand Design: New Answers to the Ultimate Questions of Life*. Transworld Publishers – Bantum Press.

Herbert, Nick (1985). *Quantum Reality: Beyond The New Physics.* Random

Hopkins, Jeffrey (1996). *Meditation on Emptiness*. Wisdom Publications, U.S.A. (First published 1983).

Kaku, Michio (2006). *Parallel Worlds: The Science of Alternative Universes and our Future in the Universe*. Penguin Books (First published by Doubleday 2005).

Klein, A. C. & Geshe Tenzin Wangyal Rinpoche (2006). *Unbounded Wholeness: Dzogchen, Bon, and the Logic of the Nonconceptual*, Oxford University Press.

Murti, T.R.V (1987). *The Central Doctrine of Buddhism A Study of the Madhyamaka System.* Unwin Paperbacks.

Oerter, Robert (2006). *The Theory of Almost Everything*. Pi Press.

Penrose, Roger (2007). *The Large, the Small and the Human Mind*, Cambridge University Press – First Published 1997.

Penrose, Roger (1995). *Shadows of the Mind*. Oxford University Press:1994, Random House-Vintage:1995

Penrose, Roger (1999). *Emperors New Mind*. Oxford University Press:1989, Oxford University Press paperback:1999

Popper, K. R. (1971). *The Open Society and Its Enemies: The Spell of Plato*, Princeton University Press - (http://en.wikipedia.org/wiki/Karl_Popper)

Schlosshauer . M, (ed.) (2011). *Elegance and Enigma: The Quantum Interviews*, Springer-Verlag Berlin Heidelberg.

Smolin, Lee (2002). *Three Roads to Quantum Gravity*. Perseus Book Group:2002 (first published 2000)

Stapp, H. P. (2007). *Mindful Universe: Quantum Mechanics and the Participating Observer*. Berlin, Heidelberg, New York, US.: Springer.

Strawson, G. et al. (ed. Anthony Freeman) (2006). *Consciousness and its place in nature: does physicalism entail panpsychism?* Imprint Academic.

Zeilinger, Anton (2010). *Dance of the Photons*. Farrar, Straus and Giroux.

[1] Ratnagotravibhaga – Direct Path to the Buddha Within
[2] http://www.moralobjectivity.net/Twb_Quantum_irrelevances .html
[3] http://www.moralobjectivity.net/concept%20-%20scepticism.html
[4] ibid
[5] http://www.moralobjectivity.net/oncept%20-%20agnosticism.html
[6] http://www.moralobjectivity.net/concept%20-%20agnosticism.html
[7] http://www.moralobjectivity.net/concept%20-%20agnosticism.html
[8] http://www.moralobjectivity.net/concept%20-%20agnosticism.html
[9] http://www.moralobjectivity.net/Death_of_Metaphysics.html
[10] Ellis, R. M. (2008).
[11] The term 'Madhyamaka' is now used to describe the philosophy and the term 'madhyamika' is used for a practitioner.
[12] Murti, T.R.V (1987) p321
[13] Murti, T.R.V (1987) p8
[14] Bruce Evans's translation of Chapter 4 of Ajahn Payutto's Buddhadhamma: 'Dependent Origination: The Buddhist Law of Conditionality'. - http://www.buddhanet.net/cmdsg/coarise.htm
[15] http://www.moralobjectivity.net/nagarjuna.html
[16] Brunnhölzl, Karl (2004) p228
[17] Ghirardi, Giancarlo (2005) p348
[18] http://www.moralobjectivity.net/concept%20-%20agnosticism.html
[19] http://www.moralobjectivity.net/concept - metaphysics.html
[20] Strawson, Galen - 'Realistic Monism: Why Physicalism Entails Panpsychism' in Strawson, G. et al. (ed. Anthony Freeman) (2006)
[21] http://www.moralobjectivity.net/concept%20-%20agnosticism.html
[22] Email correspondence
[23] Penrose, Roger (1995) p313
[24] d' Espagnat, B (2003). xvi
[25] http://www.moralobjectivity.net/concept%20-%20scientism.html
[26] Ghirardi, Giancarlo (2005) p226
[27] Ghirardi, Giancarlo (2005) p291
[28] http://philpapers.org/s/Abner%20Shimony
[29] Ghirardi, Giancarlo (2005) p226
[30] Klein, A. C. (1992) p298 quoted in Brunnhölzl, Karl (2010).
[31] Email correspondence
[32] Joos, Erich (2006). 'The Emergence of Classicality from Quantum Theory' in *The Re-Emergence of Emergence: The Emergentist Hypothesis from Science to Religion* (Eds: Philip Clayton and Paul Davies). Oxford: Oxford University Press. p54
[33] http://en.wikipedia.org/wiki/Holographic_principle
[34] Chandrakirti and Jamgon Mipham (2002) p70
[35] Oerter, Robert (2006) p130
[36] Feynman, Richard (1988) p7
[37] Stapp, Henry (2007) p139
[38] Allday, Jonathan (2009) p493
[39] Email correspondence
[40] Email correspondence
[41] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p201
[42] Michael Brooks: 'The Second Quantum Revolution,' New Scientist 23rd June 2007
[43] Vlatko Vedral quoted in New Scientist 23rd June 2007
[44] New Scientist 23rd June 2007
[45] Email communication
[46] Email communication

[47] Kaku, Michio (2006) p147
[48] See 'A Subjectivist's Guide to Objective Chance' by David Lewes and 'David Lewis's Humean Theory of Objective Choice' by Barry Loewer.
[49] Locke, J. - Essay Concerning Human Understanding 5.22
[50] Dolling, L.M.; Gianelli, A. F. & Statile, G. N. (eds) (2003) p490 – John A. Wheeler (1978): 'The 'Past' and the 'Delayed Choice' Double-Slit Experiment.'
[51] Herbert, Nick (1985) p16
[52] Penrose, Roger (1999) p295
[53] Gribben, John (2009) p511-512
[54] Reviews of Modern Physics vol XXI p343
[55] Science fiction novel by John Wyndham
[56] http://plato.stanford,edu/entries/popper/
[57] Popper, K. R. (1971). p265
[58] Eccles, John C. and Karl Popper (1984).
[59] Eccles, John C. and Karl Popper (1984).
[60] Stapp, Henry. 'Nondual Quantum Duality'
[61] Eccles' Model of the Self Controlling Its Brain: The Irrelevance of Dualist-Interactionism.
[62] Locke, J., Essay Concerning Human Understanding - (II xxiii 2)
[63] Locke, J., Essay Concerning Human Understanding, IV. X, 10, 1640
[64] 'Evolution as Algorithm'
[65] Locke, J., An Essay Concerning Human Understanding, 1690, IV, x, 10
[66] Das Wesen der Materie" (The Nature of Matter), speech at Florence, Italy, 1944 (from Archiv zur Geschichte der Max-Planck-Gesellschaft, Abt. Va, Rep. 11 Planck, Nr. 1797)
[67] http://en.wikipedia.org/wiki/Popper's_experiment
[68] Popper K R - 'Three Worlds' p143 – Tanner Lecture on Human Values April 7, 1978
[69] Popper K R - 'Three Worlds' p153 – Tanner Lecture on Human Values April 7, 1978
[70] Penrose, Roger (2007).p95
[71] Ellis…
[72] Popper K R -Three Worlds' p166-167 – Tanner Lecture on Human Values April 7, 1978
[73] Locke, J., Essay Concerning Human Understanding 5.22
[74] Penrose, Roger (2007). p50
[75] Bohm, David (2002) p250
[76] Ellis…
[77] Ellis…
[78] http://plato.stanford.edu/entries/leibniz
[79] Stapp, Henry (2004) p223
[80] Moralobjectivity – incrementality page
[81] Kaku, Michio (2006) p148
[82] Smolin, Lee (2002)
[83] A. Einstein, B. Poldolsky, and N. Nathan, "Can Quantum- Mechanical Description of Physical Reality Be Considered Complete?" Physical Review 47 (May 15, 1935): 177
[84] Ghirardi, Giancarlo (2005) p167
[85] Ghirardi, Giancarlo (2005) p185
[86] ibid
[87] Ghirardi, Giancarlo (2005) p165
[88] Ghirardi, Giancarlo (2005) p185
[89] J. S. Bell 'On the Einstein-Podolsky-Rosen Paradox' Physics I (1964) 195-200
[90] Zeilinger, Anton (2010). p273
[91] Ghirardi, Giancarlo (2005) p186
[92] Ghirardi, Giancarlo (2005) p186-7
[93] See http:/en.wikipedia.org/wiki/Popper's_experiment and http:/en.wikipedia.org/wiki/Talk:Popper's_experiment

[94] Ghirardi, Giancarlo (2005) p276
[95] http://www.aip.org/history/ohilist/25643.html p45
[96] http://www.aip.org/history/ohilist/25643.html p47
[97] http://plato.stanford.edu/entries/thomas-kuhn p2
[98] Kuhn, T. (1962, 170)
[99] Kuhn, T. (1962, 102)
[100] Herbert, Nick (1985) p16
[101] Dolling, L.M.; Gianelli, A. F. & Statile, G. N. (eds) (2003) p542
[102] ibid
[103] Al-Khalili, Jim (2003) p235
[104] d' Espagnat, B (2003). p319
[105] Feyerabend, P. Philosophical Papers Vol 1 p217
[106] Feyerabend, P. Philosophical Papers Vol 1p31
[107] Hawking, Stephen & Mlodinow, Leonard (2010). p46
[108] Hawking, Stephen & Mlodinow, Leonard (2010). p58
[109] Stapp, H. 'Quantum Theory and the Role of Mind in Nature p1
[110] E.P. Wigner, "On Hidden Variables and Quantum Mechanical Probabilities," *American Journal of Physics* 38 (1970): 1005
[111] d' Espagnat, B (2003).
[112] Zeilinger, Anton (2010). p273
[113] Ghirardi, Giancarlo (2005) p237
[114] Ghirardi, Giancarlo (2005) p236
[115] Ghirardi, Giancarlo (2005) p246
[116] Zeilinger, Anton (2010). p285
[117] Zeilinger, Anton (2010). p286
[118] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p201 – Anton Zeilinger: 'Why the quantum? "It from bit"? A participatory universe? Three far-reaching challenges from John Archibald Wheeler and their relation to experiment.'
[119] John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p577 – Wheeler, J A (1999) 'Information, physics, quantum: the search for links.' In *Feynman and Computation: Exploring the Limits of Computers*, ed A. J. G. Hey, p309 (314). Cambridge, MA: Perseus Books.
[120] Schlosshauer . M, (ed.) (2011). p165-180
[121] Ghirardi, Giancarlo (2005) p317
[122] Stapp, Henry (1995) – Why Classical Mechanics Cannot Naturally Accommodate Consciousness But Quantum Mechanics Can.
[123] Davies, P and Gribben, J, *The Matter Myth*
[124] May 21, 2001, Paris
[125] Klein, A. C. & Geshe Tenzin Wangyal Rinpoche (2006). p226