Article

Reflections on Materialist Metaphysical Dogmatism (Part I)

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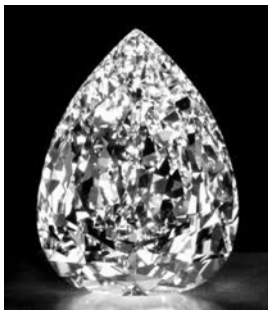
Abstract

Whilst it is true that a great deal of the details of the experimental science which is presented in programmes presented by Cox, Al-Khalili and others is correct, the overall metaphysical perspective within which these details are presented is for the most part appallingly incorrect because they do not accord with the details of modern physics, quantum physics in particular. The metaphysical framework which underpins the general worldview of the programmes presented by both Cox and Al-Khalili largely corresponds to what Stapp refers to as a 'known-to-be-false' materialist perspective. The inappropriate materialist metaphysical dogmatism which underlies such programmes leads to some silly nonsense being presented without any challenge. This article cuts through the metaphysical madness.

Keywords: Quantum theory, quantum particles, quantum entanglement, Brian Cox, Jim Al-Khalili, Hawking, Mlodinow, Richard Feynman, Henry Stapp, Rupert Sheldrake, Schrödinger, Planck, Heisenberg, Rosenblum, Kuttner, Robert Maxwell, Anton Zeilineger, Buddhist metaphysics, Madhyamaka, sum over histories, ESP, parapsychology, telepathy, reincarnation, mind and matter, consciousness, quantum metaphysics, incorrect representation of science, Diamond Cutter Sutra.



The opening screen of Brian Cox's televised night spent attempting to explain quantum theory to apprehensive celebrities announces that "You are vast and empty". This portentous observation, strangely yet appropriately, has a very Buddhist ring, although Cox is, I would think, certainly unaware of this. Within the Sutra tradition of the Mahayana, or Great Vehicle, school of Buddhism there are two types of path which may be undertaken. The first is the 'Vast Path' of

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Note: This article is adopted from the first chapter of the author's next book "'Quantum Buddhist Wonders of the Universe'.

compassionate activity, undertaken over vast stretches of time throughout countless lifetimes. The second is the 'Wisdom Path' which requires becoming thoroughly familiar with and then cognizing directly the 'emptiness' of phenomena. Vastness and emptiness, then, are central notions within Mahayana Buddhist thought and, although Cox would probably consider that the Buddhist notions involved are little more than hippy 'drivel' and 'woo-woo', we shall see they have more to do with quantum theory than one might initially think; the view that both the universe and the sentient beings within it are a matter of 'vast emptiness' is central to Buddhist metaphysics.

In his opening praise of the Royal Institution and the heroes of science who have been its members Cox warns his audience against closed-mindedness by quoting Humphrey Davey:

Nothing is so fatal to the progress of the human mind as to suppose that our views of science are ultimate, that there are no mysteries in nature and that our triumph is complete.

He then tells his audience, brandishing a million dollar diamond, that he is about to try and explain some aspects of quantum theory and that this theory, which explains the "structure of matter itself," is very strange and mysterious. It indicates that quantum level 'particles' can be in an infinite number of places at the same time and "the subatomic building blocks of our bodies are constantly shifting in response to events occurring at the edge of the universe." At this point, just a few minutes since his lighting the Davey lamp in praise of open mindedness, Cox abandons all attempts at decorous scientific even-handedness. These extraordinary quantum behaviors, he admonishes his audience, are "not a license to talk utter drivel." Quantum theory, he says, "describes the world with higher precision" than Newtonian mechanics but, he emphatically declares, "it does not allow mystical healing, ESP or New Age woo-woo." Quantum physics is done by physicists "without star signs tattooed on their bottom." At this point his audience laughed appreciatively. What they were appreciating, however, is far from clear. For, given that by their own admission just about all of them did not have a clue about quantum theory, how they could possibly know whether or not Cox himself was talking drivel at this point is indeed a mystery, quantum or otherwise.

According to Cox quantum theory describes the structure of matter with greater precision than any theory heretofore but does not introduce anything dramatically mysterious into our understanding of reality. Listening to Cox one would think that there is not much metaphysically, or for that matter *physically*, different between quantum theory and the 'classical' worldview of the nineteenth century. It's just that physics has managed to describe the material world with much, much greater precision. In fact the dramatic increase in precision is so remarkable that one would expect, on Cox's view, the entities described with this precision to be in an infinite number of places at the same time! Furthermore, although quantum physics may suggest strange phenomena such as quantum entities being in an infinite number of places at the same time, such phenomena do not, in Cox's account, give any leeway for any 'paranormal' phenomena. However, as we shall see, there are cogent reasons for thinking that Cox himself, in this lecture, indulges in his own brand of woo-woo, better known in his case as misdirection and obfuscation.

The first thing one might say about Cox's viewpoint is that if it were valid then there would be quite a few significant and respected physicists who would look rather feeble minded for not seeing the lack of mysteriousness and lack of paradox that Cox effortlessly discerns with barely a flicker of grin. The following passage is from Jonathan Allday's work *Quantum Reality: Theory and Practice* (2009):

The problem is that the small scale laws describe a way of behaving that, judged by the standards of everyday experience, is utterly bizarre. It is very difficult to see how all the business going on at the atomic scale can lead to the regular, reliable world we spend our lives in.[1]

Allday collaborates in the writing of excellent physics textbooks for college students, but he is by no means well known. Roger Penrose, of course, is an intellectual heavyweight in the field. The following passage is from Roger Penrose's work *Shadows of the Mind*:

Taken at its face value, the theory seems to lead to a philosophical standpoint that many (including myself) find deeply unsatisfying. At best, and taking its descriptions at their most literal, it provides us with a very strange view of the world indeed. At worst, and taking literally the proclamations of some of its most famous protagonists, it provides us with no view of the world at all.[2]

In this book Penrose also tells the following story:

I cannot resist quoting a remark that was made to me by Professor Bob Wald, of the University of Chicago, at a dinner party some years ago: If you really believe in quantum physics, then you can't take it seriously.[3]

Heisenberg, one of the founding fathers and the inventor of quantum matrix mechanics, lamented after a dinner discussing the nature of the quantum world:

Can nature possibly be as absurd as it seems to us in these atomic experiments?[4]

More recently the quantum gravity theorist Lee Smolin says of the Heisenberg Uncertainty Principle, which states that it is not possible to know a quantum particle's precise position and momentum at the same time, that:

…the mind rebels: it is hard to work one's way through to the logical consequences of a principle like the uncertainty principle when one's first response is simply to disbelieve it. I myself do not really believe it, and I do not think that I am the only physicist who feels this way. But I persist in using it because it is a necessary part of the only theory I know that explains the main observed facts about atoms, molecules and elementary particles.[5]

Aephraim M. Steinberg, writing in 2004, points out that:

For all of our apparent understanding of quantum mechanics, our ability to calculate remarkable things using this theory, and the regularity with which experiment has borne out these predictions, at the turn of the twenty first century it seems as if there are as many puzzles on the road to a true *understanding* of quantum theory as there were at the start of the previous century.[6]

But how can this be? According to Cox it is all very straight forward, we have just got a more *precise* description of the structure of matter, there is nothing strange or mysterious about the

situation. It seems that Cox's view is wildly at variance with many authorities. For another example Michael A. Morrison, David Ross Boyd Professor of Physics and General Education, Emeritus at the University of Oklahoma, asserts, or rants even, that:

My point, which you'll hear me rant about again, is that at both the conceptual level and the mathematical level, quantum mechanics is not just a funny looking reformulation of classical physics. The two physical theories are fundamentally physically different.[7]

Morrison seems to have a fairly prestigious academic position in the field of physics education, but he seems to be saying something completely contrary to Cox's perspective. Cox quite clearly thinks, and proclaims, that there is no physical discontinuity between the two descriptions; quantum theory is just a more precise description. Morrison, on the other hand, is so convinced as to the truth of the opposite conclusion that he is moved to 'rant' about the fundamental discontinuity between the two descriptions.

In this context it is worth noting some things that Cox's quantum compatriot Jim Al-Khalili, who was part of the audience and constituted one end of the rope standing wave demonstration (see image at beginning of chapter), has to say regarding the problematic nature of quantum theory in his book *Quantum: A Guide for the Perplexed*. Here is a distillation of some of his quantum musings concerning the 'irrational' nature of the double slit experiment, in which the manner in which the quantum world operates at least *seems* to be altered by the conscious choices made by experimenters:

In fact quantum mechanics does provide us with a perfectly logical explanation of the two-slit trick. But it is an explanation of only what we observe and not of what is going on when we are not looking. But since all we have to go on is what we see and measure, maybe it makes no sense to ask for more. How can we assess the legitimacy or truth of an account of a phenomenon that we can never, even in principle, check? As soon as we try we alter the out-come.

Maybe I am asking too much of the word 'logical'…

….

Physicists have been forced to admit that, in the case of the double-slit trick, there is no rational way out. We can explain what we see but not why. However strange you may find the predictions of quantum mechanics, it must be emphasized that it is not the theory – mankind's invention – that is strange, but rather Nature herself that insists on such a strange kind of reality on the microscopic scale.[8]

….

Many physicists make statements such as: the world of atoms and below is so far removed from our own experiences in the macroscopic world that we have no right to expect things to behave in a way we can describe using everyday concepts. I know this does not sound very helpful, and even a bit of a cop out. We should be disturbed by the way the atom behaves. But many of the greatest physicists believe this to be a dangerous and futile pursuit, and that the worrying is best left to the philosophers, who have nothing better to do with their time![9]

This last rather dismissive remark regarding philosophers is actually quite revealing; it reveals a dismissive attitude to metaphysical conceptual coherence. It is the remarkable philosophical incompetence and naiveté of many physicists such as Cox and Al-Khalili, combined with a determination to undermine clear quantum implications on the basis of a pre-judicial disbelief, which leads to incorrect and obfuscating presentations such as that given by Cox to his uncomprehending audience of celebrities.

Al-Khalili's remark concerning the "dangerous and futile" nature of trying to establish some notion of what *really* is going on (although why it could possibly be 'dangerous' is beyond me, I do not think the Mafia are involved!) corresponds to what is termed the 'shut up and calculate' attitude, which is the intellectual position, or perhaps avoidance of a position is a better description, that because the 'physical' implications are so bizarre it is better just to use the quantum equations without worrying about what really is going on. Such a position, however, is directly contrary to that presented by Cox in his lecture, which bear in mind is that quantum theory is just such a very precise description of reality we need not be surprised by its oddity. Indeed, directly after the last paragraph in the above quote Al-Khalili writes:

Some physicists may criticise a non-technical book like this, which over-emphasizes the mystery of quantum mechanics instead of stressing its accuracy and power in explaining so many phenomena. … My response to these physicists who claim not to be disturbed by quantum is to insist that they have simply become so desensitized to its implications through over-familiarity with the subject![10]

One can only wonder whether after Cox had finished the lecture Al-Khalili took him aside and told him he needed to re-sensitize himself to the disturbing implications of quantum mechanics. I somehow doubt it!

Al-Khalili proclaims that "many of the greatest physicists believe" that drawing substantial conclusions from quantum theory is a "dangerous and futile pursuit". But he does not tell his readers that some of the 'founding fathers' came to some radical metaphysical conclusions on the basis of their understanding of quantum theory. For instance Max Planck, who was a thorough materialist in his early career, in his later life came to a very different conclusion:

All matter originates and exists only by virtue of a force... We must assume behind this force the existence of a conscious and intelligent Mind. This Mind is the matrix of all matter.[11]

And according to Erwin Schrödinger:

Mind has erected the objective outside world … out of its own stuff.[12]

More recently the physicists Bruce Rosenblum and Fred Kuttner, in their important book *Quantum Enigma: Physics encounters consciousness*, make the following observation regarding the far reaching implications of quantum theory:

…we suspect that something beyond ordinary physics awaits discovery. Not all physicists would agree. Many would like to dismiss the enigma, our 'skeleton in the closet'[13]

According to Rosenblum and Kuttner there is a quantum 'skeleton in the closet' of quantum theory which consists of the fact that physics seems to have "encountered consciousness." This is something that, Rosenblum and Kuttner claim, the physics community has been trying to keep secret:

In physics departments a conforming mind-set increasingly meant that an untenured faculty member might endanger a career by serious interest in the fundamentals of quantum physics. Even today it is best to explore the meaning of quantum mechanics while also working a 'day job' on a mainstream physics topic.[14]

And the one thing that, R and K tell us, physicists really had to stay away from if they valued their careers was the clear implication of an inter-connection between the quantum realm and consciousness, even though, as R and K indicate, the evidence is now increasingly compelling:

Consciousness and the quantum enigma are not just two mysteries; they are *the* two mysteries; first, our physical demonstration of the quantum enigma, faces us with the fundamental mystery of the objective world 'out there;' the second, conscious awareness, faces us with the fundamental mystery of the subjective, mental world 'in here.' Quantum mechanics seems to connect the two.[15]

We seem to be well into the domain of 'woo-woo' now, R and K must surely have star signs tattooed on their bottoms! And they turn out not to be the only ones. For instance here is Penrose angling for a tattoo:

…almost all the 'conventional' interpretations of quantum mechanics ultimately depend upon the presence of a 'perceiving being'…[16]

Although it must be quickly added that at the time that Penrose wrote this he refused to believe it. When discussing the many-worlds quantum interpretation, Wojciech Zurek, the originator of the quantum Darwinism perspective, tells us that it seems that:

…the ultimate evidence for the choice of one alternative resides in our illusive "consciousness"[17]

Henry Stapp is a quantum physicist has been around long enough to have been able to discuss quantum philosophical issues with 'founding father' Werner Heisenberg and he has come to uncompromising conclusions about the metaphysical implications of the quantum revolution:

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.[18]

Is there no end to the woowoo!

Actually it gets worse. Recently Stapp has ventured to suggest that:

…the basic orthodox structure [of quantum mechanics] … allows for the possibility that human personality may survive bodily death.[19]

Stapp must have an entire Zodiac on his butt.

If Cox's evaluation of the situation were to be true we would have to attribute hippy status to Professor Stapp and the other apparent woo-woo merchants we have met so far, but, of course, such an attribution is ridiculous, just as ridiculous as Cox's pervasive materialist slant in the context of quantum theory. In fact when one reads Stapp's paper one finds that, whereas Cox, like so many, is full of materialist preconception and prejudice which precludes him actually examining the evidence in a measured way, Stapp is actually doing just that. He tells us that his conclusion as to the *possibility* of personality survival and a relation to quantum theory has been prompted by the evidence *despite his doubts*:

While insufficient to quell my life-long doubts, this account has rendered reasonable the task of examining whether the phenomenon in question, if *assumed* to be veridical, could be reconciled with contemporary physical theory in a natural and reasonable way.[20]

Before we look at such issues in greater detail, however, it is necessary to examine Cox's incorrect representation of the quantum situation.

Cox begins his exposition by holding up a magnificent diamond to the audience and asking how a substance can be "so ethereal yet be so hard it can drill through solid rock?" Quantum physics, he says, explains "the structure of matter itself" and therefore answers this question. In the case of the diamond we now know that the way that its atoms are arranged within its crystal structure is as shown is figure 2. This shows that there is a great deal of 'empty' space between each atom. So perhaps this may have been the first new piece of intriguing information for some of the audience. Although a diamond is one of the hardest substances we know of, its crystal lattice is full of 'emptiness' so to speak. Despite this emptiness, however, diamonds are the hardest natural substance because of their crystal structure which consists of repeating units of carbon atoms joined to four other carbon atoms by the strongest chemical linkage called covalent bonds. Each carbon atom is in a rigid tetrahedral network where it is equidistant from its neighboring carbon atoms. The structural unit of diamond consists of 8 atoms, arranged in a cube. This network is very stable and rigid, which is why diamonds are so very hard and have a high melting point.

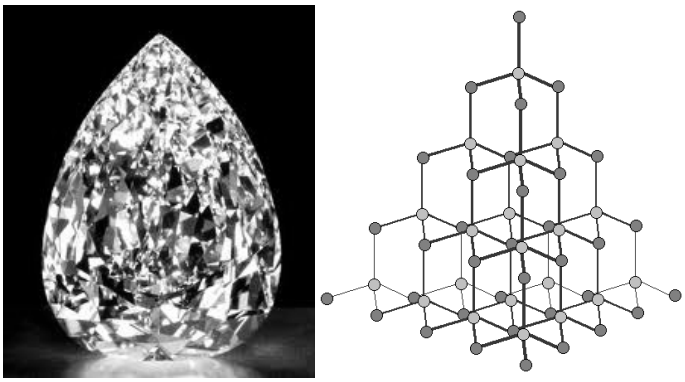


Figure 1 & 2 – A diamond and its atomic structure

The descent into substantial emptiness, however, does not end there. Just as a diamond turns out to have an internal structure which consists of a great deal of emptiness, and at this point the term 'emptiness' is being used with its general Western connotation of 'nothingness', i.e. there is absolutely nothing there (we are ignoring virtual particles etc. at this point), so too atoms have an internal structure which also involves a huge amount emptiness. As many people know (perhaps not all of Cox's audience, they really did seem to be quite ignorant of science) atoms themselves are supposed to be made up of smaller constituents, protons, neutrons and electrons, furthermore protons and neutrons are said to be made up of internal entities called quarks. For our purposes we may ignore the quark level and stick with the positively charged protons, the neutral neutrons and the negatively charged electrons shown in figure 3. The protons and neutrons make up the nucleus and the electrons orbit around the nucleus, held in their orbit by the attractive force between the positive charge of the central protons and the negative charge of the electrons.

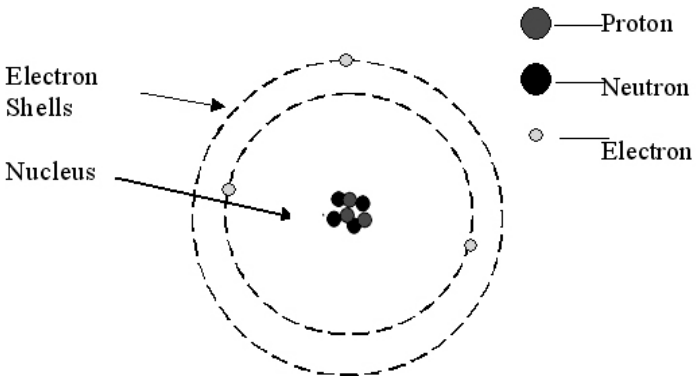


Figure 3 – Schematic and putative structure of atom (not to scale)

The amount of emptiness within atoms is shocking, very shocking if you actually contemplate it deeply. Cox describes the situation by saying that if the audience imagined him to be the nucleus of an atom and he was standing somewhere on the white cliffs of Dover then the electrons would be somewhere in Northern France. This really does mean that, even at this level - and there is a further level to move to although Cox misses this level out for his own purposes - the amount of 'stuff' in the apparently 'material' world is negligible. Indeed, as Cox points out, the amount of empty space in an atom is 99.9999999999999% and that's thirteen nines after the decimal point. It is at this point that Cox says to the audience "you are vast and empty" and in order to press the point home tells them that if all the space was squeezed out of all the people on the planet the amount of actual 'stuff' left would fit into the space occupied by the diamond that he had been holding in his hand.

The fact of the 'empty' nature of all matter gives us an opportunity to briefly consider one of Cox's absurd claims regarding scientific method. At an earlier point in his exposition he portentously claimed, as a matter of absolute truth in science, that "there are no absolute truths in science." This is an often repeated simplistic piece of nonsense which is actually absolutely untrue. In order to see this it is only necessary to consider Cox's own assertion of the emptiness of his million pound diamond, what is the likelihood of this scientific truth being overturned at some future point of investigation? Are scientists likely to discover at some future point that matter is actually continuously solid? It is surely pretty safe to say that the fact that the apparently solidity of the material world is only an appearance and internally there is actually a great deal of empty space is an 'absolute truth of science', so what is Cox on about. Does he have any idea? Clearly he is completely incorrect.

Whilst it is true that a great deal of the details of the experimental science which is presented in programmes presented by Cox, Al-Khalili and others is correct, the overall metaphysical perspective within which these details are presented is for the most part appallingly incorrect and precisely because they do not accord with the details of modern physics, quantum physics in particular. The metaphysical framework which underpins the general worldview of the programmes presented by both Cox and Al-Khalili largely corresponds to what Stapp refers to as a 'known-to-be-false' materialist perspective. The inappropriate materialist metaphysical dogmatism which underlies such programmes leads to some silly nonsense being presented without any challenge. So whilst the BBC allows presenters like Cox to grin their way around the world to various exotic locations to present spectacular series such as 'The Wonders of the Solar System' and 'Wonders of the Universe', to the delight of vast and empty numbers of viewers, it also allows them to utter utter metaphysical (non-hippy) drivel and contradict themselves without any challenge. No one seems to notice. An example of this is provided by Cox's remark whilst watching an eclipse of the sun in Varanasi, India, that "if anyone wanted proof that we are animals standing on a big solid lump of rock hurtling around the sun, this is it", or something similar. But now at this celebrity lecture we are told that the seeming solidity of any piece of apparently solid material 'stuff' is not at all what it seems, it is mostly empty. Doesn't that apply to the Earth?

Such metaphysical mismatches can be regularly found between the details of the modern science being presented and the more philosophical moments. The BBC blurb for 'Wonders of the Universe.' tells us that:

Brian Cox reveals how the most fundamental scientific principles and laws explain not only the story of the universe, but the story of us all.[21]

The story of the universe is the 'story of us all' because all of the constituents that we are made of are, obviously, the stuff of the universe, which means that the very atoms of our bodies are derived ultimately from the atomic interactions within stars. However, along the way Cox makes observations which point us in a more intriguing direction. "Life," he concludes, "is the means by which the universe understands itself." Furthermore it seems that sentient beings are the agents through which the "universe becomes conscious of itself." But you will search in vain for

any indication of how exactly supposedly mindless bits of 'stuff' magically manage to get 'conscious' of themselves! Where exactly does the consciousness come from?

There is indeed a great deal of metaphysical madness in Cox's simplistic materialist worldview. Let's return for a moment to Cox's absolutist assertion that "there are no absolute truths in science." What are we to make of someone who declares at the outset of a lecture that there are absolutely no scientific absolute truths who then, at a later point, also asserts that the Pauli Exclusion Principle is an "unbreakable law of nature." Does he actually know what he is talking about? If you follow through some of his claims with precise philosophical analysis, which virtually no one bothers to do, you will find that it is probably an absolute truth that when it comes to issues of a more metaphysical or philosophical nature that Cox actually does not know what he is talking about.

The problem with such vague blanket assertions such as that made by Cox here is that when they are made in this manner, which is to say without any comprehension of the metaphysical-epistemological details involved, they are little more than empty lip service to some assumed notion of scientific humility which is transgressed a few sentences later when Cox tells his audience that there are certain claims such as 'mystical healing and ESP' which science has, according to him, discounted with absolute certainty. If this were the case then it is very obvious that there must be some form of absolute truth in science, in this case the absolute certainly that ESP, for instance, has been proven, according to Cox, to be false and impossible.

It is worth pursuing this issue of what is meant by 'absolute truth' a little further because it is in fact central to our comprehension of the enormous significance of the quantum revolution. In fact, in a very deep and significant sense the quantum revolution in physics did break through to an absolute truth concerning the nature of reality. In this context the Buddhist metaphysical doctrine of the 'two truths' or 'two realities' is of great significance, for it is a simple, yet profound, doctrine which can precisely elucidate the situation. According to this central Buddhist doctrine, which derived from the original teaching of the Buddha, the way in which reality appears to sentient beings, which is termed the 'seeming' or 'conventional' reality (*samvrti-satya*), is entirely incorrect as to the actual nature of reality, which is termed 'ultimate' or 'absolute' reality (*paramartha-satya*). In particular Buddhist metaphysics indicates that the appearance of the world within the sense-fields of sentient beings as being comprised of independent entities which have their own inherent internal solidity, independent of all other entities including the mind of observers, is false. Thus the eleventh century Buddhist adept Dromtonpa declared:

Now I shall cast to the winds concepts of solid objects with mass.
I shall burn the logs of conceptualizing thoughts into flames.[22]

To make this insight clear the *Madhyamaka* (Middle Way) Buddhist philosophers employed the technical term *svabhava* which is translated as 'inherent existence' or 'true existence'. *Svabhava* is something which all sentient beings, including animals, project into the world and take as being actually existent in the external world, although in reality it does not exist in the world.

This projection of independent 'inherent existence' into the process of reality is a deeply innate mode of perception for all sentient beings; the sense organs and the mind automatically convey the apparently 'external' world into the experience of sentient beings as being comprised of independent and self-enclosed entities. Furthermore these entities 'seem' to act upon each other through the operation of 'real' and inherently existent causes and forces. One might say that the projection of inherent existence into the experiential world produces the appearance of a thoroughly Newtonian world. This is the world which is described by what is termed 'classical', or pre-quantum, physics.

According to the central Buddhist metaphysical insight, however, the ultimate truth concerning the nature of reality is that it is absolutely devoid or 'empty' of inherent existence. This is the Buddhist notion of 'emptiness' or *shunyata*, which is the fact that all phenomena are 'empty' of *svabhava* or inherent existence. It is important to note that the use of the term 'emptiness' here is not the same, although it is related, to the way that Cox uses the term. Cox uses the term to indicate a 'nothingness' whereas the Buddhist version of emptiness indicates a field of appearances which have no independent internal solidity or inherent existence of their own. One reason that Buddhist metaphysics gives for this situation is that all phenomena are interconnected with all other phenomena, so no phenomena can be said to exist independently of other phenomena. Emptiness, the lack of inherent existence in all phenomena, is the Buddhist view of the nature of ultimate or absolute reality and it corresponds precisely with quantum reality; as Professor Vlatko Vedral has pointed out: "quantum physics is indeed very much in agreement with Buddhistic emptiness."[23]

In the early days of quantum theory the notion of the complete insubstantiality of the quantum realm was some way ahead. A great many physicists prior to 1900 and shortly thereafter thought that matter was continuously 'solid'. Planck, for instance, thought that matter was continuous, as Al-Khalili tells us:

Planck was conservative in his view and, in the early part of his career did not even believe in the existence of atoms, as advocated by contemporaries such as Ludwig Boltzmann. Planck felt that it would soon be proved that matter was continuous in the sense that it was not ultimately composed of 'building blocks', but could infinitely be divided up and still retain its essence.[24]

Dirac around 1918 considered atoms as being 'very hypothetical things'[25]; and before the advent of quantum physics mass was considered to be an inherent and objective property that objects had as part of their own ontological makeup.

With reference to Planck's early belief that matter was continuous 'stuff' which had an unvarying 'essence' running through it without any internal gaps and structure it is worth looking into the Buddhist reasoning why matter must have internal structure. It is a beautiful example of the power of Buddhist metaphysical analysis. Often one can find remarkably lax modes of philosophical reasoning in Western philosophy which, contrary to a great deal of Western arrogance concerning the powers of Eastern philosophical analysis, is to my knowledge *never* found in Buddhist metaphysical analysis. It required various quantum experiments to convince Planck and others of the atomic makeup of matter. Buddhist philosophers, however, pondering

the issue a couple of thousand years before such spectacular experiments could be conceived of came to similar conclusions by employing spectacular razor sharp analysis (in fact the Buddha declared the material world to be like 'foam'[26]). The reasoning by which Buddhist philosophers argued for the conclusion that there must be some kind of momentary atomic internal structure of matter is remarkable, although completely obvious and perspicacious when comprehended.

The argument requires, like all Buddhist *Madhyamaka* ('Middle Way') reasoning, that we do not let conceptual boundaries slip and blur. In particular if we assert that the internal 'essence' of a substance is continuous and unchanging then there can be no variation at all within the internal stuff of any substance. This means that there can be absolutely no weak points because the substance internal to the entity we are considering does not vary in any aspect, its essence is uniform. In this case it does not make sense for any material entity either to break or wear away. Here is the actual reasoning given by the fifth century Buddhist adept Vasubandhu:

The change that these conditioned phenomena undergo over time is reasonable only if they are subject to a form of disintegration in which they arise and pass away with each moment; this phenomena is not reasonable if entities remained in an unchanging state.[27]

In other words, if material entities were solidly continuous, with no internal structure, they simply could not deteriorate over time in the manner that they actually do. This is an example of the power of what might appear to be, on some occasions, quite simple *yet rigorous* modes of reasoning employed within Buddhist philosophy. In this case the reasoning is simply that if the material 'stuff' of reality was internally continuous, with no fluctuations of internal structure whatsoever, then there is absolutely no reason why any material object should deteriorate.

Buddhist philosophy was, and is, founded on the principle that there must be rigorous internal coherence to the structure of reality and also to the structure of conceptual thinking and analysis concerning reality; it abhors ad-hoc, incoherent explanations. Consider the situation in which someone takes a soft material object, putty perhaps, and breaks it into two pieces; if the matter of this piece of putty had actually been continuous, and for Buddhist philosophers this would entail that every part of the lump of putty was exactly, absolutely and without deviation the same in constitution, or in 'essence', then any deviation would be inexplicable without internal structure. The breaking of the lump of putty in the particular place where it did would be inexplicable, no, actually more than this – impossible. If we really think what the notion of continuity of matter really entails then we cannot fail to see that it would clearly mean that all material objects would be necessarily unbreakable!

This analysis leads on to Vasubandhu's presentation of the two realities, one provisional, relative, seeming or conventional, and the other ultimate or absolute:

Things which, when destroyed or mentally dissected,
Can no longer be identified by the mind,
Such as pots or water, are relative;
All else besides is ultimately existent.[28]

This view corresponds to an 'atomic' presentation of the 'two realities' and at this point we connect back up with Cox's presentation.

We left Cox at the point where he gleefully asserted the 'vast emptiness' of everything based on the fact that all material entities are 99.9999999999-999% empty space, the rest being atomic bits and pieces. Let us suppose for the sake of analysis that the atomic bits and pieces are inherently, absolutely and ultimately existent. In the rigorous world of Buddhist metaphysics this means that the atomic constituents cannot be reduced to anything simpler, they cannot depend upon any other phenomena because they are ultimately existent, eternal bits and pieces of reality, they are the eternal, unchanging atomic Lego from which all other phenomena are constituted. This viewpoint clearly introduces a dramatic division into modes of reality because the entities which have ultimate existence are the atomic bits and pieces which are inherently existent, ultimately and absolutely existent, changeless and eternal. Everything else, sentient beings, the entities of the apparently material world which such beings inhabit, only has a derived, relative, seeming or conventional existence. They do not last and they do not have an ultimate existence.

Some early Buddhist schools of thought considered that the ultimate constituents of reality must be 'infinitesimal particles' which only had momentary existence; and the Buddhist philosophers pursued the issue of what this would mean for their notions of 'reality'. From this model of reality, which is analogous to the situation of atomic theory of early twentieth century physics, objects of everyday world with which we are familiar cannot be considered to be 'ultimately real' precisely because they can be decomposed into the constituent particles which are 'ultimate', and these 'ultimate' particles are 'ultimate' precisely because they cannot be so decomposed. Thus according to the analysis of the Buddhist philosopher Dharmakirti:

… a term such as "water jug" is simply a linguistic convention employed as a convenient means to indirectly express multiple infinitesimal particles that, due to their proximity, causally support each other such that they together perform functions that are of interest to us. When we are thirsty, certainly it is easier to say, "Bring the water jug," than it is to say, "Bring some mutually supporting infinitesimal particles that, through that causal support, serve the functions associated with the concept 'water jug.'"[29]

Such a consideration may seem to be going into the realms of absurdity and indeed from the perspective of everyday life, pursued without concern of anything beyond everyday survival, it is. But Buddhist philosophy is, and one would have thought that Western science and philosophy should be, conducted with the aim of comprehending the nature of reality on all levels of experience, and knowing what the ultimate causal elements of reality are and what are derived aspects, is a necessity in this concern.

The crucial point here is that if it were to be the case that the only causally effective and constitutive elements within the phenomenon of a water jug were to be such infinitesimal particles, and we consider only causally effective and constitutive elements to be ultimately 'real', then, from an ultimate point of view, the water jug is not ultimately 'real'. And this would mean, furthermore, that human bodies and perhaps minds, and therefore you, me and everyone,

are also not ultimately real but only have a derived reality based upon the functioning of the ultimately 'real' bits and pieces of 'reality'. This would reduce everything except for the ultimate bits and pieces to a kind of illusion. As the contemporary Buddhist philosopher Karl Brunnhölzl points out:

…according to quantum physics there are no such things as matter, roads, cars, or bodies, so who or what is driving home after an exciting day at the quantum lab.[30]

The assertion here is that the 'seeming', 'conventional' realm we apparently inhabit does not exist ultimately. Seen from this perspective it becomes clear that physics has clearly penetrated an absolute truth. No matter what further magical mathematical discoveries are made concerning the functioning of the quantum realm it is clearly impossible that they could possibly undermine this fundamental and shocking discovery concerning the illusory nature of the world we inhabit.

As we have seen, even if it were to be the case that the 0.00000-00000001% of the apparently material stuff of reality that seems to be substantial and not empty turned out to be comprised of inherently existent atomic bits and pieces, the world we are familiar with would be an illusion made up from those ultimately 'real' bits and pieces. This illusory status, however, becomes even more ethereal when we discover that even those 'ultimate' bit and pieces depend in some way upon the minds of observers. The quantum instigator Max Planck, who as we have seen began his career believing in the inherent existence of solidly continuous matter, towards the end of his life said that:

I regard consciousness as fundamental. I regard matter as derivative from cons-ciousness.[31]

We have now come to the point in Cox's exposition where Jim Al-Khalili and another member of the audience demonstrate stationary waves by jiggling a length of rope up and down with various degrees of vigour. This is to give a feel for the way that electrons can only occupy certain positions around the nucleus of an atom because the wave-motions associated with the energies of electrons can only fit coherently around the nucleus so that the wave meets at the same point of vibration as shown in figure 4. An electron standing wave fits around the nucleus so that an integral number of half-wavelengths fit into the circumference of the orbit. This means that when the wave motion of the electron has travelled around the circumference it meets its starting point at the same amplitude as the starting point. Figure 5 shows Cox drawing some standing wave graphs for n=1, n=2 and n=3. Figure 6 indicates the kind of picture of an atom that would result if electrons were to be waves of 'energy', as implied by Cox. The issue which immediately arises now is clearly as to the actual nature of the electrons. Are they particles? Are they waves? Or a bit of both? This is a question that Cox fails to address, thus avoiding a central, and crucial, issue of quantum physics, what kind of 'stuff' actually 'exists' at the quantum level?

Cox tells the audience that the lowest energy electron state has a radius of 3 times 10 to the power -10 of a meter, which is of course a very, very small interval (0.0000000003m) and yet the nucleus is a factor of a quarter million times smaller than this. This is why, he says, atoms are so big (in comparison to its constituents) and yet so empty.

He then goes on to say that we can imagine electrons to be trapped inside an atomic box and "when an electron gets trapped it exhibits a wave-like behaviour." This is a very neat and yet ultimately incorrect account of the situation. The type of 'stuff' which is indicated by the term 'matter' is not the kind of stuff which can constitute a tiny little 'particle' at one point in time and then transmute into a spread out wave of immaterial energy at another point in time. At least this is not the kind of stuff conceived of by the pre-quantum 'classical' physicists and certainly not the kind of 'material' stuff imagined by the majority of the audience. So we might have thought that Cox might have at least have pointed out that the 'stuff' that electrons are made of is not the kind of stuff that the audience generally conceived the world to be made up of. But this point is glossed over.

So what kind of 'stuff' are electron waves made of? Tony Hey and Patrick Walters, in their book *The New Quantum Universe,* a book that one of Cox's heroes - physicist Richard Feynman - described as "a damn good book", so it should be fairly reliable, tell us that electron waves are in fact electron *probability* waves:

In the electron case, the steep walls of the potential box act like the fixed end points of the vibrating string and instead of waves on a string we have electron probability waves.[32]

But Cox says nothing about the electron waves having anything to do with probability. In his co-authored with Jeff Forshaw book *why does $E=mc^2$* Cox and Forshaw write concerning the notion of a 'particle':

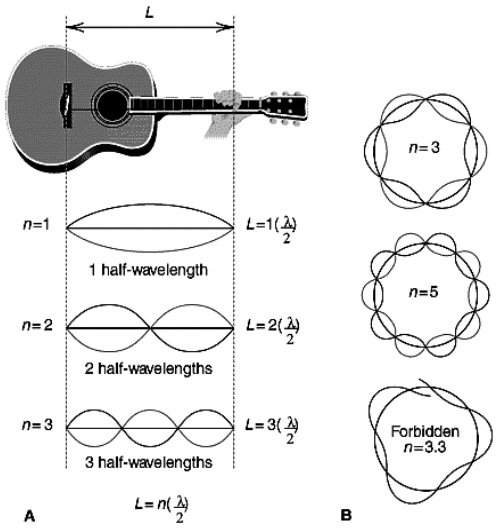


Figure 4

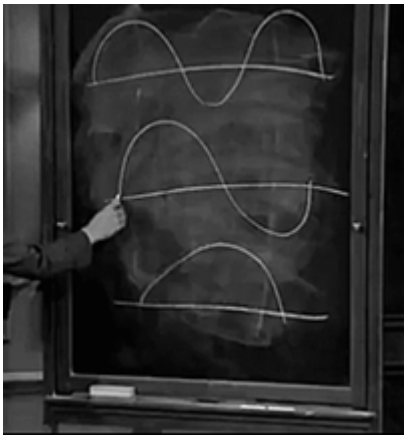


Figure 5

Figure 6

One subtlety that we have not mentioned is that although we keep speaking of particles, it really is something of a misnomer. Those are not particles in the normal sense of the word. They don't go bouncing off each other like miniature billiard balls. Instead they interact with each other much more like the way surface waves can interact to produce shadows on the bottom of the swimming pool.[33]

Sounds almost mystical! But still no mention of probability waves; the authors get around to talking about probability when referring to the nature of the Standard Model 'master equation':

We are encouraging you to conjure up, in your mind's eye, an imaginary electron field. It might be surprising that our master equation is so noncommittal. It doesn't work with certainties and we cannot even track the electron around. All we can do is say that it is more likely to be found over here … and is less likely to be found over there … .We can put definite numbers on the chances of finding the electron to be here or there, but that is as good as it gets. This vagueness

in our description of the world at the very smallest distance scales occurs because quantum theory reigns supreme there, and quantum theory deals only in the odds of things happening. There really does appear to be a fundamental uncertainty built into concepts of position and momentum at these tiny distances.[34]

So Cox starts his lecture extolling the *precision* of quantum theory and in this book claims that quantum theory produces "vagueness in our description of the world at the very smallest distance scales!" Here we are encouraged to imagine an 'imaginary electron field' which is noncommittal about where the electron is located. The use of the phrase 'this vagueness in our description' is meant, of course, to apply to the fact that the master equation can only provide probabilities of finding the electron in various places. But, however, it also applies to Cox and Forshaw's own description, as they seem determined to avoid being clear that until the electron is looked for it does not exist in the usual sense of the term. In fact, according to non-tattooed quantum physicists Rosenblum and Kuttner the very act of 'looking' or measuring brings the electron into existence. Furthermore:

…physics' encounter with consciousness, demonstrated for the small, applies to everything. And that 'everything' can include the entire Universe.[35]

This undoubtedly will get the Cox seal of woo-woo disapproval so perhaps we had better appeal to a heavyweight in the field, Roger Penrose:

At the atomic level 'objects' can only be understood in terms of the interaction between the processes of preparation and measurement. The end of this chain of processes lies always in the consciousness of the human observer.[36]

Penrose in his several books on the subject has regularly written that he is temperamentally incapable of accepting this conclusion but at the same time he, like many others who hate the conclusion, behaves with integrity and admits where the evidence points. Amit Goswami, a physicist who Cox would probably consider to be a hopeless hippy, having been a central participant in the awful cult 'New Age' film *What the Bleep Do We Know* and written books such as the excellent *The Self-Aware Universe*, calls this apparent quantum phenomenon the 'observer effect':

In quantum physics, objects are depicted as possibilities (a possibility wave); yet when an observer observes, the possibilities collapse into an actuality (the wave collapses into particle, for example). This is the observer effect.[37]

Respected physicist Giancarlo Ghirardi, on the other hand, is definitely not of a bottom tattooing disposition as he writes in the preface of his excellent book *Sneaking a Look at God's Cards: Unraveling the Mysteries of Quantum Mechanics* that he "put particular effort into not leaving any room in the text for hints and implications that can lead to illegitimate evasions often made recently, even by authoritative figures, when it comes to quantum mechanics [providing] valid proofs for parapsychology, paranormal phenomenon, oriental philosophies, and so forth…."[38] And yet he clearly considers there is a big problem with the way in which the 'vagueness' of the quantum realm becomes the familiar everyday world. In the case of a chair he writes:

…according to the formulism the chair can be found … in a state analogous to that of the photon above:

$$| ? > = 1/\sqrt{2} [|there> + |here>]$$[39]

And Ghirardi comments on this situation:

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?[40]

The 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.*

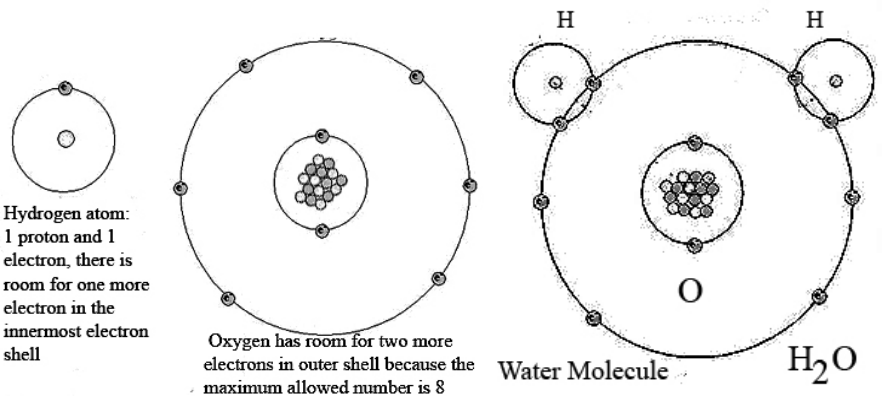
The notion of a quantum probability wave and the attendant issue of the 'measurement problem', which is the issue of how probabilities become actualities, is generally considered, apart from Cox it seems, to be verging on the paradoxical. It is a notion that is mysterious to many physicists, appar-ently including Cox's compatriot Jim Al-Khalili, for here is what Al-Khalili writes in his book *Quantum: Guide for the Perplexed*:

For me the biggest mystery of all lies at the heart of reality: how to explain the weird behaviour of the subatomic world. We have a very powerful theory that explains the atomic world-quantum mechanics. But the problem is no one understands what it means.[41]

Why Al-Khalili did not get Cox to explain it all to him *is* a quantum mystery!

Furthermore, at the end of his documentary series about the history of the development of quantum physics, *Atom,* Al-Khalili looks into the camera with intense seriousness and tells the audience "If you want to see fear on the face of a physicist ask them about the measurement problem." Does Cox know about this lack of backbone in the quantum physics com-munity when confronted with the measurement problem? Is he their saviour perhaps? For in his lecture Cox breezily presents the situation as if it were the most natural thing in the world. When electrons get trapped they turn into waves, otherwise they are particles, problem sorted! But if this were true then it would follow that there are an awful lot of respected physicists, including Al-Khalili (unless Cox has enlightened him recently), who on this particular issue are demonstrating a remarkable degree of obtuse stupidity and lack of intellectual fiber!

The next issue that Cox addresses is that of why, given the fact that atoms are so 'empty', the stuff of the world is so solid. This is the issue of the nature of the strong bonding achieved by covalent bonding. The "unbreakable" physical principle underlying this mechanism is the Pauli Exclusion Principle. This is generally explained as the fact that within an atom no two electrons can occupy the same state and because of this must fill out electron shells outwards from the nucleus and, when the outermost shells have empty slots or 'lonely' electrons, atoms of reactive elements seek to share electrons in order to complete the outermost shells. This mechanism underlies the covalent bonding which produces compound substances such as water (figures 7 & 8).



Figures 7 & 8

At this point Cox introduced a spectacular aspect of the Pauli Exclusion Principle which has previously seldom been drawn attention to. According to Cox the exclusion principle requires that every electron in the entire universe is in a different quantum state. This assertion prompted debate regarding whether or not Cox's assertion is true, but the truth or falsity of this assertion need not concern us here. What is worth noting is the fact that if Cox's assertion were to be true then there would at least be a possible mechanism which could underlie the phenomenon of telepathy. This is not to say that telepathy is in any way proved by Cox's vision of an electronically interconnected universe, but neither could quantum theory rule it out. If we accept that consciousness must somehow emerge from the quantum realm, which it surely must because there is nowhere else it could come from unless we reinstate God, and if the quantum realm is fundamentally interconnected as Cox claims (it is of course interconnected anyway by quantum non-locality), then it follows that we should not be surprised if there did turn out to be some kind of interconnection at a deep level of consciousness.

The usual presentation of the exclusion principle limits its effectiveness to electrons within any particular atom. According to Cox, however, it applies to every electron in the universe, which means that every electron in the universe must be in a slightly different quantum energy state, which also means that all the electrons in the universe are instantaneously inter-connected. This leads to the second banner headline of the lecture: 'Everything is connected to everything else.' This Cox tells us, whilst cupping and gently rubbing the diamond in his hands, means "something very odd". For his caressing of the diamond results in the diamond heating up and because of this the electrons within it must be adopting higher energy levels. And this also means, Cox asserts, that "all the electrons in the universe are instantaneously but imperceptibly shifting their energy levels."

This remarkable picture of a fundamentally interconnected universe, within which every part shifts with and reflects the conditions everywhere, resonates with the doctrine of interconnectedness depicted in the Buddhist *Avatamsaka Sutra*. In this image the whole universe is portrayed as an interpenetrating multidimensional net of jewels, which may be thought of as representing the infinite sparks of interconnected consciousness which underlie the appearances

of the phenomenal world. Jewels are set at every intersection of the net and each jewel reflects the light reflected in all the jewels around it, and each of those jewels in turn reflects the light from all the jewels around them, and this multifaceted mutually reflective process is repeated infinitely. In this way, all phenomena – events, entities and sentient beings reflect and express the radiance of the entire universe. This later became incorporated into the Hua-yen doctrine which views the entire cosmos as a single nexus of conditions in which everything simultaneously depends on, and is depended on by, everything else:

There is a wonderful net which has been hung by some cunning artificer in such a manner that it stretches out indefinitely in all directions. In accordance with the extravagant tastes of deities, the artificer has hung a single glittering jewel at the net's every node, and since the net itself is infinite in dimension, the jewels are infinite in number. There hang the jewels, glittering like stars of the first magnitude, a wonderful sight to behold. If we now arbitrarily select one of these jewels for inspection and look closely at it, we will discover that in its polished surface there are reflected all the other jewels in the net, infinite in number. Not only that, but each of the jewels reflected in this one jewel is also reflecting all the other jewels, so that the process of reflection is infinite.[42]

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