Article

Quantum Evo-Devo Universe: Quantum Evolution and the Evidence of Evolutionary-Developmental Biology

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Abstract

All animals, of whatever species whatsoever, share a fundamental genetic structure which underpins a hierarchical development of differentiation. It is shown here that when this revolution in our understanding of the functioning of genes and the DNA components of genes is placed in the context of the other great twentieth century revolution in science – the quantum revolution – the new metaphysical worldview which emerges goes far beyond the new vistas currently being explored by the Evo Devo community. In particular, it will become clear that the primary process of evolution is not that which takes place over time on the material plane but, rather, it is that process of development which cascades from a deep quantum level of intentionality through a sequence of immaterial and subtle 'implicate orders' of 'unfoldment', to use the terminology coined by physicist David Bohm, until there is apparent manifestation on the 'material' plane'. This article is adopted from one of the chapters in Graham's latest book 'The Grand Designer' which can be found at www.shunyatapress.com.

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The dramatic and far reaching nature of the discoveries which led to the development of the perspective of evolutionary-development biology have, in large degree, still to be appreciated. Indeed, as we shall see in the course of this paper, it might be said that to a great extent the hugely significant challenge to the materialistic grounding of the mainstream view within evolutionary thinking has been ameliorated by attempts to claim that, although the implications of the evolutionary-development paradigm are indeed remarkable, they are easily incorporated into the Darwinian fold. As Sean B. Carroll sums up the Darwinian perspective in his book on 'the new science of Evo Devo' *Endless Forms Most Beautiful*:

> Darwin asked his reader to consider how slight changes, introduced at different points in the process (of evolution) and in different parts of the body, over the course of many thousands or a million generations, spanning perhaps tens of thousands to a few million years, can produce different forms that are adapted to different circumstances and that possess unique capabilities. That is evolution in a nutshell.[1]

What Carroll does not point out is the overwhelming predominance of a materialist meta-physical paradigm which underpins the Darwinian worldview. Thus when Richard Dawkins laid the metaphysical foundations for his exposition of his vision of *The Blind Watchmaker*,

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he did so by claiming the validity of asserting a foundational metaphysical materialist worldview 'for everyday purposes':

> We peel our way down the hierarchy, until we reach units so simple that, for everyday purposes, we no longer feel the need to ask questions about them.[2]

In his book *Darwin's Dangerous Idea* Daniel Dennett, Dawkins' compatriot in the cause of materialism, is intellectually pugilistic in his rallying cry for the worldview of materialism:

> An impersonal, unreflective, robotic, mindless little scrap of molecular machinery is the ultimate basis of all the agency, and hence meaning, and hence consciousness, in the universe.[3]

Thus Darwinism and materialism have become almost complementary aspects of a common 'naturalist' worldview. A worldview within which the 'gene,' in large part thanks to the strident proselytizing activities on the part of Dawkins, became considered to be the ontologically privileged material unit which had somehow magically evolved a desperation to survive. In his book *The Extended Phenotype* Dawkins makes the following impassioned and wildly anthropomorphic declaration of the ontological primacy of the 'gene':

> …we should see through individual organisms. We see through them to the replicating fragments of DNA within, and we see the wider world as an arena in which these genetic fragments play out their tournaments of manipulative skill. Genes manipulate the world and shape it to assist their replication. It happens that they have 'chosen' to do so largely by molding matter into multicellular chunks which we call organisms, but this might not have been so. Fundamentally what is going on is that replicating molecules ensure their survival by means of their phenotypic effect on the world. It is only incidentally true that those phenotypic effects happen to be packaged up into units called individual organisms.[4]

This is an astonishingly implausible claim which basically asserts that all biological organisms, all cultural activities, and consciousness itself are nothing other than expendable epiphenomenal products which have been adventitiously generated in order that the ultimately fundamental units of reality - genes – may survive, even though in reality these putatively ultimate units do not materially survive as the same 'stuff' any more than any other apparently 'material' aspect of an organism.

One of the core tenets of this materialist Darwinism was the belief that the genes involved in the evolution of different species would themselves be different, different species would not have common gene structure. Thus the evolutionary biologist Ernst Mayr wrote confidently in the 1960's that:

> Much that has been learned about gene physiology makes it evident that the search for homologous genes is quite futile except in very close relatives. If there is only one efficient solution for a certain functional demand, very different gene complexes will come up with the same solution, no matter how different the pathway by which it is achieved. The saying "Many roads lead to Rome" is as true in evolution as in daily affairs. [5]

An excellent example of a pronouncement made on the basis of little evidence but a huge emotional investment in the materialist Darwinian worldview, an investment which can still be found in much 'scientific' writing. However, this presuppositional assumption has now

been shown by the evolutionary-development revolution in biology to be completely false; as Carroll writes:

> The first shots in the Evo Devo revolution revealed that despite their great differences in appearance and physiology, all complex animals-flies and flycatchers, dinosaurs and trilobites, butterflies and zebras and humans-share a common "tool kit" of "master" genes that govern the formation and patterning of their bodies and body parts. … The important point to appreciate from the outset is that this discovery shattered our previous notions of animal relationships and of what made animals different, and opened up a whole new way of looking at evolution.[6]

In other words, all animals, of whatever species whatsoever, share a fundamental genetic structure which underpins a hierarchical development of differentiation. As we shall see, when this revolution in our understanding of the functioning of genes and the DNA components of genes is placed in the context of the other great twentieth century revolution in science – the quantum revolution – the new metaphysical worldview which emerges goes far beyond the new vistas currently being explored by the Evo Devo community. In particular, it will become clear that the primary process of evolution is not that which takes place over time on the material plane but, rather, it is that process of development which cascades from a deep quantum level of intentionality through a sequence of immaterial and subtle 'implicate orders' of 'unfoldment', to use the terminology coined by physicist David Bohm, until there is apparent manifestation on the 'material' plane'.

In order to appreciate the full impact of the 'whole new way of looking at evolution' it will be useful to appreciate the view that had become central to the hardcore materialist 'neo-Darwinian' perspective as presented in the early writings of Richard Dawkins (he has become rather ambiguous and contradictory on the issue in recent times) and the continued materialist interpretation of evolution preached by Daniel Dennett. As we have see above, the received, and completely false, wisdom of the academic 'authorities' in the field prior to evo-devo was that the genes responsible for different species would be different, and the more distant the phyla involved the greater the difference would be expected to be. Thus Dawkins, writing in 1998, tells us that:

> The genes that survive in camels will, to be sure, include some that are particularly good at surviving in deserts, and they may even be shared with desert rats and desert foxes. But, more importantly, successful genes will be those that are good at surviving in an environment consisting of the other genes that are typically found in the species. … It is not the genes of any given individual that cooperate well together. They have never been together in that combination, for every genome in a sexually reproducing species is unique … It is the genes of the species at large that cooperate, because they have met before, often, and in the intimately shared environment of the cell…[7]

It is impossible not to point out in passing that this is actually incoherent mythology, a neo-Darwinian piece of, unsubstantiated even at the time, internally inconsistent fantasy which has now been shown, by the evidence, to be beyond the misguided. Suppose, for instance, someone were to claim that the genes that survive in camels were not good at surviving in deserts! Furthermore is it actually a sane possibility that the various genes within a species would not be good at cooperating? According to Dawkins the genes within particular individuals within a species do not cooperate because they have not met before, but, on the

other hand, the genes of the species have often met before and therefore do cooperate. Surely this is an extremely unlikely scenario, the genes of a particular species happily cooperating together, until, that is, they happen to congregate together in an individual of the species! It is also a scenario completely at variance with the evidence of evo-devo which indicates that the genes within any individual do nothing else but cooperate, indeed if one thinks about the issue for even a moment it is difficult to comprehend how an embryo could possibly develop without cooperation, so what the particular 'cooperation' Dawkins is referring to, a cooperation not exhibited by genes within the individual, is difficult to fathom.

Leaving aside this particular piece of Dawkinsian incoherence, the picture of ('selfishly') self-sufficient, and self-enclosed, genetic material units, carrying items of on-board information, units which become increasingly disparate as species and environment diverge, is clear. Thus 'surviving genes in camels', we are told, 'may *even* be shared with desert rats and desert foxes', presumably because of the common environment. The implication, however, is that species inhabiting differing environments will not share commonality of genes. This fundamental, and mistaken, neo-Darwinian view, then, is that the more widely species diverge from each other, so also does the genetic make-up of those species. As Carroll elucidates the entrenched viewpoint:

> The classification of organisms, the assignment into like and unlike, has largely been driven by a consideration of form. So the long standing assumption has been the greater the disparity in form, the less, if anything, any two species would have in common at the level of their genes.[8]

So here we find Carroll indicating that the view which Dawkins so often stridently proclaimed to be 'scientific fact' was actually always an 'assumption!

It was this neo-Darwinian metaphysical mythology that was completely discredited when the evidence became available. Carroll writes that 'this view was entirely incorrect' and he quotes Stephen Jay Gould:

> The central significance of our dawning understanding of the genetics of development lies not in the simple discovery of something utterly unknown … but in the explicitly unexpected character of these findings, and in the revisions and extensions thus required of evolutionary theory.[9]

It is intriguing that Gould should paper over the fact that the evo-devo revolution actually indicated the complete fallaciousness of core assumptions of the materialistic appropriation of Darwinism that had occurred by using terms such as 'revisions and extensions'. For the revolution in a sense was as profound as the quantum revolution in physics and, as we shall see, has a lot to do with the quantum revolution, although most current proponents of the evo-devo perspective seem to be hard at work to preserve an outmoded and inappropriate materialist perspective.

In is also revealing that Gould refers to the 'unexpected character of these findings' for one of the first things which should surely strike anyone of insight on coming across the evo-devo is that the elucidation provided actually contains a much greater level of coherency than the previous understanding. Consider, for example, Myers' confident and utterly fallacious claim that 'very different gene complexes will come up with the same solution, no matter how different the pathway by which it is achieved.' The "Many roads lead to Rome" view is completely counter intuitive; the notion that genes should diversify and differentiate into

radical different characters, becoming more and more disparate as the species draw apart and yet at the same time should converge on identical solutions to various evolutionary challenges is surely unlikely, however different the species involved may be. Neither was there evidence for it, it was simply considered as being 'obvious', so obvious that some proponents of completely fallacious worldviews made good names and livings for themselves promulgating falsehoods. For now we know that:

> Natural selection has not forged many times completely from scratch; there is a common genetic ingredient to making each eye type, as well as to the many types of appendages, hearts, etc. These common ingredients must date deep back in time, before there were vertebrates or arthropods, to animals that may have first used these genes to build structures with which to see, sense, eat or move. These animals are the distant ancestors of most modern animals, including ourselves.[10]

This is a paradigm which accounts for the facts of evolution far more coherently, as well as being in accord with actual evidence, than the 'Many Roads' scenario.

In order to prepare the way for an initial appreciation of the evo-devo paradigm it is useful to consider the 'object-oriented' paradigm within computer modeling which constitutes the initial phase of computer systems development. The object of this approach is to be able to design a computer software system in a hierarchical modular fashion in which the system starts at the base as a highly abstract module and then descends through levels of 'object-classes' of increasing complexity; each level adds functionality to the level above. Thus in figure 1 we see that at the top of the class tree there is the most 'abstract' class which is just a bank account. Within this class only the information which is common to all bank accounts can be placed, information which is specific to various types of bank account are contained in the classes on lower levels of the tree.

A further refinement of this hierarchical structure which is a vital part of the object-orientation paradigm is the idea of 'virtual members'. These are members of a class which form part of the overall structure but cannot be fully specified within the class because the exact form of the member depends upon the implementation of members at a lower level of the hierarchy. So the top level 'bank account' class might look as shown in figure 2. The personal details of the account holder can be 'implemented' within this level but the 'virtual' members will be fully specified at a lower level of the object hierarchy. Thus the 'virtual' members specify an 'abstract' structure which can be implemented in different ways at a later point depending upon the paths taken through the lower levels of the hierarchy.

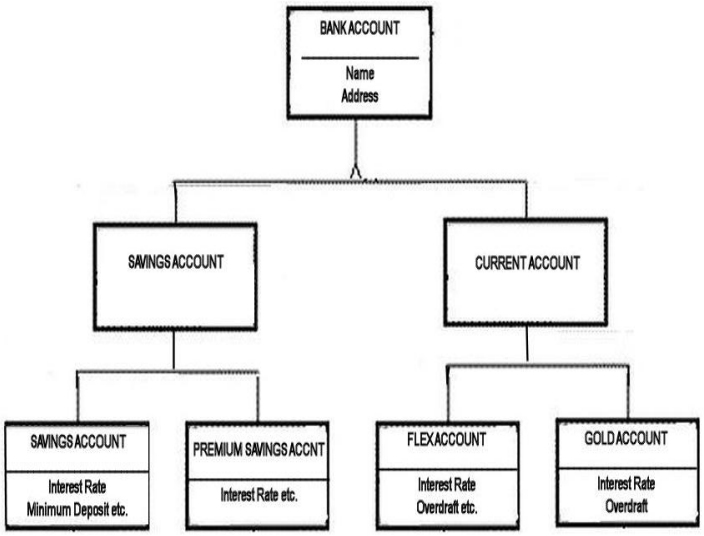


Fig 1

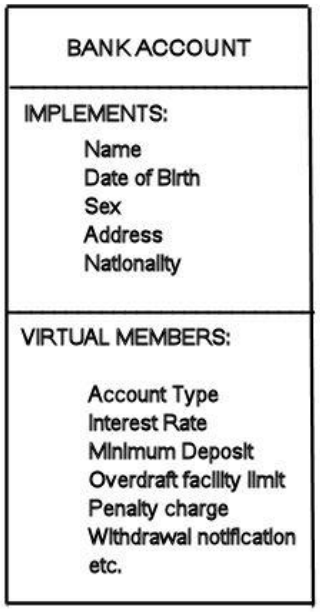


Fig 2

The findings of the evo-devo revolution now indicate that a similar hierarchical modular development is fundamental within the evolutionary development of species. Figure 3 gives a flavor of this perspective in a very crude and reduced form, indicating the principle rather than detail. The essential point is that, whereas the previous view of divergent 'random' mutation of material gene units asserted the lack of common structure between divergent species it now turns out that in fact there is a common structure, which is clearly apparent within the genetic structure underlying all species.

The first indication of this commonality was a result of research into the genetic makeup of fruit flies and mice. In order to elucidate this, a quick outline of the terminology is required. The fundamental process which appears to drive the process of the embryonic development is the division and differentiation of cells (the reason for the word '*appears*' will become apparent later) which is itself determined by the functioning of the strings of DNA within the cells. Each *chromosome* within a cell is a long molecule of DNA (Deoxyribonucleic acid); the chromosome in turn is identified as consisting of smaller strands of DNA called *genes*, so *genes* are smaller components, each occupying its own particular location within the chromosome, some of which are identified as having particular tasks within the development of the embryo (figure 4a). DNA itself is composed of two strands of *nucleotides* wrapped around each other in the famous double helix configuration; each nucleotide is comprised of one of four distinct *bases*: Adenine (A), Cytosine (C), Thymine (T), Guanine (G), and these bases map on to each other to form the DNA helix as indicated in fig 5: A can only link with T, and G with C.

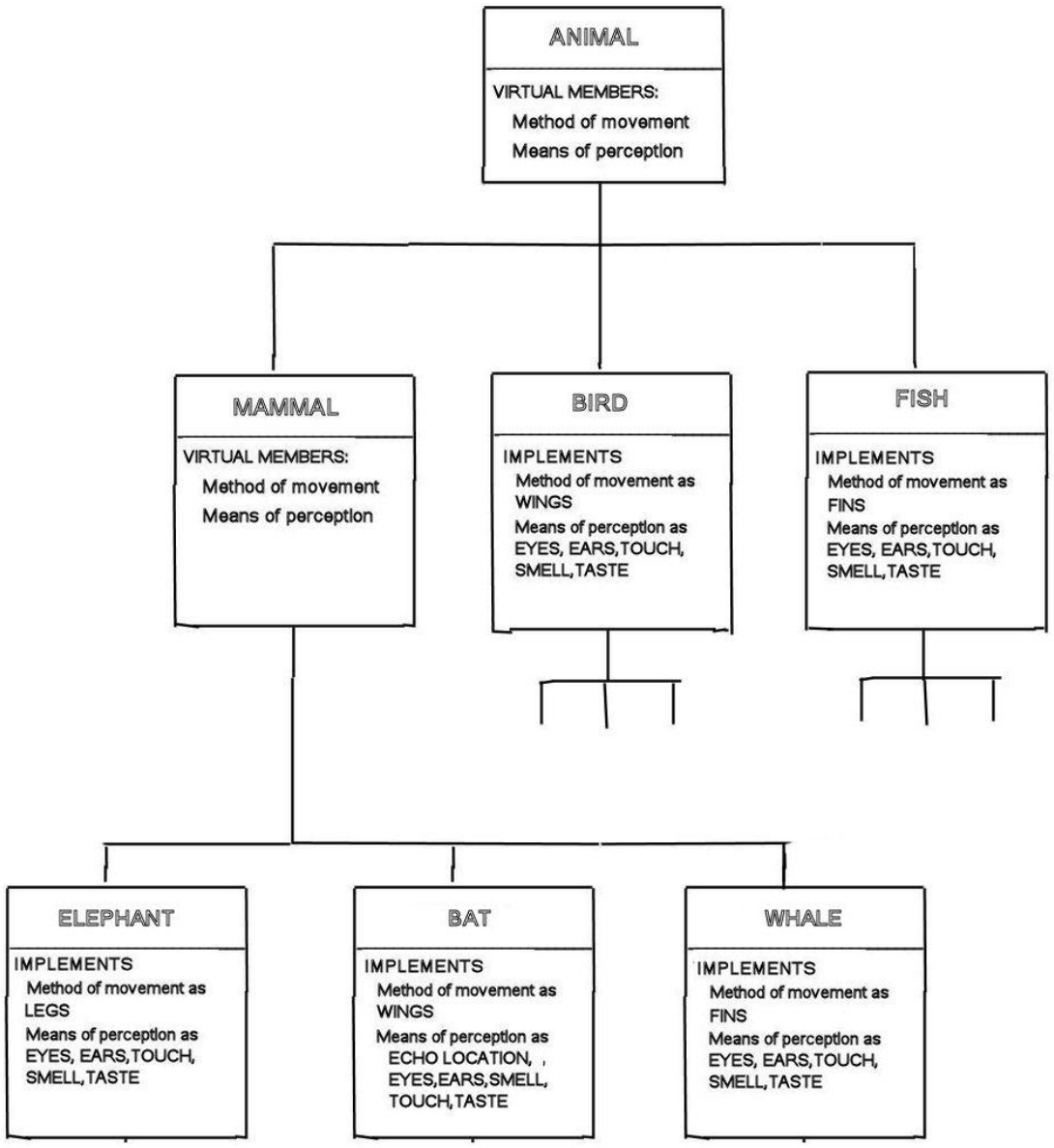

ANIMAL
VIRTUAL MEMBERS:
Method of movement
Means of perception
MAMMAL
VIRTUAL MEMBERS:
Method of movement
Means of perception
BIRD
IMPLEMENTS
Method of movement as WINGS
Means of perception as EYES, EARS, TOUCH, SMELL, TASTE
FISH
IMPLEMENTS
Method of movement as FINS
Means of perception as EYES, EARS, TOUCH, SMELL, TASTE
ELEPHANT
IMPLEMENTS
Method of movement as LEGS
Means of perception as EYES, EARS, TOUCH, SMELL, TASTE
BAT
IMPLEMENTS
Method of movement as WINGS
Means of perception as ECHO LOCATION, , EYES, EARS, SMELL, TOUCH, TASTE
WHALE
IMPLEMENTS
Method of movement as FINS
Means of perception as EYES, EARS, TOUCH, SMELL, TASTE

Fig 3

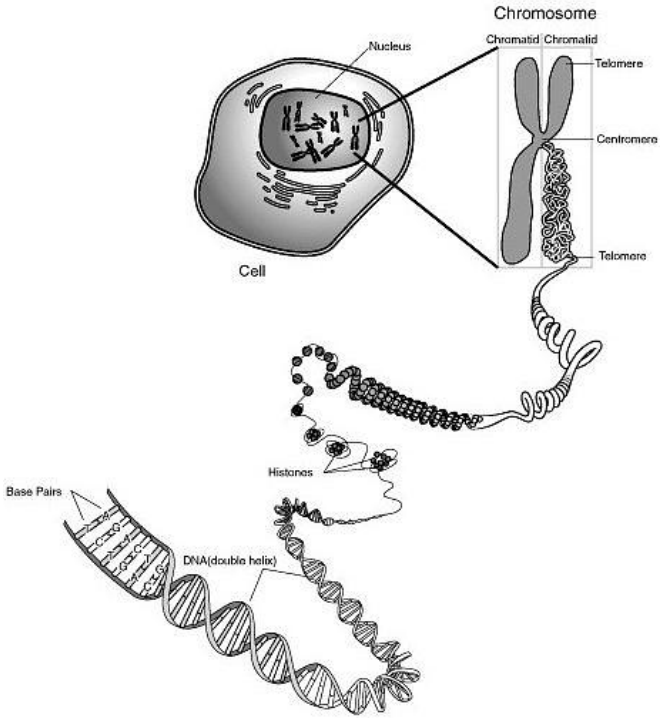


Fig 4

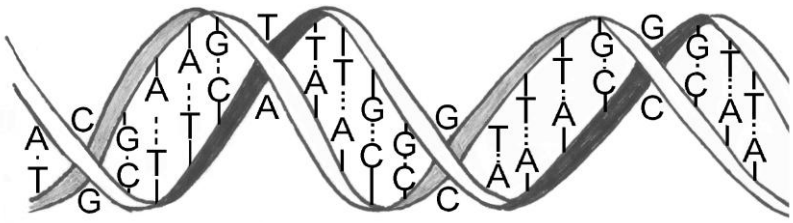


Fig 5

Within the functioning of cell the DNA is responsible for the manufacturing of proteins through the intermediary production of 'messenger' RNA (mRNA). A single strand of mRNA is produced from one strand of the DNA double helix, a process termed 'transcription'. Subsequently the mRNA strand is 'decoded' into a protein sequence; this process is termed 'translation'. Proteins are comprised of sequences of *amino acids*, and this sequence determines the configuration and chemical properties of the target proteins; and these properties determine the function of the protein in the functioning of the organism, whether they function as carriers of oxygen or are constituents of muscle fiber and so on.

One of the crucial discoveries which opened the way to the evo-devo paradigm was the discovery by François Jacob and Jacques Monod of the fundamental switching mechanism which takes place in order to regulate the mode of functioning of genes. In their investigation of the functioning of the intestinal bacterium E.Coli Jacob and Monod discovered the existence of gene 'repressor' sites which determine whether or not a gene is 'on' or 'off' and, therefore, whether gene transcription into mRNA takes place. This mechanism is mediated by the production, in certain circumstances, of a DNA 'binding protein'; this binding protein binds with a specific DNA sequence and thereby turns the gene on or off.

The next piece of the puzzle was provided by the mapping of the genes on the third (of four) chromosome of the fruit fly onto the parts of the fly's anatomy that they directed:

> …the genes sat close together in two clusters. One cluster, the Bithorax Complex, contained three genes that affected the back half of the fly; the other, the Antennapedia Complex, contained five genes that affected the front half of the fly. Even more provocative, the relative order of the genes in the two clusters corresponded to the relative order off the body parts they affected…[11]

This correspondence between genes and the parts of the fruit fly, and the fruit fly egg, is shown in figure 6.

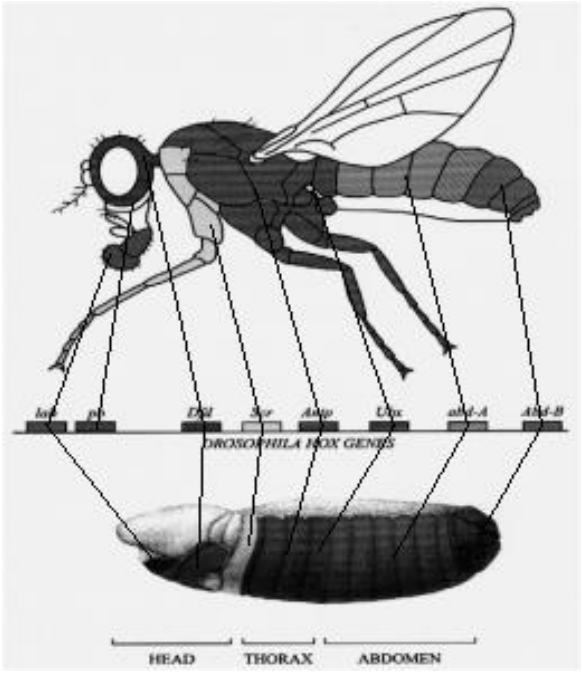


Fig 6 – Hox genes in the Fruit Fly.

These two pieces of the puzzle linked together beautifully when the proteins which made up the genes were analyzed and it was discovered that all eight genes had a short stretch of a 60 amino acid domain that were all similar in sequence. This shared sequence was called a 'homeobox' and the corresponding protein domain was called the 'homeodomain'; subsequently the genes were dubbed '*Hox*' genes. It then became apparent that the homeodomains were DNA-binding domains which were triggered by corresponding proteins, an insight which indicated that genes were switched on or off by the presence of the relevant binding proteins; so the presence of proteins acted as activators of switches that determined the manner of functioning of various *Hox* genes.

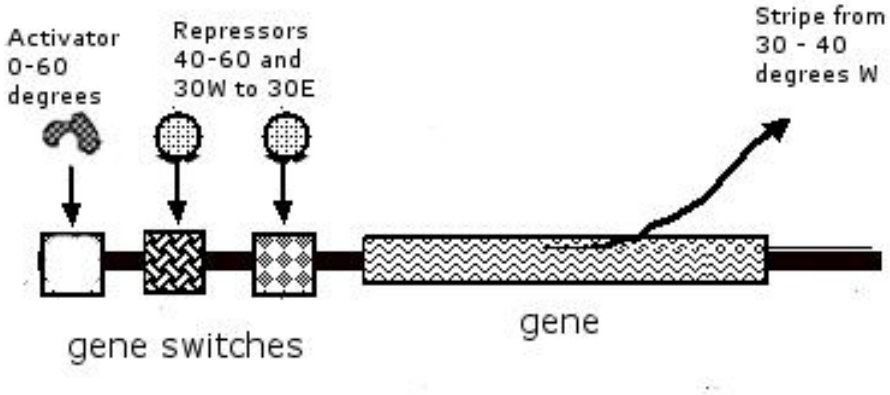


Fig 7

Carroll gives an example of how *Hox* genes and gene switches function to determine the longitudinal stripe markings in a fly embryo. Specific protein activators and repressors bind to various switch locations on the DNA strand to the side of the actual gene; this is 'similar to the way a specific key fits into a particular lock.' Thus in fig 7 the combination of the activator and repressor proteins determine that the mRNA protein is 'expressed' and activates a particular stripe in the embryo. The question which naturally arises, of course, is what determines the particular combination of activators and repressors that activate the switches at any particular point in development. It turns out that there is a sequential cascade of activation of switches, so one set of activators and repressors determine the proteins which are operative in the next phase; as Carroll says it is a 'chicken and egg' scenario:

> Ultimately, the beginning of spatial information in the embryo often traces back to asymmetrically distributed molecules deposited in the egg during its production in the ovary … (so the egg did come before the chicken)…

However, Carroll declines to speculate on where the first 'egg' came from.

The next remarkable discovery was of the same genetic structure and functioning in many diverse animals, 'various bugs, earthworms, frogs, cows, and humans':

> …the similarities among the species were astounding … Such sequence similarity was just stunning. The evolutionary lines that led to flies and mice diverged more than 500 million years ago, before the famous Cambrian Explosion that gave rise to most animal types. No biologist had even the foggiest notion that such similarities could exist between genes of such different animals. These *Hox* genes were so important that there sequences had been preserved throughout this enormous span of animal evolution.[12]

When the arrangement of the *Hox* genes in mice was figured out the mapping of structure, including the isomorphism between gene order and body structure, between the fruit fly and mice turned out to be, as Carroll says, 'amazing'. Figure 8 shows the correspondences between the common underlying gene structure and fly and mouse embryo. So, as Carroll points out:

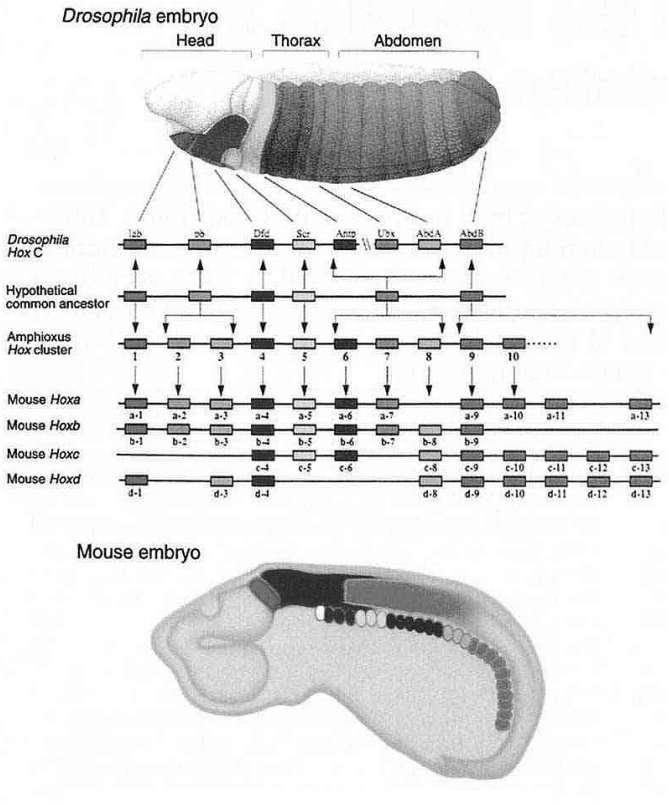


Fig 8

> It was inescapable. Clusters of Hox genes shaped the development of animals as different as flies and mice, and now we know that includes just about every animal in the kingdom, including humans and elephants.[13]

And it soon became apparent that this commonality extended to other fundamental types of gene complexes. The next type of gene to be shown to be common across species was the so-called *eyeless* gene (so called because, when mutated in flies, it is responsible for the loss of eyes) which is called *Aniridia* in humans and *Small eye* in mice, together these three genes are collectively known as *Pax-6* and they have been found to be significant for the development of all kinds of different types of eyes across species. The fact that the gene responsible for the development of eyes is common is dramatic (or, as Caroll says, 'intriguing and provocative') because humans and mice have camera-type eyes whereas flies have compound eyes; so the same gene regulates the development and placement of eyes but the type of eye depends on other factors. This feature was demonstrated in an experiment in which mouse *Small eye* genes were transplanted into various strange places in flies such as the wings. The result was the development of fly type eye structures on the fly wings, structures induced by the presence of mouse eye-producing genes.

Another component of what Carroll calls the 'gene tool kit' is the *Distal-less* (*Dll*) gene, which was so called because when it is mutated the distal, or outer, parts of fly limbs fail to develop. Again these genes are found to be operative in the development of 'all sorts of things that stuck out of animal bodies:'[14]

> These included chicken legs, fish fins, the appendages of marine worms (called 'parapodia'), the ampulae and siphons on sea squirts, and even the tube feet on sea

> urchins. This was another example, like *Pax-6*, of a tool kit gene involved in building vastly different structures that only share, at most, the common feature of projecting away from the main body. These animals are also representatives of different major branches of the animal tree.[15]

The final component of the gene toolkit mentioned by Carroll is the *tinman* gene, which is so named after the character in *The Wizard of Oz* who lacked a heart; flies have an open circulatory system, which means they do not have a heart as such. These genes were found to have mammalian versions (NK2 family) which are significant in heart formation in vertebrates, including ourselves.

The multi-functionality of the *Distal-less* gene is remarkable. As Carroll points out, fourteen or more different types of appendages project out from the body of a Crayfish (fig 9) and the *Distal less* gene is significant in the development of them all. But the *Distal less* gene is not only responsible for land (underwater or dry land) limb development; it is also significant in the placing of spots on butterfly wings:

> *Distal-less* still kept its old job: it was also deployed in the distal parts of all developing butterfly limbs, just as in all other insects and arthropods. The spots of the *Distal-less* expression in butterfly wings were a new trick, "learned" long after its ancient role in limb-building. Remember everything about a toolkit protein's action depends on context.[16]

It is in passages such as this that Carroll subtly reveals his adherence to the old neo-Darwinian notion that that the development of species, a process driven by changes in the way in which various gene components are expressed through the operation of the surrounding regulatory switching protein mechanisms, is a result of random mutations which occur over time, which in this particular case allows *Distal-less* gene mechanism to 'learn' a new role.

In the old Dawkins style model it was, fallaciously, asserted that the actual material makeup of the genes themselves mutated and thereby produced new phenotypes (fully developed organisms) ready to be filtered and winnowed by the tooth-and-claw fight with the environment. But in the new Evo-Devo vision, as portrayed by Carroll, it is changes in the regulatory switches, rather than the genes, that are responsible for evolutionary changes. The actual mechanism or mechanism responsible for such changes, however, is left somewhat hazy. In the case of the *Distal-less* regulatory mechanism becoming involved in the determination of the patterning of the outer butterfly wing adornment, for instance, we are simply told that it somehow 'learned' to add this functionality to its repertoire over the course of time. But towards the end of his book Carroll nails his materialist and mechanistic colors to the evolutionary flagpole when he considers the remarkable fact that the same features, which are determined by the functioning of the same gene complexes (genes plus regulatory protein mechanisms), are found across diverse species, a discovery which is redolent with resonance of the dreaded notion of 'design':

This vestigial remnant of the neo-Darwinian worldview, however, is no more than an implausible echo of what was, in the days of the ascendency of the neo-Darwinian mytho-logical worldview, nothing more than a speculative and incoherent fantasy which was adopted in order to preserve a Newtonian materialism which was itself heading for extinction.

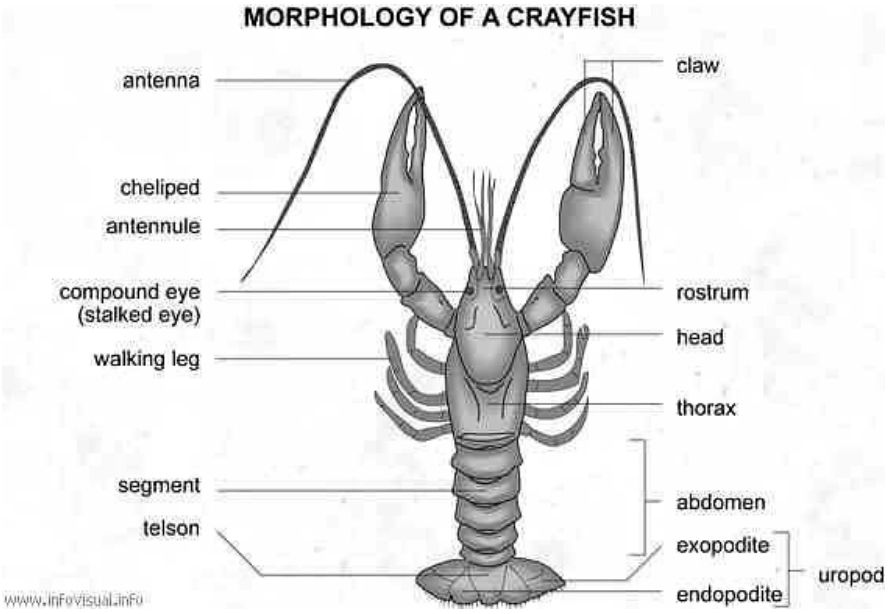


Fig 9

> These instances of evolution repeating itself directly address difficulties some have had in grasping the role of random mutation in the evolutionary process. Some people have found it hard to imagine how novelty and complexity arise from a "random process." The key distinction is that while the generation of genetic variation by mutation is a completely random process, the sorting out of these variations as to which will persist and which will be discarded is determined by a powerful, selective nonrandom process. Of the hundreds of millions or billions of individual base pairs in an animal genome, all are equally susceptible to random copying errors or physical damage that cause mutations. But only a tiny fraction of all possible mutations can alter a mammal's coat in a viable manner, or reduce a stickleback's spines without causing catastrophic collateral damage. In large populations of animals, over eons of time, such mutations will arise simply as a matter of probability. When they do occur, positive selection upon the trait they affect will cause them to spread in populations over time.[17]

The extent of the desperation in this presentation is clearly apparent in the fact that it is an account which posits the most unlikely scenario, the notion that accumulation of evolutionary *errors* is responsible for the astonishingly organized and coordinated growth of increasingly complex and evolved biological organisms, *in the face of contrary evidence* that there is an inbuilt directionality and at least an minimal intentionality or what Paul Davies calls a 'subtle teleology' within the process of evolution. The very example of the functioning of E. Coli which Carroll uses to illustrate the role of proteins as triggers for the activation of genes mitigates against the mythology of randomness. As Professor Patricia L. Foster, of the Biology Department of Indiana University, points out:

> When populations of microorganisms are subject to certain nonlethal selections, useful mutants arise … whereas useless mutants do not. This phenomenon, known as adaptive, directed, or selection-induced mutation, challenges the long-held belief that mutations only arise at random and without regard to utility. [18]

And, of course, the neo-Darwinian worldview has nothing to say on the presence of consciousness, and, within humans, full-blown self-consciousness, as a significant feature of the organisms produced by the universal evolutionary process.

In his excellent book *Life's Solution: Inevitable Humans in a Lonely Universe* Professor Simon Conway Morris has also demonstrated the prevalence of the convergence of evolutionary 'solutions' to survival challenges across widely differing species, a phenomenon which suggests that templates for the structure of various components of plant and animal physiology are seeded into the potentialities underlying the evolutionary process. And the conclusion he draws is that, contrary to the 'drunken walk' within a maze of mechanistic randomness viewpoint of various materialist evolutionary biologists, there is teleology towards the production of increasing levels of complexity, and associated sentience, within the ground potentiality of the process of evolution such that the end point of an organism having the kind of self-aware intelligence of human beings is an inevitability:

> So, if convergence is going to be a guiding principle in the understanding of evolution, then of all the areas worth investigating one of the most interesting must surely be to look at what constraints if any, accompany the development of sensory organs. It is here, if anywhere, that we can approach the wider problem of the evolution of the nervous systems, brains, and perhaps ultimately sentience. And this is turn might give some clues as to whether indeed intelligence is some quirky end point of the evolutionary process or whether in reality it is more-or-less inevitable, an emergent property that is wired into the biosphere.[19]

In other words Conway Morris adopts a 'Anthropic' perspective which hold that it is sentience and consciousness which are the driving force and target of the evolutionary process, a viewpoint not entertained willingly amongst the denizens of materialist enclaves, but, as we shall see, a perspective which is now increasingly suggested by quantum evidence.

The American cognitive scientist and philosopher Jerry Fodor, Professor of Philosophy at Rutgers University, in a recent essay *Why Pigs Don't Fly*, has questioned the neo-Darwinian assumption of random 'adaptationism' and has indicated that there are perhaps more viable alternatives:

> Everybody thinks evo-devo must be at least part of the truth, since nobody thinks that phenotypes are shaped directly by environmental variables. Even the hardest core Darwinists agree that environmental effects on a creature's phenotype are mediated by their effects on the creature's genes: its 'genome'. Indeed, in the typical case, the environment selects a phenotype by selecting a genome that the phenotype expresses. Once in place, this sort of reasoning spreads to other endogenous factors. Phenotypic structure carries information about genetic structure. And genotypic structure carries information about the biochemistry of genes. And the biochemical structure of genes carries information about their physical structure. And so on down to quantum mechanics for all I know.[20]

And here Fodor takes the descent through the levels of the physical world down to the physical description of the functioning of reality which most physicists consider to be ultimate explanatory level: quantum physics. Furthermore it is significant that Fodor qualifies his statement of the possibility that quantum physics might be significant in the process of evolution by the phrase 'for all I know', indicating a lack of knowledge to adjudicate the

possibility. For it seems to be the case that very few writers and commentators on the issue, at least within the fold of evolutionary biologists, do have the necessary acquaintance with the radical findings of quantum theory in order to approach the issue of the possibility that evolution is primarily driven from the quantum level. Thus Dawkins tells us that, when it comes to quantum theory:

> …this is where I must make my excuses and leave. Sometimes I imagine I have some appreciation of the poetry of quantum theory, but I have yet to achieve an understanding deep enough to explain it to others.[21]

What Dawkins does not tell us, however, is how, given his incompetence at the quantum level, he can possibly be certain, as he certainly seems to be, that genes are the 'selfish' ontologically primary drivers of the evolutionary process. For, as Fodor indicates, genes can themselves be reduced to their molecular constituents and the functioning of such molecular units depends upon the details of quantum physics. As Johnjoe McFadden, Professor of Molecular Genetics at the University of Surrey, points out:

> Watson and Crick's structure (of DNA) was therefore the culmination of centuries of biological progress. The great mysteries were laid bare: how biological information was encoded, how it was inherited and how it was changed. But it also pointed in a quite surprising direction, towards the involvement of that other great triumph of the 20th century science – quantum mechanics – in the fundamental basis of life and the driving force of evolution."[22]

It is truly remarkable how most so many interested parties working in the field of evolutionary biology remain quite happy to ignore the dramatic discoveries of quantum physics, discoveries which have completely revolutionised our understanding of what *appears* to be a 'material' world. For if one thing has been established beyond doubt by the quantum revolution it is that Cartesian-Newtonian type 'matter' 'does not exist', to quote quantum physicist Professor Henry Stapp. Furthermore it is now necessary to accept that the ultimate nature of what appears to be the material world is actually, again quoting Stapp, 'idea-like', or of the nature of Mind.

This viewpoint is becoming increasingly established within quantum philosophy, although there are stubborn pockets of materialist desperation resisting the cascade of quantum evidence. And, furthermore, it is a conclusion which was clearly reached by many of the founding fathers of quantum theory, which is why Max Planck asserted that:

> All matter originates and exists only by virtue of a force... We must assume behind this force the existence of a conscious and intelligent Mind. This Mind is the matrix of all matter.[23]

And Schrödinger wrote that:

> Mind has erected the objective outside world … out of its own stuff.[24]

Furthermore, in his 1944 book *What is Life* Schrödinger explicitly wondered whether there might be a quantum basis for the genetic mechanism of inheritance.

More recently physicist Amit Goswami has indicated the necessity of placing the operations of a universal field of awareness-consciousness as being fundamental in the orchestration of the evolutionary process:

> …if we do science on the basis of consciousness, on the primacy of consciousness, then we can see in this phenomenon creativity, real creativity of consciousness. In other words we can truly see that consciousness is operating creatively even in biology, even in the evolution of the species.[25]

This proposal will be vigorously resisted by the materialist minded cohorts of the greater number of evolutionary biologists within which the notion of the materialist 'chance and necessity' paradigm predominates; however, it is the kind of perspective which is required by the quantum evidence.

In my previous essay *The Grand Designer: Can Hawking's Godless Theory of Everything Run Without God* (Vol 1, No. 7 – 2010) I demonstrated that if one took the core proposals for the basis of the Theory of Everything contained within Hawking and Mlodinow's book *The Grand Design* seriously then the conclusions they reach, in particular the conclusion that a 'whole universe' can 'just appear out of nothing' is clearly at variance with the earlier assertion that at the moment of the big bang the universe 'appeared spontaneously, starting off in every possible way,' and then subsequently sentient beings somehow 'choose' or 'create' for themselves which universe they will occupy through the exercise of perceptual weeding out of possibilities.

This perspective clearly requires that at the moment of 'creation' there must be a quantum field of infinite potentiality which contains its own mechanism of unfoldment, rather than a pure 'nothingness' which Hawking and Mlodinow seem to favor. Furthermore this universal field must be of the nature of consciousness-awareness. The conclusion that the ultimate nature of the universal process must be of the nature of consciousness follows exactly from Hawking and Mlodinow's adherence to Feynman's 'sum over histories' approach to quantum theory, which requires that:

> The histories that contribute to the Feynman sum don't have an independent existence, but depend on what is being measured. We create history by our observations, rather than history creating us.[26]

In other words it is the exercise of sentient 'observation', or perception, which creates 'our history', which also means that sentient perception determines the nature of the universal process backwards in time, and also forwards in time, through the weeding out of potentialities. Thus in their chapter 'Choosing our Universe' Hawking and Mlodinow tell us that in one possible universal history the moon is made of 'Roquefort cheese' but somehow the perceptual activities of the sentient beings of the current universe has vetoed this possibility and opted for a moonrock moon; although there may be other universes which do have a Roquefort cheese moon, the sentient beings in our universe have, over vast time over scales, 'chosen' moonrock.[27]
This view agrees with the understanding of the visionary physicist John Wheeler, who also concludes that the evolution of the universe eventually requires the participation of sentient beings in the determination of its nature:

> 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.[28]

And:

> Law without law. It is difficult to see what else than that can be the plan of physics. It is preposterous to think of the laws of physics as installed by Swiss watchmaker to endure from everlasting to everlasting when we know that the universe began with a big bang. The laws must have come into being. Therefore they could not have been always a hundred percent accurate. That means that they are derivative, not primary … Events beyond law. Events so numerous and so uncoordinated that, flaunting their freedom from formula, they yet formulate firm form … The universe is a self excited circuit. As it expands, cools and develops, it gives rise to observer-participancy. Observer-participancy in turn gives what we call tangible reality to the universe … Of all the strange features of the universe, none are stranger than these: time is transcended, laws are mutable, and observer participancy matters.[29]

A significant observation in this quote is that the universe 'as it expands, cools and develops, it gives rise to observer-participancy. Observer-participancy in turn gives what we call tangible reality to the universe…' which indicates an interdependent evolutionary process which physicist Amit Goswami calls a 'tangled hierarchy' within which the observing aspect and the observed aspect of the evolutionary process develop inter-dependently through a sequence of increasingly 'explicate', or materialized, levels of manifestation. This viewpoint corresponds closely to the suggestion by the significant trailblazing physicist David Bohm who suggested that the appearance of the material world emerges through initially subtle levels of 'implicate orders' which manifest through quantum layers, which he dubbed 'implicate orders', towards a final 'material' manifestation. As we shall see, this view of a vertical downward (or upward depending upon one's point of view) evolution through quantum levels of manifestation provides a much more coherent and fertile elucidation of the manner in which the common structures underlying the morphology of biological life came into being.

In his book *Life Without Genes* Adrian Woolfson presents us with a poetic vision of the sort of field of potentiality that he imagines must have 'existed' before the dawn of life within the universe:

> In the beginning there was mathematical possibility. At the very inception of the universe fifteen billion years ago, a deep infinite-dimensional sea emerged from nothingness. Its colourless waters, green and turquoise blue, glistened in the non-existent light of the non-existent sun … A strange sea though, this information sea. Strange because it was devoid of location …[30]

This field, of course, can only be the quantum wavefunction of the universe, a universal wavefunction which contains:

> …all possible histories … through which the universe could have evolved to its present state…[31]

This perspective, of course, is completely harmonious with the Hawking-Mlodinow version; the quantum wavefunction of the universe contains all the future evolutionary possibilities for the development of sentient beings and the environments inhabited by then. And from out of the vast entangled web of infinite possibilities for manifestation only certain privileged, because viable within the context of the details of the evolution of this particular universe, members will actually make it into reality:

> An information space of this sort would furnish a complete description of all potentially living and unrealizable creatures…[32]

The fact that not all possibilities for the manifestation of sentient beings and the environments inhabited by them are actualized, thereby leaving some potentialities as 'unrealized' is, again, in line with the Hawking-Mlodinow perspective, wherein many potentialities, the unlikely possibility of a cheese-moon being an example given by them, are weeded out by the choices that the universal consciousness, which at some point becomes embodied within evolved sentient beings, makes along the way. The dramatic implication, then, is that the potential forms of all sentient beings must be 'contained' as pure potentiality within the ground of the universal quantum consciousness which awaits unfoldment at the edge of time.

The attitude to the notion that the quantum level of reality, the level which just about all physicists now consider to the ultimate and grounding level, is at least inextricably entangled with the phenomenon of consciousness (Rosenblum and Kuttner – *Quantum Enigma*) or, even more radically, consists of a field of pre-individualized awareness-consciousness (Stapp, Goswami, Hameroff and others), on the part of those who lean towards a materialist view of reality is ambiguous to say the least. The quantum evidence is now so now ineluctable that denying it is really not a viable option. However, an option often resorted to is to falsely claim that the quantum evidence is so confusing that the matter has not been decided yet. In a recent book called *Life Ascending*, which won the 2010 Royal Society Prize for Science Books, the author Nick Lane refers to the views of the Scottish physicist Graham Cairns-Smith who suggests that what we call 'matter' must itself have subjective features and must also in some fashion partake of the nature of consciousness, which was the position advanced by Bohm; Lane writes that:

> Matter is conscious in some way, with 'inner' properties, as well as the familiar external qualities that physicists measure. Pan-psychism is taken seriously again. It sounds preposterous. But what arrogance to think that we know all there is to know about the nature of matter! We don't. We don't even understand the way quantum mechanics works. … We don't know enough about the deep nature of matter to know how neurons transform brute matter into subjective feelings.[33]

This passage illustrates the kind of intellectual schizophrenia which seems to be at the root of current thinking in biology and neurophysiology and other associated disciplines; and it is also necessary to point out in passing that the assertion that 'we don't even understand the way quantum mechanics works' is completely untrue – we have a very precise understanding, it's just that most people don't like the quantum implication that consciousness is the primary constituent of reality. The fact that the concept of 'matter' has been thrown into dramatic ambiguity by quantum physics, so much so that the respected physicist Henry Stapp has repeated many times that Cartesian-Newtonian type matter 'does not exist,' and physicist and respected science writer John Gribben has written a book entitled *The End of the Matter Myth*, not to mention pronouncements such as that made in 1931 by Max Planck that he regarded 'consciousness as fundamental. I regard matter as derivative from consciousness'[34], does not stop misguided biologists and others lamenting that they do not know how 'brute matter' is 'transformed' into 'subjective feelings.' How can a non-existent, mythological assumed aspect of reality transform into anything?

This is not to say that the material world is completely non-existent, this would be a ridiculous assertion. The point concerns the ultimate nature of what appears to be an

'external' material world which is conceived of as being independent of mind. The evidence of quantum theory quite clearly is that what appears to be a sphere of materiality which has its own inner self-enclosed independent essence cannot actually be like this. Quantum theory unambiguously tells us that what we thought was independent 'matter' is actually dependent upon mind. As quantum physicist Wojciech H. Zurek, the primary instigator of the theory of 'quantum Darwinism,' a quantum viewpoint which is fundamental for understanding the Evo-devo evidence, tells us:

> Given almost any initial condition, the universe described by [the quantum wavefunction] evolves into a state containing many alternatives that are never seen to coexist in our world. Moreover, while the ultimate evidence for the choice of one alternative resides in our elusive "consciousness," there is every indication that the choice occurs much before consciousness ever gets involved and that, once made, the choice is irrevocable.[35]

Although at first sight the implication of the quantum evidence might seem to be that individual consciousnesses 'collapse' the wavefunction, in fact it is actually more correct to consider the appearance of the material world to be an inter-subjective process which operated at a much deeper quantum level that individuated consciousness, and, furthermore, prior to the manifestation of sentient beings within the process of evolution there must be an inner cognitive function within the field of potentiality which operates to unfold potentialities and thereby also unfold and evolve the future sentient beings destined to inhabit the unfolding universe.

Nick Lane suggest that such a 'pan-psychic' viewpoint is 'preposterous' and, although he pays a brief lip-service to the fact that we do not know 'all there is to know about the nature of matter' he quickly falls back into the familiar, and for many cosy, materialist worldview of the pre-quantum, pre-twentieth century perspective, the perspective of gentlemen fossil collectors and intrepid explorers and species collectors of tropical rain forests. This tendency to constantly fall back into a default position of primary materialism, even whilst in the midst of making observations which should alert the writer in question to the fallacious nature of the perspective is astonishing. Lane, for example, in referring to the work of the neuroscientist Gerald Edelman, tells us that:

> Edelman refers to the process of brain development as *neural darwinism*, which emphasises the idea that experience selects successful neural combinations. All the basic tenets of natural selection are present; we start out with a massive population of neurons, which can be wired up in millions of different ways to achieve the same ends. The neurons vary amongst themselves and can either grow more robust or wither away; there is competition between neurons to form synaptic connections and differential survival on the basis of success.[36]

Here Lane at first reiterates the recent discovery of neuroplasticity, the fact that, contrary to what the vociferous 'experts', again on the basis of prejudice and minimal evidence, in the field of neuroscience prior to the appalling Silver Spring Monkey experiments, the mind's intentionality is able to determine the wiring of the brain. In the Silver Spring experiments the nerve ganglia that supplied sensation to the brain from the monkeys' arms and legs were cut and various forms of encouragement, such as electric shocks, were used to force the monkeys to use the limbs they could not feel. Subsequently it was discovered that significant cortical remapping had occurred, showing that being forced to use limbs with no sensory input had triggered changes in their brains' organization. This evidence of the brain's

plasticity helped overturn the widely held view that the adult brain cannot reorganize itself in response intentional actions. Professor of Psychiatry Jeffrey Schwartz, in his excellent book *The Mind and the Brain* says of this discovery:

> Mind, we now see, has the power to alter biological matter significantly; that three pound lump of gelatinous ooze within our skull is truly the mind's brain.[37]

Lane, however, turns this perspective on its head and, in the same way that Dawkins gives an inappropriate ontologically privileged status to 'selfish' genes, gives the brain's neurons an equally inappropriate status, for as Stapp points out:

> …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.[38]

By this dramatic assertion Stapp is emphasizing the fact that the quantum realm is primary; there is no 'Newtonian' type matter, and therefore no *ultimately* existing self-sufficient neurons, in existence.

The inappropriate positing of the 'material' brain as being the *ultimate* source of the phenomenon of consciousness derives from the simplistic observation that there is an obvious connection between damage to various areas of the brain and consequent behavior:

> …specific brain injuries (lesions) cause specific reproducible deficits. It's hardly surprising, but a lesion in the same area causes the same deficit in different people, or for that matter in animals.[39]

However, as we shall see, this crude materialist assumption is incorrect. The fact that the brain is *ultimately* an apparent 'material' organization which emerges from a deeper level of quantum functioning in no way undermines the apparent coherent 'material' functioning of the quantum structure of the brain. It simply means that, at the level at which our 'material' bodies and our sense faculties function, the coherent functioning of the ultimate quantum Mindnature, to employ a term of the Buddhist Dzogchen tradition, manifests as the apparently 'material' world. But this does not mean that the evidence as to the ultimate quantum Mindnature of reality is false. The situation is that a deep implicate field of quantum awareness-consciousness organizes itself through a cascade of quantum 'implicate orders' that finally produce the explicate structures of the brains of sentient beings in order to manifest as individuated consciousness within the manifested dualistic universe.

David Bohm encapsulated this vision in his notion of the holomovement:

> …the notion of the holomovement was enriched by going from a three dimensional space to a multidimensional implicate order and then to a vast 'sea' of energy in 'empty' space, so we may now enrich this notion further by saying that in its totality the holomovement includes the principle of life as well. Inanimate matter is then to be regarded as a relatively autonomous sub-totality in which, at least as far as we know, life does not significantly manifest. … Indeed, the holomovement which is 'life implicit' is the ground of both 'life explicit' and of 'inanimate' matter, and this ground is what is primary, self-existent and universal.[40]

This characterization of the universal ground of 'life implicit', within which the potentialities for sentient beings and their environments have an origin bears an significant resemblance to the Buddhist Dzogchen account of the universal ground:

> The root of our material-mental universe is this self-existent pristine cognitiveness, a point instant virtual singularity; since its facticity is open-dimensioned and not discernable as any concrete thing, it is a meaning-saturated field as pristine cognitiveness. The radiation field of this open dimension is the intrinsic photic character of pristine cognitiveness. Since this is there as its own lucency (in its prismatic character) as yet undifferentiated into color values, it is the quasi-mirroring pristine cognitiveness. Since these modes of pristine cognitiveness have one and the same operational source, differing only in name, this facet is termed the selective mapping pristine cognitiveness. Since these modes of pristine cognitive-ness are self-existent, identical with respect to their lucency and indivisible, this facet is termed the auto-reflexive identity pristine cognitiveness. Since by understanding correctly the meaning-value of this cognitive character of Being all intentional ideation is actualized spontaneously and this facet is termed the precisely actualizing pristine cognitions as the operational source of the intelligible universe that the eighty-four thousand portals to life's meaning opens up. [41]

Here the unfolding principle which drives the evolution of the sentient beings both downwardly through implicate orders of manifestation, and also across time, is 'pristine cognitiveness'. This is the fundamental universal cognitive function which is able to trigger the quantum sea of potentiality into action, and through this action, which takes place over vast time scales, sentient beings of all possible varieties consistent with the nature of the manifesting universe come into being, each embodying a tiny quantum of the universal 'pristine cognitiveness' which provides the driving force for the evolution of the universe. Thus, as Bohm indicates, 'life implicit' becomes both 'life explicit' and 'inanimate' matter.

In the following elucidation the interconnections between the Dzogchen account, based on Herbert V. Guenther's excellent exposition *Matrix of Mystery: Scientific and Humanistic Aspects of rDzogs-chen Thought*, of how a fundamental field of 'pristine cognitiveness' materializes into individualized centers of dynamic meaning-experiencing, or sentient beings, and the account based on the quantum insights on the part of Bohm is uncanny. According to Bohm:

> We can say that human meanings make a contribution to the cosmos, but we can also say that the cosmos may be ordered according to a kind of 'objective' meaning. New meanings may emerge in this over all order. That is we may say that meaning penetrates the cosmos, or even what is beyond the cosmos. For example there are current theories in physics that imply that the universe emerged from the 'big bang'. In the earliest phase there were no electrons, protons, neutrons, or other basic structures. None of the laws that we know would have had any meaning. Even space and time in their present well-defined form would have had no meaning. All of this emerged from a very different state of affairs. The proposal is that, as happens with human beings, this emergence included the creative unfoldment of generalized meaning. [42]

Guenther describes the beginning phases of the evolution of the manifested and materialized world of dualistic experience from the 'evolutionary zero point' according to the Dzogchen worldview as follows:

> It is excitatory intelligence that provides the necessary programming information for initiating a dramatic unfolding process (the big bang) tending towards ever greater

> degrees of complexity (the evolving universe) while simultaneously, throughout all its phases, retaining the intelligence that initiated the process. When this big bang occurs, the surging of intelligence-qua-isotropic radiation develops a special envelop-like structuring of radiation field…The unitary process as an envelop-like structure which results from this surging of intelligence is termed the meaning-saturated field as pristine cognitiveness. [43]

At this point there is still no 'matter', the appearance of the material world comes into manifestation at a later point of quantum evolution from the evolutionary zero point. What we are discussing at this level of development is the cascade of quantum templates of meaning-manifestation, levels of quantum downward evolution from the nondual zero point, levels that Bohm termed 'implicate orders', each implicate order enfolds a new level of meaning evolution in a quantum descent into apparent materiality, and this descent requires the materialization of sentient beings as carriers of individualized awareness of a particular locus of meaning-awareness:

> Later, with the evolution of new forms of life, fundamentally new steps may have evolved in the creative unfoldment of further meanings. That is, we may say that some evolutionary processes occur which could be traced physically, but we cannot really understand them without looking at some deeper meaning which was responsible for the changes. The present view of the changes is that they are random, with selection of those traits that were suited for survival, but that does not explain the complex, subtle structures that actually occurred. [44]

Here Bohm indicates the serious shortcomings of the materialistic and mechanistic view of the evolutionary process enshrined in the materialistic vision of the Darwinian evolutionary process. The view pugilistically promoted by Dawkins and Dennett for instance is that the universe has always been fully materialized and that evolution is nothing more that the non-intentional and mechanical activity of essentially lifeless matter, an extraordinarily counter-intuitive, but for some incomprehensible reason, widely accepted belief. In contrast to this, now completely unacceptable, vision of the lifeless magically becoming life through blind mechanical churning of mindless bits and pieces of inert matter, Bohm is suggesting that evolution must be driven by an intentionality which acts towards the manifestation of life through increasingly more materialized levels of quantum potentiality. Evolution, according to Bohm, must essentially be an intentional quantum process by which subtle quantum structures cascade down to less subtle levels to eventually become fully 'materialized'. This process, according to Bohm, requires:

1. A set of implicate orders
2. A special distinguished case of the above set, which constitutes an explicate order of manifestation.
3. A general relationship (or law) expressing a force of necessity which binds together a certain set of the elements of the implicate order in such a way that they contribute to a common explicate end…[45]

And elsewhere he indicates a set of nested orders: explicate, implicate, super-implicate, super-super-implicate….

In the imagery of Dzogchen, as the 'excitatory intelligence' manifests through the subtle or 'implicate' quantum levels towards manifestation on a materialized level it creates

'envelopes', which we can identify as quantum demarcation structures which designate boundaries which the cognitive process of materialization, which thereby marks out areas of differentiation between the activity of subjective cognition and the projected stabilized cognized objects, in this way the 'pristine cognitiveness' hides its unitary nature in an imaginational field of activity, a field of activity within which the possibilities for the evolution of sentient beings and the collective environments shared by the various varieties of sentient beings takes shape:

> This field envelope exhibits an intentional structure, constituted both as an intending act phase and an intended object phase…[46]

This account, which asserts that the cascade into manifestation begins at a deep subtle level of potentiality with the mere glimmer of quantum-intentional movement, prompted by the internal 'pristine cognitiveness', a subtle quantum intentionality that produces the first implicate order of subtle intentional-subject and intended object, without any further content than this mere subtle intentional duality, easily melds with the most recent 'quantum Darwinism' proposal that the nature of the quantum stuff of reality is epiontic:

> …quantum states, by their very nature share an epistemological and ontological role – are simultaneously a description of the state, and the 'dream stuff is made of.' One might say that they are *epiontic*. These two aspects may seem contradictory, but at least in the quantum setting, there is a union of these two functions.[47]

In this new quantum paradigm we find that the insight brought to modern Western philosophy by Bishop Berkeley that 'to be is to be perceived' is now validated at the fundamental level of quantum theory: the epistemological act of perception actually creates a moment of ontology. And this does not mean that something already existing is known to be existing, it means, rather, that the very perceptual act creates the existence at the quantum level, one might say that the 'collapse of the wavefunction' actually is one moment of quantum perception which itself is a moment of quantum ontology. Furthermore the epiontic paradigm indicates that repeated perception creates a resonant latency for the same perception to occur again, so the more often a perception is repeated the more probable it becomes. This process of 'quantum Darwinism', which I have explored in detail in relation to various formulations in my article *Bohm's Implicate Order, Wheeler's Participatory Universe, Stapp's Mindful Universe, Zurek's Quantum Darwinism and the Buddhist Mind-Only Ground Consciousness* (JCER, Vol. 1 Issue 8), underlies Edelman's 'neural Darwinism' as well as biological evolution over time, in the latter context it finds its most explicitly developed formulation in Rupert Sheldrake's proposal of the functioning of quantum morphogenetic fields.

The Russian physicist and quantum philosopher Michael Mensky has also formulated a similar perspective. According to Mensky consciousness is an interior aspect or quality of the wavefunction which reflexively operates upon quantum potentialities for experiential existence. For individuated consciousness itself to become manifest from fundamental awareness as an explicit experiential aspect of reality it must bring an experienced world into being; and such a world is manifested through the actualisation of the potentialities within the wavefunction and the subsequent selection of primary experiential pathways. According to Mensky a crucial question which requires explication is why the alternatives

which naturally arise are classical, or at least close to classical, in demeanour. Mensky gives the following account:

> If the picture of the world as it appears in consciousness were far from classical, then, due to quantum non-locality, this would be a picture of a world with 'locally unpredictable' behaviour. The future of a restricted region in such a world could depend on events even in very distant regions. No strategy of surviving could be elaborated in such a world for a localised living being. Life (of the form we know) would be impossible. On the contrary, a (close to) classical state of the world is 'locally predictable'. The evolution of a restricted region of such a world essentially depends only on the events in this region or not too far from it. Influence of distant regions is negligible. Strategy of surviving can be elaborated in such a world for a localised living being.[48]

Entangled quantum phenomena can instantaneously affect each other over vast cosmic distances. In fact distance does not seem to be an issue for this kind of entangled mutual determination. It follows, therefore, that in a non-classical, quantum-entangled scenario there would be no environments wherein environmental behaviour was determined purely by local events. Such environments would not be locally coherent and predictable and consequently they could not support coherent life. If Mensky's argument is correct then the classical lineaments of a life-supporting manifested reality is fashioned by consciousness itself for its own manifestation!

In quantum field theory there in a non-substantial entangled quantum field of potentiality and within the process that Mensky envisages it is through the operation of a primitive level of quantum consciousness that this entangled and interdependent field is localised through the quantum evolution of the 'classical' world of individualised sentience and materiality. Furthermore, Mensky indicates that the level of consciousness at which the process begins is:

> …the most primitive, or the most deep, level of consciousness, differing perceiving from not perceiving.[49]

Such deep levels of consciousness contain shared structures of possible experience. These aspects of the structures of consciousness are coterminous with those that the analytic psychologist C.G. Jung called archetypes. Although Jung's archetypes are primarily concerned with deep emotional determinations of aspects of reality, his work led him to suggest, like Bohm, that there is a deep level of connection between the physical world and the realm of the subjective.[50] This view of the deep inner and hidden connection between the manifest realms of the objective world and the subjective experiential world was also shared by physicist Wolfgang Pauli who corresponded for a time with Jung on the subject. The experiential templates for the material world, which can be thought of as archetypal templates which interact with the established features of the objective wavefunction that provides the potential for a material world, must be shared, at least in part, by all sentient beings.

Mensky's account of how such deep structures of consciousness, which select the experiences conforming to a stable material world from the wealth of quantum possibility, arise in the first place provides a fertile starting point for the development of the view of evolution as an essentially quantum process which begins with the operation of the interior quantum 'pristine cognitiveness' operating within the field of quantum potentialities. And the starting point, at the very base of the hierarchical cascade of implicate orders into

material manifestation is the glimmer of the division into perceiver and perceived. Within this division into the possibility of observer and an observed, a fundamental division which takes place at a deep hidden quantum implicate level, the universe becomes self-referring and self-observing, a process which now gives rise to what Goswami calls a 'tangled hierarchy', which can be compared to Bohm's cascade of 'implicate orders', of self-observation through which the fluid quantum nature of the fundamental ground becomes increasingly divided into quantum template 'prototype' sentient beings and inhabited environments. These prototype quantum potentialities only 'exist' as quantum potentialities until consciousness intervenes to fully materialise them, a process which Goswami and others suggest may occur backwards in time, a quantum viewpoint which means that evolution would be a far more bizarre and complex process than envisaged by the single dimensioned Darwinian perspective. For within this quantum perspective it would be the case that until sentient beings began to solidify the process of quantum evolution, backwards in time, the process would be only occurring at the quantum level. This scenario involves the possibility that vast ages prior to the Cambrian, for instance, would *at that time* only be quantum processes, a viewpoint which is consistent with the Hawking-Mlodinow meta-physical vision of the evolution of the universe and its inhabitants. As Goswami indicates:

> Life and by implication we ourselves are here because of the way the universe is designed in possibility so we can collapse the possibility into manifestation.[51]

As we shall see, this perspective can bring coherent elucidation to some perplexing evolutionary conundrums such as the meaning of the Cambrian 'explosion.' However, such a perspective seems seriously counter-intuitive and Nick Lane would almost certainly employ the term 'preposterous' to describe it. But surely we have to decide whether we take the quantum evidence and implications seriously or not?

This understanding of the nature of quantum evolution is consistent with the fact that in quantum field theory the ultimate quantum field contains no substantiality; there is only a field of potentiality which is 'operated' upon by 'creation' (and 'destruction) operators. This description can easily be viewed as an 'objective' presentation of the action of a fundamental 'pristine cognitiveness', also termed within Dzogchen as an 'excitatory intelligence', operating to unfold sentient potentialities. The very first glimmer of epiontic quantum perception, deep within the quantum ground, would simply be a movement of consciousness which gathers into a centre an intentional disposition for perception towards an aspect of the ground of reality which is interdependently posited as being that which is perceived. The first quantum implicate templates, therefore, would simply be that of perceiver-perceived, or 'grasper' and 'grasped' as Buddhist Mind-Only philosophy terms the division. At this point there is only the intention to produce a realm of dualistic experience embodied within a multitude of sentient beings, but as yet there is no actual full-blown perceiving going on, we are still in the early phases of quantum implicate manifestation and there is the mere potentiality for a division into perceiving beings and perceived entities.

The next movement towards manifestation would be to divide the perceiving aspect into actual varieties of perception: some form of sight or echo-location etc., hearing, smelling, touching, tasting. This step will be accompanied by the kind of objects which can be perceived according to which sense faculty and so on. Also there must be a determination as to mode of movement according to the potential environment. These determinations will begin at a very subtle 'virtual' quantum level, and in this way the actual basic templates of

possible sentient beings might be determined within quantum implicate orders prior to actual manifestation on the apparently 'material' world. This process will cascade down, through many quantum implicate levels, or 'orders', to ever more explicate 'gross' levels of manifestation, until, of course, an actual teaming experiential dualistic interconnected manifold of perceiving creatures and concomitant perceived worlds is 'created' from out of the epiontic field of quantum potentiality. Such a view accounts for aspects of evolution far more coherently than the currently accepted materialistic Darwinian paradigm and also for such anomalies as the Cambrian explosion.

A good example to consider is the case of the *distal-less* gene which has been discussed above. As with the example of the Crayfish the *distal-less* gene complex has a remarkable range of applications. Conway Morris describes the situation as follows:

> As with *Pax-6* the original function of this gene is not certain, but some evidence suggests that its primary role was linked with the development in the embryo of the nervous system, and especially the sensory organs. Now it so happens that in arthropods many of the sensory organs are located on the appendages, and accordingly when there was need for improved sensory perception so parts of the body protruded to extend the sensory range of the sensory cells. Only later were such outgrowths on occasion employed for such purposes as locomotion. The widespread expression of the gene *distal-less* is, therefore, effectively a reflection of the recurrent and independent of such limbs: in a sense *distal-less* hitchhikes as a sensory protrusions and is subsequently transformed to allow an additional function such as a leg or an antenna.[52]

So it appears that the same gene complex responsible for organizing protrusions for extending the range of sensory apparatus were 'only later' 'employed for such purposes as locomotion. The impression which is easily gleaned from such presentations is that there must be a sequence of animals across which a sense protrusion is, dues to chance random mutation, gradually transformed into walking apparatus. But the notion that there could have been an intermediate animal which used the same protrusion to see and walk, or smell and walk or hear and walk etc. is clearly difficult to contemplate seriously. This sense of dissonance is even more pronounced with the transformation which is supposed to have taken place, via 'natural selection', from gills to wings:

> The gill-to-wing theory always had evidence in its favor (just not enough weight to settle the matter). But, if indeed insect wings came from crustacean gill branches, does this mean that some kind of crayfish or shrimp just crawled onto land and started flying? No, not at all. There were many evolutionary steps between animals that carried a set of respiratory appendages and the origin of powered insect flight on two pairs of wings as we know it today.[53]

But such a dogmatic and dubious belief in the power of gradualist 'natural selection' cannot mask the fact that, if this account were to be correct, there must be a point in the evolution from gill to wing when the final creature in the evolutionary sequence abandoned the gill function completely and threw in its lot with a life on the wing, just as a few mutations back there must have been an animal using its wings for extracting the odd fix of oxygen from water. Does this sound plausible?

The biologist Lisa Nagy has asked:

> Should vertebrate and insect limbs be considered homologous [meaning descended from a common ancestor] because they are patterned by similar gene networks? Or is the similarity an example of molecular convergence…[54]

In light of the discussion so far, however, the most plausible and coherent explanation of the phenomenon is that what Carroll calls 'toolkit genes' reflects the fact that there are 'toolkit' morphogenetic templates or prototypes for various modules of animal construction which reside as quantum 'virtual' morphogenetic field modules within quantum implicate orders. Rupert Sheldrake describes the process of embryonic development as follows:

> The development of multicellular organisms takes place through a series of stages controlled by a succession of morphogenetic fields. At first the embryonic tissues develop under the control of primary embryonic fields. Then … different regions come under the influence of secondary fields, in animals those of limbs, eyes, ears etc. … Generally speaking, the morphogenesis brought about by the primary fields is not spectacular, because it establishes the characteristic differences between cells in different regions that enable them to act as the morphogenetic germs of the organ fields. Then in the tissues developing under their influence, germs of subsidiary fields, fields which control the morphogenesis of structures within the organ as a whole…[55]

Thus the development of the embryo is controlled by a nested hierarchical of morphogenetic fields, which are, according to Sheldrake, 'quantum probability fields'[56] akin to Bohm's implicate orders. This, of course, is exactly what we should expect in a quantum Evo-Devo universe; the development of the embryo cascades through hierarchical levels of quantum morphogenetic fields in the same way that evolution also took place through a sequence of quantum implicate orders.

Figure 10 shows the very basic and partial beginnings of a hierarchical tree diagram indicating the kind of structure which one can conceive as underlying the upper implicate levels of the manifestation of various animals. The first division of the unified quantum ground is, as indicated above, the mere glimmer of perception; a movement of intentionality on the part of the universal 'pristine cognitiveness' in the direction of producing a manifested world by unfolding as many of the potentialities, which are latent within the possibilities for sentient life contained within the ultimate field of potentiality, as is coherently possible. If the quantum Evo-Devo perspective is correct, then, in contrast to the neo-Darwinian materialist random-chance story in which the natural environment exists fully and materially formed prior to Life making a bid for survival, the true evolutionary process is one in which sentient beings and their environments evolve interdependently through quantum implicate levels. Thus the various requirements for body structure, sensory organs, means of movement dependent upon the environment and so no are fulfilled by the evolutionary process, both synchronically through quantum implicate orders and diachronically (over time), by a modular 'pick and mix' process. The modular 'design' of the Duckbilled Platypus is intriguing in this context. When the naturalist George Shaw, Keeper of the Department of Natural History at the British Museum, received a specimen from Captain John Hunter in Australia he remarked that it was "impossible not to entertain some doubts as to the genuine nature of the animal, and to surmise that there might have been practiced some arts of deception in its structure."[57]

Whilst it is true, of course, that at the fully manifested level all sentient beings inhabit the 'same' material world in the sense that the quantum ground of potentiality within which all sentient beings exist have the same potentialities awaiting unfoldment, each type of sentient being will unfold a different continuum experience of the 'material' world. But all the possible worlds inhabited by the varieties of sentient beings are clearly consistent and coherent in their overlapping features. The entire interconnected system is a coherently inter-

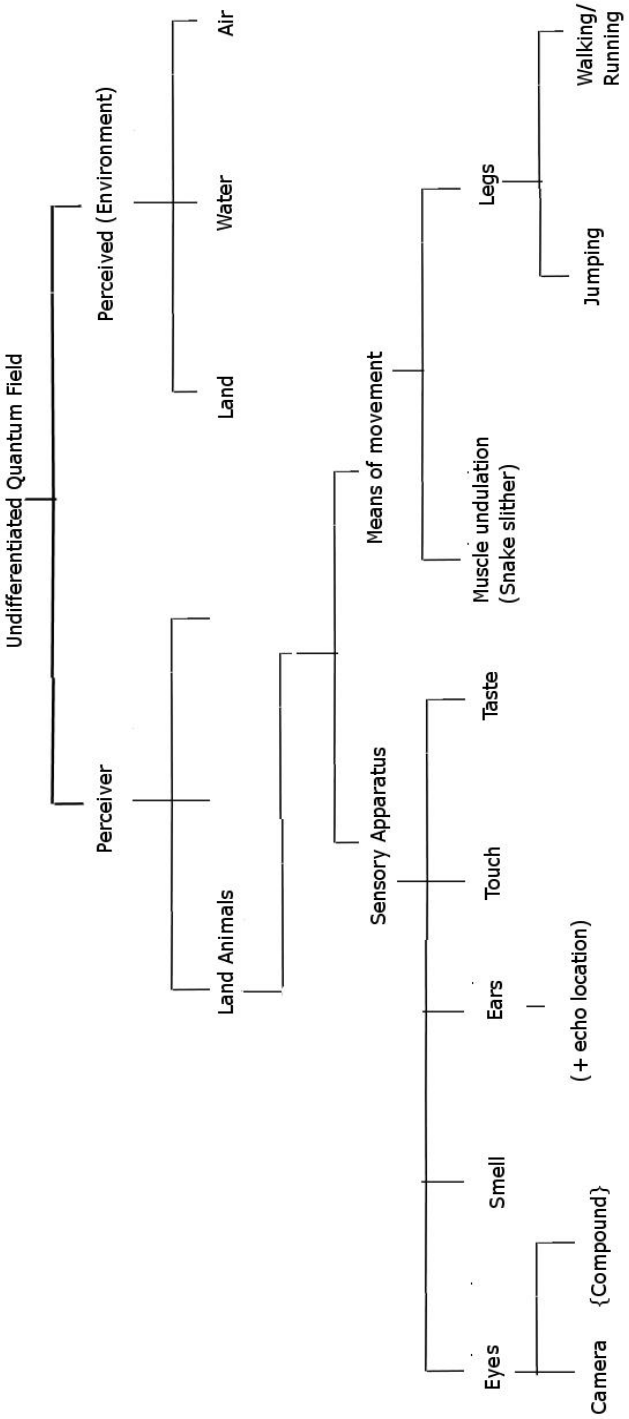


Fig 10

dependent creation etched out of the potentialities within the ultimate quantum field of universal awareness. Darwin himself was not unfamiliar with the notion of an inter-dependent aspect within the process of evolution for at the beginning of his chapter *The Struggle for Existence* in his *The Origin of Species* we can read:

> How have all those exquisite adaptations on the part of one organization to another part, and to the conditions of life, of one distinct organic being to another being been perfected? We see these beautiful *co-adaptations* most pleasantly in the woodpecker and mistletoe…[58]

It would have been impossible, of course, for Darwin to have been aware of the quantum origin.

This view of the process of the unfolding of the multifarious possibilities within the quantum ground of reality through a universal unfolding of potential perceiving organisms can be immediately applied to some iconic Darwinian scenarios. We shall consider Darwin's finches and the African cichlids.

The crucial Darwinian point concerning the Galapagos finches is that the beaks were supposed to have evolved by natural selection to fit the environmental surroundings, in this case the kind of nuts available being the evolutionary environmental factor (fig 11). This process is generally considered to have taken place gradually over a long time span due to random mutation. But the evidence gathered by researchers trying to support the neo-Darwinian gradualist account actually undermines it:

> He describes the evidence they gathered demonstrating the correlation of beak size with food supply … and follows that with a good summary of the observations that the Grants made of beak size on the Island of Daphne Major after a drought. As the available supply of edible seed dwindled, only tough hard-to-open seeds were left, and only birds with larger, deeper beaks could eat them. Subsequent generations showed a dramatic increase in overall beak size in the population.[59]

This, however, does not indicate a mechanism which hangs around for a random mutation to ride to the rescue of the starving finches; it indicates an exquisitely tuned responsive interaction between the population about to inhabit an environment and the conditions of the environment immediately prior to the habitation by the subsequent generations. It is as if the experiences of the finches inhabiting the environment during the drought had left a trace within a deep level of the quantum field which then determined the form of the subsequent generations of finches. This corresponds exactly to Rupert Sheldrake's notion of a 'morphogenetic field', a kind of memory within nature, and the Buddhist alayavijnana, the ground consciousness, and Bohm's 'implicate order'. All of these, of course, map onto the notion of the universal quantum field of reality.

The way that such a mechanism could function is easily comprehended when one recalls that according to quantum theory it must be the case that all possibilities for manifestation are contained within the universal quantum wavefunction. This is the basis for the Everett-DeWitt many-worlds theory of the functioning of reality, which says that all the possibilities within the universal wavefunction do actually happen in different experiential worlds.

The Quantum Mindnature vision of the functioning of reality, which gives rise to a quantum Evo-Devo perspective asserts that whilst all the possibilities for the type of finch beak are contained within the universal wavefunction, which one is expressed depends upon the environmental conditions that the finches are about to be expressed into, so to speak. There is a 'morphic resonance' between the implicate finch template about to manifest and the possibilities for manifestation such that the most appropriate manifestation for the environmental conditions occurs.

This perspective is not only consistent with the current evidence, it also adds completion and depth were at the moment there is only detail. Work on the actual mechanism underlying the phenomenon of the morphing finch beak has been carried out by Dr. Cliff Tabin and a team of developmental biologists at Harvard Medical School. The key to the process was found to lie within the operation of the BMP4 (bone morphogenetic protein number 4) gene which signals for the production of the BMP4 protein. This gene turns out to be remarkably multitalented as it also coordinates the development of the embryo.

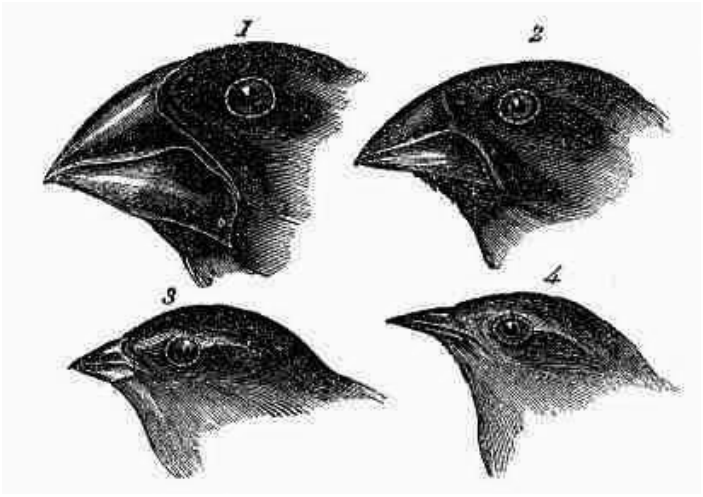


Fig 10

In order to verify the significance of the BMP4 gene in the morphology of beaks the researchers artificially increased the production of BMP4 in chicken embryos and the beaks of the chicks became wider and more robust. Researchers also found that a different gene was responsible for the expression of another protein, calmodulin, which resulted in long probing beaks. So the operations of just two genes, which coordinate the expression to the amounts of two different proteins, appear to control the morphology of beaks. This leads to significant insights. New morphic forms can arise through the subtle operation of existing genes. It appears as if there is an overall template for a finch, for instance, which could be conceived of as being of the form of a Sheldrakian 'morphogenetic field', which is then tweaked in its expression by the detailed operation of the genes underlying the template. Viewed from the perspective of Zurek's quantum Darwinism, it becomes clear that both the morphogenetic template field of the finch and the information which determines the actual expression of the details of the template, the exact form of the beak for instance, must reside in a quantum information field. This is clearly homologous to Bohm's notion of the

implicate order. This is a dramatic insight bringing together crucial insights from cutting edge quantum theory and evolutionary biology, and we can only expect exciting developments are close at hand within this field.

What is quite clear from the evidence so far, however, is that the materialistic notion of gradual step by step random mutation which is promulgated with pugilistic fervor by Richard Dawkins and others turn out to be completely false. The only reasonable picture that can be drawn in the light of all the evidence available clearly points to the 'emergence' of the subjective perceiving aspect of the overall quantum process, together with the objective environmental container (the terms 'container' and 'contained' are used within Buddhist philosophy), in co-dependence on the overall interconnected field conditions. Such a co-ordinated co-arising through levels of quantum resonance is completely consonant with quantum non-locality. I hope that John Wheeler would have approved of my appropriation of his famous graphic image in figure 11 which illustrates this viewpoint.

It has been suggested by some Evo-Devo enthusiasts that the emerging perspective clearly shows that some form of subtle teleology is clearly indicated within the process of reality. The form of this teleology, however, has yet to be explicated. The Quantum Mindnature perspective, with its assertion of the minimalist teleology of a self-perceiving function within the quantum ground of reality, as is clearly indicated by the phenomenon of the collapse of the wavefunction, provides exactly the form of teleology that is required to explain the developmental evolution at all levels, even that of the cosmos itself. Also, quite clearly this perspective completely elucidates the nature of the 'goldilocks enigma' of the anthropic fine-tuning of the universe.

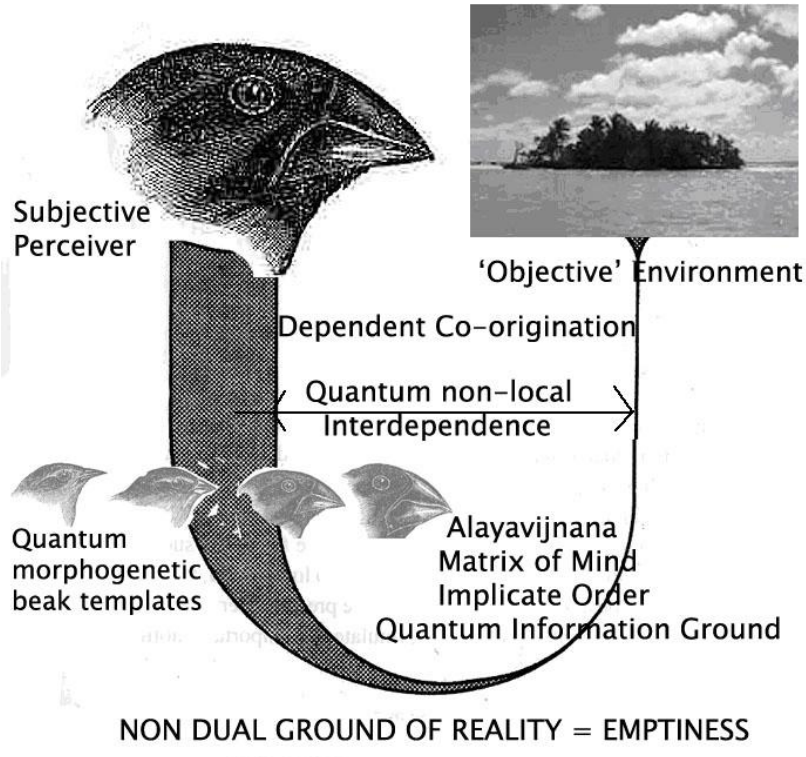
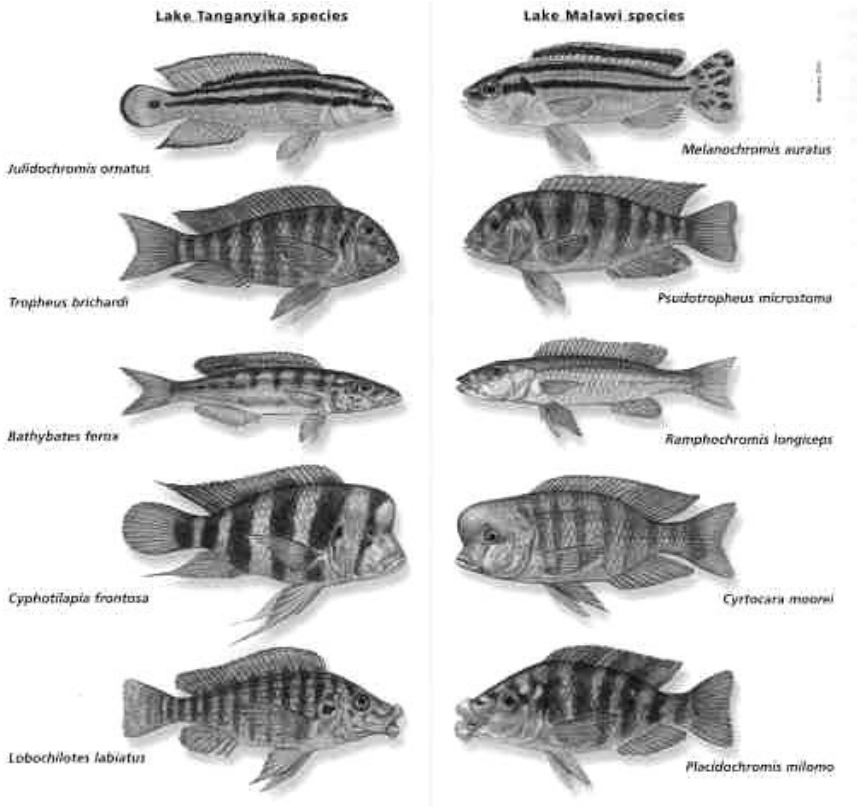


Fig 11

Another 'iconic' Darwinian phenomenon is that of the African fish called cichlids which have evolved into such a huge diversity of species that they have become one of the best known evolutionary radiations. The cichlids have evolved into a dramatic diversity of different shapes and sizes, with a variety of jaw types which are adapted for different kinds of foods. Research has shown that exactly the same process operates in this case as in the case of Darwin's finches. All of the different types of cichlid have the same gene profile but the astonishing diversity is produced by the expression of the basic gene profile into different forms according to the environmental opportunities. It seems that the same template will be expressed in any form which will fit into an environmental niche. This is exactly what one would expect of a creative self-perceiving universe which operates in order to maximize the number of perceiving organisms, of all possible types, according to the possibilities offered by the surrounding environments. This process, however, is not one in which the environment is fixed and given but, as we have seen previously, it is a process of interdependent co-origination between perceiving organisms and their environment.



A simple analogy that Dawkins offers in order to illustrate the 'sieving' process of the environment which he considers to be fundamental to 'natural selection' is that of a hole which is able to sort balls into those bigger than it and those smaller:

> the result of one sieving process are fed into a subsequent sieving, which is fed into …, and so on.[60]

The random jiggling of the sea of endless possibility, thrown up by the chance workings of completely non-conscious, non-intentional molecular interactions is ordered, in small gradual steps, by the taming influence of the natural sieve (fig 12).

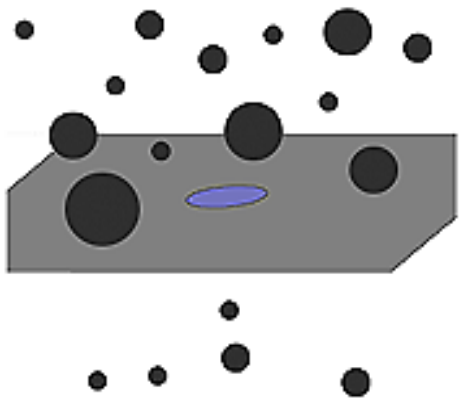


Fig 12 Dawkins' Balls

This picture, however, has one small, but vastly significant mistake. Where does the sieve come from? In the example of the balls and the hole, for instance, the hole is external to the random system of balls waiting to be ordered. The theory of evolution, if it is to claim an ultimate significance, should be self-contained, that is to say it should apply to the universe as a whole, *without recourse to external agencies*. This is, after all, exactly the kind of metaphysical requirement that Dawkins appeals to in his refutation of the notion of a creator God. And the fact that Dawkins does consider his vision to have ultimate metaphysical relevance is clearly apparent; he tells us, for instance, that:

> Darwinism is true, not just on this planet but all over the universe wherever life may be found.[61]

The sieve, therefore, must be internal to and generated by the evolutionary process itself. The only other alternative is that the sieve is already in place, expectantly waiting for emergent life to make a bid for survival so to speak.

The only metaphysically viable possibility is that the sieve is generated by the very process which Dawkins is trying to explain by means of the sieve; which means that the sieve must be itself generated by its own process of sieving! This might seem like a tall order, but in fact it is easily elucidated in the quantum Mindnature Evo-Devo perspective.

The environment, which arises interdependently through the quantum Evo-Devo evolutionary process, is relatively stable in relation to the flexibility of perceiving organisms; this is indicated by figure 13. In this image we can see that the kind of evolutionary sieve that Dawkins requires can be generated by the evolutionary process itself.

The process of a self-resonating, self-manifesting process of evolution which is depicted in fig 13 is a beautiful example of a process of dependent origination; both aspects, subjective and objective, of the manifestation arise in dependence upon the other. Indeed, as we have seen, Darwin himself was not unfamiliar with the notion of a co-dependent aspect within the process of evolution.

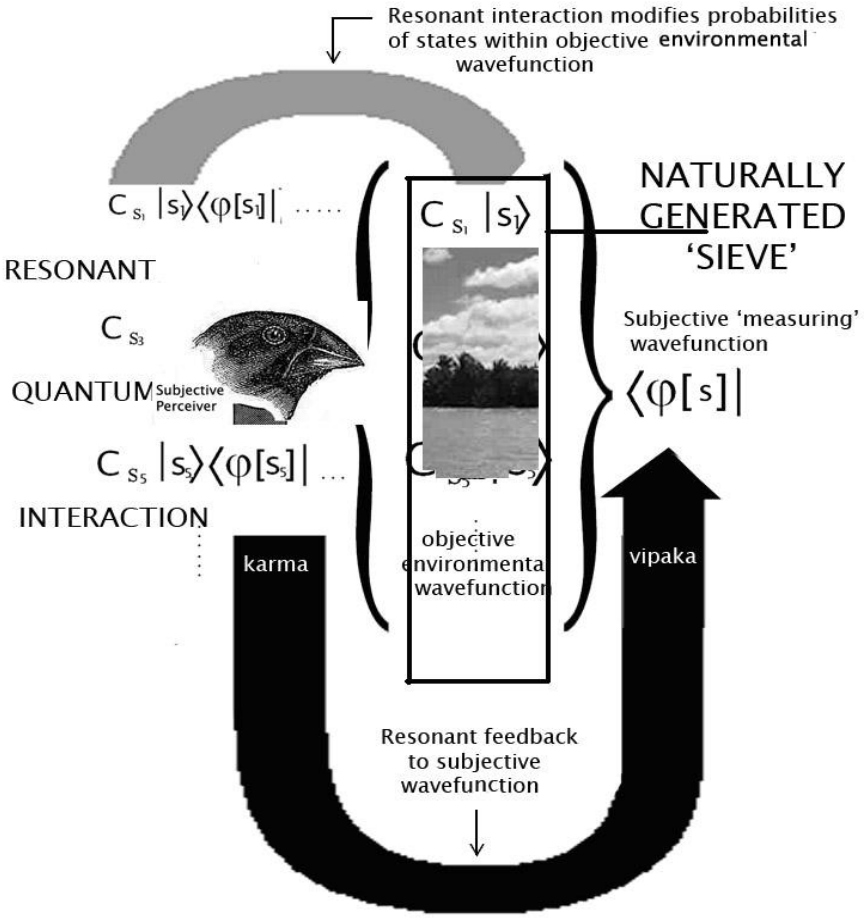


Fig 13

At the end of his recent reworking of his controversial 1981 book *A New Science of Life* Rupert Sheldrake writes that:

> The hypothesis of formative causation is a testable hypothesis about objectively observable regularities of nature. It cannot explain the origination of new forms and new patterns of behaviour, nor can it explain subjective experience. Such explanations can be given only by theories of reality more far-reaching than those of natural science, in other words by metaphysical theories.[62]

If the formative causation hypothesis was to be shown to be correct by experimentation and observation, Sheldrake goes on to say, this would not mean that the materialist-mechanistic worldview would necessarily be shown to be invalid, it would, however, have to compete with other metaphysical theories. In this section we shall briefly examine how the Quantum Mindnature metaphysical perspective constitutes a precise and coherent account of how formative causation would naturally emerge from the internal perceiving operations at the quantum level.

The following brief outline of Sheldrake's proposal is based on his own summary in *A New Science of Life.* He suggests the existence of morphogenetic fields which are responsible for molding the physical stuff of reality into the forms that is adopts. Morphogenetic fields provide:

> …further type of causation … responsible for the forms of all material morphogenetic units (sub-atomic particles, atoms, molecules, crystals, quasi-crystalline aggregates, organelles, cells, tissues, organs, organisms). Form, in the sense used here, includes not only the shape of the outer surface of the morphogenetic unit but also its internal structure.[63]

The morphogenetic field which moulds any particular morphogenetic unit provides a 'virtual form' which directs, through some natural mechanism (the inverse quantum Zeno effect) the way in which the physical 'stuff' is organized. Inorganic morphogenesis is rapid but organic morphogenesis takes place through a hierarchy of levels (akin to Bohm's nested implicate orders) of developmental pathways, each pathway is called a 'chreode'. Thus the development of an organism takes place through the operation of a succession of nested morphogenetic fields. Morphogenetic fields are established over time through a process of 'morphogenetic resonance' which depends on 'patterns and structures of vibration'[64] Once the morphogenetic structure is established there is a continued action of morphogenetic resonance which stabilizes the unit and, furthermore, the stability of the morphogenetic field itself depends on the repeated manifestation of the morphogenetic unit it gives rise to, so there is an interdependent relationship between the morphogenetic field and its morphogenetic unit. This means that 'phenomena become more probable the more often they occur.'[65]

The isomorphism between Sheldrake's notion of morphogenetic fields and the probabilistic quantum wavefunction is quite clear:

> …morphogenetic fields are not precisely defined but are *probability structures* that depend on the statistical distribution of previous similar forms. The probability distributions of electronic orbitals described by solutions of the Schrödinger equation are examples of such probability structures, and are similar in kind to the probability structures of the morphogenetic fields of morphogenetic units at higher levels.[66]

Morphogenetic fields, then, are exactly the kind of quantum probability fields which would be created or built up by the kind of processes involved in the quantum Mindnature perspective. The close connection between the formative causation hypothesis and the quantum Mindnature perspective resides in the fact that it is the quantum process of repeated perception or activation at the quantum level that builds up the probability structures within wavefunctions; it is this internal quantum process, therefore, that creates morphogenetic fields. In other words morphogenetic fields can be considered to be classical level expressions of thee deep operations of the quantum level of consciousness.

As we have seen the manifestation of the dualistic realm of experience takes place through a hierarchy of quantum levels, beginning with the merest spontaneous movement of the ground consciousness towards the activity of perception. This movement of universal intentionality, which is a naturally innate function of universal 'empty' consciousness, has the effect of activating, and thereby strengthening the latencies of, potentialities within the

ground of reality. Once the process has began the quantum process of manifestation cascades through increasingly more complex levels of manifestation.

Sheldrake himself says that the hypothesis of formative causation itself does not explain the genesis of the cascade of the manifestation of the evolutionary process; it only describes the mechanisms involved once the process gets going:

> The action of the morphogenetic field of a morphogenetic unit on the morphogenetic fields of its parts, which are morphogenetic units at lower levels, can be thought of in terms of the influence of this higher level probability structure on lower level probability structures; the higher-level field modifies the probability structures of the lower-level fields.[67]

This process of higher-level fields controlling and modifying lower-level fields is, Sheldrake tells us, illustrated by the way in which molecules modify the fields of the atoms which make it up. The hierarchical morphogenetic field control mechanism underlies important biological phenomena such as protein folding. Furthermore the inverse Zeno effect which is involved in the operation of enzymes is exactly such a quantum phenomenon that seems to control a 'classical' level manifestation.

The evidence which has been claimed for the formative causation hypothesis is controversial and is generally discounted by mainstream workers in the field. And, because the power of the dominance of the materialist worldview is still overwhelming (which itself is surely an example of 'the presence of the past!') the kind of evidence required in order to convince skeptics would have to be irresistible. This is because there seems to be a deeply ingrained antagonistic prejudice towards theories which threaten materialistic approaches to understanding the process of reality.

The approach adopted within the quantum Mindnature perspective in challenging the mechanistic-materialist worldview begins from a significantly different point because it takes the quantum evidence as it is now as the ground for developing a metaphysical overview, an overview which precisely coheres with all significant current quantum perspectives. As this work shows the breadth, scope and depth of the overarching and detailed metaphysical perspective is so dramatic that it is difficult to conceive of an alternative metaphysical perspective bringing together diverse areas of discourse together in such a detailed and precise manner. It was not anticipated at the outset, for instance, that the natural evolutionary development of the quantum Mindnature perspective itself would account for the process of evolution as well as otherwise unexplained phenomena within the field of evolutionary development. And one of the significant implications of this perspective is that something akin to formative causation must be operating at, and through, the quantum level.

Sheldrake identifies four possible metaphysical theories which count account for the formative causation hypothesis:

Modified Materialism: is definitely not a feature of the quantum Mindnature perspective. It is actually difficult to see how any kind of materialism can account for morphogenetic fields which are non-local. Quantum phenomena are, of course, non-local, but quantum phenomena are not 'material' in the manner in which 'classical' materialism conceives of 'matter.' As Stapp says there is 'no room' for 'classical matter in a quantum universe.

The conscious self: According to Sheldrake:

> The conscious self can be thought as not interacting with a machine, but with morphogenetic fields. These morphogenetic fields are associated with the body and depend on its physical and chemical states. But the self is neither the same as the morphogenetic field, nor does its experience simply parallel the changes brought about within the brain by energetic and formative causation. It 'enters into' the morphogenetic fields, but it remains over and above them.[68]

The suggestion which Sheldrake makes for how the 'self' can influence the physical body closely parallels Michael Mensky's viewpoint proposed in the Extended Everett Concept paper and it also incorporates elements of Stapp:

> …how does [the self] act upon the external world through morphogenetic fields? There are two ways in which it could do so: first, by selecting between different possible morphogenetic fields, causing one course of action rather than another; and second, by serving as the creative agency through which new morphogenetic fields come into being … In both cases it would act like a formative cause, but one that is, within limits, free and undetermined from the point of view of physical causation. It could indeed be thought of as the formative cause of causes.[69]

The creative universe: Sheldrake's version of the creative universe is based upon Henri Bergson's proposal of the *élan vital,* a vital spark at the core of reality driving the process of manifestation and evolution. The translation that Sheldrake makes of Bergson's term is 'vital impetus', and quite clearly this perspective is completely in accord with the view developed within this work that the ground of reality has as an innate function of its own nature the mere requirement of perception of its own potentialities. The drive towards perception is exactly the *élan vital* driving the process of reality.

As Sheldrake indicates this metaphysical viewpoint implies a hierarchy of levels of individuated consciousnesses:

> Such creative agencies could give rise to new morphogenetic fields by a kind of causation very similar to … conscious causation … In fact, if such creative agencies are admitted at all, then it is difficult to avoid the conclusion that they must in some sense be conscious selves.[70]

According to Sheldrake such a viewpoint cannot account for how or why the universal process got underway in the first place and does not provide a 'goal' for the process. However, the metaphysical perspective proposed by the Quantum Mindnature Universe, which is based on the evidence of quantum theory, supplies the explanation of both genesis and 'goal', although the goal is not achieved once and for all time but is, rather, a continuous process, by the same simple and natural observation: there is at the heart of the universal consciousness an inner pressure towards perception of the latent potentialities of the 'empty' ground of reality. This pressure towards perception is evidenced in the 'collapse of the wavefunction'. As Sheldrake points out this perspective does not imply any independent 'transcendent' creator. The creative force is simply an innate aspect of the universal process of reality.

Transcendent reality: The notion of a transcendent creative agency is fraught with difficulty because of the different ways in which the term 'transcendent' may be understood. Some presentations of this position leave the detailed delineation of the metaphysical structure of the 'transcendence' being claimed conveniently ambiguous so that various dubious claims can be implied.

The significant issue is whether the creative agency conceived of is asserted to be substantially and effectively independent of the realm of manifestation that it is supposed to be creator of. This is the position of most fundamentalist Christian beliefs which picture an independent God fashioning a separate domain for his created creatures, giving them a set of laws to follow and then stepping back to survey the disastrous results. For Buddhist philosophy such a simplistic picture is simply logically incoherent. If the supposedly 'creative' agency were to be completely independent and separate of the creation, which is to say an absolutely and irrevocably different and separate nature, then it could not have any creative relationship with something that it is totally separate and independent of.

The kind of 'transcendence' which is incorporated into the quantum Mindnature perspective is the subtle Advaita (non-dual) metaphysical structure which asserts that there is an ultimately non-dual creative process of reality that creates a vast illusion of dualistic experience. From this perspective there is not so much a 'creation' as a continuous process of creating on the part of the non-dual creative ground. The details of this perspective, as shown in this work, are remarkably subtle; one of the subtleties being the fact that the sentient being caught up in the dualistic play of illusion are themselves agents of the creative force.
If we construe the phrase 'transcendent conscious being' in following passage as referring to the non-dual creative aspect of an interdependent and interconnected process of reality, Sheldrake's characterization of the notion of transcendent reality comfortably applies to the quantum Mindnature universe:

> If this transcendent conscious being were the source of the universe and everything within it, all created things would in some sense participate in its nature. The more or less limited 'wholeness' of organisations at all levels of complexity could then be seen as a reflection of the transcendent unity on which they depended, and from which they are ultimately derived.[71]

Such a view precisely applies to the metaphysical position developed in detail within this work. The illusory and limited sense of selfhood that is part of the dualistic experience of non-enlightened sentient beings is precisely a reflection and embodiment of the unity of non-dual creative source and, furthermore, the change of state from the unenlightened perspective to an enlightened perspective is itself an illusion though which the illusion of separation dissolves.

This subtle Advaita metaphysics of a transcendent and immanent reality embraces and includes the previous two positions of 'conscious selves' (although they are ultimately illusory) and the 'creative universe':

> …this fourth metaphysical position affirms the causal efficacy of the conscious self, and the existence of a hierarchy of creative agencies immanent within nature, and the reality of a transcendent source of the universe.[72]

The Quantum Mindnature metaphysical perspective developed in this work on the basis of all the currently available quantum evidence and interpretations provides exactly such a metaphysical perspective which elucidates and explains how the mechanisms of formative causation would be produced through the epiontic operations of the quantum levels of the universal ground consciousness which is the quantum Mindnature Matrix of the Universe.

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[1] Endless Forms p5
[2] Blind Watchmaker
[3] Dennett – Darwin's Dangerous Idea p27
[4] Extended Phenotype p5
[5] Endless Forms p72
[6] Endless Forms p9
[7] Reweaving the Rainbow p213
[8] Endless Forms p54
[9] P72
[10] P72
[11] P61
[12] P64
[13] P65
[14] P69
[15] P70
[16] P208
[17] P290
[18] Foster P. L. (1993) 'Adaptive Mutation: The Uses of Adversity' in *Annual Review of Microbiology* Vol 47 p467-504
[19] Conway Morris p148
[20] New York Review of Books
[21] Dawkins, Richard (2006). *Unweaving the Rainbow* p50
[22] Quantum Evolution - Mcfadden
[23] 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)
[24] Schrödinger, E. (1944) p121.
[25] Interview with – in What Is Enlightenment.
[26] See *The Grand Design* p140
[27] See *The Grand Design* p140
[28] Barrow, 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.
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[30] Woolfson, Adrian (2000) p74
[31] Barrow, D. John & Tipler, Frank J. (1986) p105
[32] Woolfson, Adrian (2000) p76
[33] Life Ascending p252
[34] *The Observer* (January 25th, 1931)
[35] Decoherence and the Transition from Quantum to Classical – Revisited p4
[36] Life Ascending p247
[37] Schwartz, Jeffrey M. & Sharon Begley (2003) p369
[38] Stapp, Henry (2007) p139
[39] Life Ascending p240
[40] Essential Bohm p102
[41] Matrix of Mystery p52
[42] Essential Bohm p180
[43] Matrix of Mystery p51
[44] Essential Bohm p180
[45] EB p103
[46] Matrix of Mystery p51
[47] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p136 – Wojciech H. Zurek: 'Quantum Darwinism and envariance.'
[48] Rosenblum, Bruce and Kuttner, Fred (2006) p179

[49] Mensky, Michael: 'Reality in quantum mechanics, Extended Everett Concept, and Consciousness' p6
[50] Jung, C.G.(1977) p538
[51] Creative Evolution p113
[52] Life's Solution p242
[53] Endless Forms p176

[54] Nagy in American Zoologist
[55] A New Science of Life p136
[56] A New Science of Life p104
[57] http://www.museumofhoaxes.com/hoax/Hoaxipedia/Duckbilled_Platypus/
[58] Darwin, Charles (1859)
[59] Jonathan Wells and Darwin's Finches.
[60] Dawkins, Richard (2006) *The Blind Watchmaker* p45
[61] Dawkins, Richard (2006). *The Blind Watchmaker*
[62] NSOL p237
[63] NSOL p143
[64] NSOL p144
[65] NSOL – Back cover blurb
[66] NSOL p145
[67] NSOL p105
[68] NSOL p240
[69] NSOL p241
[70] NSOL p243
[71] NSOL p244
[72] NSOL p244