Article

Metaphoric Phantoms of Matter in Mind

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Abstract

In his recent book The Tell-Tale Brian Vilayanur Ramachandran explores in great metaphoric detail his materialist notion that consciousness is nothing more than the brain's neurons linking and resonating together in synesthetic-metaphoric patterns determined by materialist-mechanistic evolution. In this exploration of his account of metaphor and language, taking account of the actual evidence provided by evolutionary development biology and quantum physics, we find that his naïve materialist perspective of how brain functioning creates the world of meaning is nothing more than a phantom in his brain.

Keywords: Ramachandran, The Tell-Tale Brain, Sean B. Carroll, Dawkins, Dennett, Stapp, Hawking, Wheeler, Bohm, materialism, evolution, evo-devo, language, synesthesia, metaphor, consciousness, intelligent design, creationism.

Early on in his recent work *The Tell-Tale Brain* V. S. Ramachandran recounts a conversation that he once had with a member of a 'creation science institute', a vocation which Ramachandran indicates must be oxymoronic. Having established the mental defectiveness of his interlocutor by association with the notion of creationism Ramachandran proceeds to tells us about the account given by the 'distinguished looking man' of the process of vision:

> There is an optical image of the chair in my eye – on my retina. The image is transmitted is transmitted along a nerve to the visual area of the brain and you see it. Of course, the image is upside down, so it has to be made upright again before you see it.[1]

This account, Ramachandran tells us, 'embodies a logical fallacy called the homunculus fallacy', which is the mistaken view that there must be a 'little man – a homunculus – inside you head looking at the image and interpreting or understanding it for you.'[2] Now, although one might accept that the creationist's account of the mechanism of vision is somewhat vague, imprecise and perhaps inept, given that he is addressing someone he might know to be a researcher into neurological mechanisms, it does not explicitly require the adoption of the notion of a homunculus inside the skull. Our unfortunate target for Ramachandran's implicit ridicule might just as likely, if pressed, in fact more likely if you think about it for a moment, to have suggested that there must be some kind of brain mechanism doing the job of reverting the image, rather than an interpretative inhabitant inside the skull. However, I guess that creation scientists are oxymoronic enough to warrant the odd lampoon.

An interesting side effect of this unkind treatment on the part of Ramachandran is the standard that it sets for the evaluation of Ramachandran's own somewhat cavalier accounts of the mechanisms which he thinks are responsible for the remarkable phenomena he describes

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in his book. Consider this account from an earlier part of the book of why a patients' phantom limb was exorcised along with the associated pain by the patient using a mirror in order to make his mind and brain 'think' that his remaining arm, reflected in the mirror, was the missing limb, a technique or trick Ramachandran calls 'mirror visual feedback':

> When faced with such a welter of conflicting sensory inputs-no joint or muscle feedback, impotent copies of motor-command signals, and now discrepant visual feedback thrown in via the mirror box-the brain just gives up and says, in effect, "To hell with it, there is no arm." The brain resorts to denial.[3]

Sounds like the kind of explanation a neuroscientist might come up with at a dinner party to entertain non specialists.

Ramachandran is quite exuberant with his metaphoric and anthropomorphic treatment of the brain and elements of the brain such as neurons. Does the fact that when the region of the brain called the angular gyrus is damaged a patient can no longer do simple arithmetic indicate that the ability to 'know number' and perform arithmetic is 'neatly packaged in the small tidy confines of the angular gyrus'? [4] Damage to this area also leads to a loss of ability to use metaphor, so we know that Ramachandran's angular gyrus is in good working order. Does the fact that certain 'mirror neurons' in the brain of a monkey 'fire' in response to the observation of another member of the species performing some task actually mean that the mirror neurons are:

> adopting the other animal's point of view. These neurons … were for all intents and purposes reading the other monkey's mind, figuring out what it was up to.[5]

Admittedly Ramachandran, in places, indicates that his brain is operating with the neurons responsible for employing metaphors firing vigorously:

> It is as if higher brain functions are reading the output from [mirror neurons] and saying (in effect), "The same neuron is now firing in my brain as would be firing if I were reaching out for a banana; so the other monkey must be intending to reach for that banana now'. It is as if your mirror neurons are nature's own virtual-reality simulations of the intentions of other beings.[6]

But the relentless use of this kind of personification of various areas of the brain and 'neural circuits' leads to the image of various bits and pieces of the brain behaving like little homunculi interpreting or understanding inputs, messages and so on. And on some occasions he invokes the metaphorical empathizing power of the mirroring capacity of some neurons quite literally:

> Imagine the head surgeon's astonishment when he found that the sensory pain neuron he was monitoring responded equally vigorously when a patient watched another patient being poked! It was although the neuron was empathizing with someone else. ... I like calling these cells "Gandhi neurons" because they blur the boundary between self and others - not just metaphorically, but quite literally, since the neuron can't tell the difference.[7]

But a few paragraph on Ramachandran' metaphor neurons (probably in his inferior parietal lobule) are firing at full capacity when he offers an possible explanation as to why the empathetic firing of sensory mirror neurons don't cause us to 'feel everything we witness':

> …perhaps the null signal ("I am not being touched") from skin and joint receptors in your own hand block the signals from your mirror neurons from reaching conscious awareness. The overlapping presence of the null signals and the mirror neuron activity is interpreted by the higher brain centers to mean "Empathize, by all means, but don't literally feel that other guy's sensations.[8]

According to Ramachandran the phenomenon of metaphor is crucial to the evolution of language. So important is the function of 'cross-sensory association' that he speculates that the necessity to develop such a capacity may be responsible for the evolution of the angular gyrus:

> This leads me to wonder whether the angular gyrus may have originally evolved for mediating cross-sensory associations and abstractions but then, in humans, was coopted for making all kinds of associations, including metaphorical ones.[9]

And, as he views and presents his vision against the background of a deeply entrenched belief in a hardcore materialist version of evolution - the evolutionary paradigm associated with Richard Dawkins and Daniel Dennett - it is useful to examine the naïve evolutionary perspective that he adopts.

At the outset of his discussion of the evolution of language Ramachandran remarks that:

> With so many interlocking parts working in such a coordinated manner, it's hard to figure out, or even imagine, how language could have evolved by the essentially blind process of natural selection. (By "natural selection," I mean the progressive accumulation of chance variations that enhance the organism ability to pass on its genes to the next generation). It's not difficult to imagine a single trait, such as a giraffe's long neck, being a product of this relatively simple adaptive process. Giraffe ancestors that had mutant genes conferring slightly longer necks had better access to tree leaves, causing them to survive longer or breed more, which caused the beneficial genes to increase in number down through the generations. The result was a progressive increase in neck length. [10]

As we can see Ramachandran's presentation of the process of evolution is indeed 'relatively simple' and certainly glosses over the fact that in recent years the original simplistic version of materialist Darwinism has had to be radically overhauled in ways which undermine the materialist basis of the usual view of 'natural selection'. Most significantly the assumption that the genes in each species must be essentially different has been shown to be mistaken. For instance the molecular biologist Sean B. Carroll writes in his excellent account of the evolutionary-development revolution *Endless Forms Most Beautiful* that the notion that the same solution to the development of various types of eye structure, the same solution being found in widely differing species, was due to different evolutionary paths has clearly been shown to be radically incorrect. The evolutionary biologist Ernst Mayr wrote 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. [11]

However, this assumption, which Mayr so confidently asserted was 'evident', has now been shown by the evolutionary-development revolution in biology to be completely false, there was absolutely nothing 'evident' about it at all! 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.[12]

In other words, all animals, of whatever species whatsoever, share a fundamental genetic structure which underpins a hierarchical development of differentiation:

> Because parts of the genetic tool kit are shared among most branches of the animal kingdom, they must date back, at least, to some common ancestor of those branches. That would place their origin far back in time, before the Cambrian explosion that marked the emergence of large, complex animal bodies, more than 500 million years ago.[13]

This clearly means that the fundamental gene template structure underlying all forms of animal life was in place at the very beginning of evolutionary diversification. As Carroll's explanation of the operation makes clear, the evolution through 'random mutation' producing the long neck of giraffes or the long truck of elephants and so on applies to the manner in which the basic template becomes modified, apparently through interaction with the environment, although, as we shall see, the notion that this is a mechanism mediated purely on the gene level, or that the entire process is essentially 'random', is now beginning to look suspect, there is evidence that intentional-like quantum processes, or 'quantum epiontic' processes, may be involved.

An example of the fact that the various species are the result of variations based upon the theme of a fundamental animal template is provided by *Hox* genes:

> A large body of work—on birds, frogs, mammals, and snakes, as well as insects, shrimp, and spiders—has proved that shifts in where *Hox* genes are expressed in embryos are responsible for the major differences among both vertebrates and arthropods. Those shifts account, for instance, for the way a snake forms its unique long body, with hundreds of rib-bearing vertebrae and essentially no neck, in contrast to other vertebrates [see photograph (below – fig 1)]. The shifts explain why insects have just six legs and other arthropods have eight or more. The new imagery of evo-devo can pinpoint when and how the development of these animals diverges. The study of *Hox* genes has shown how, at an entirely new and fundamental level, these animals are the products of variations on ancient body plans—not wholly independent inventions.[14]

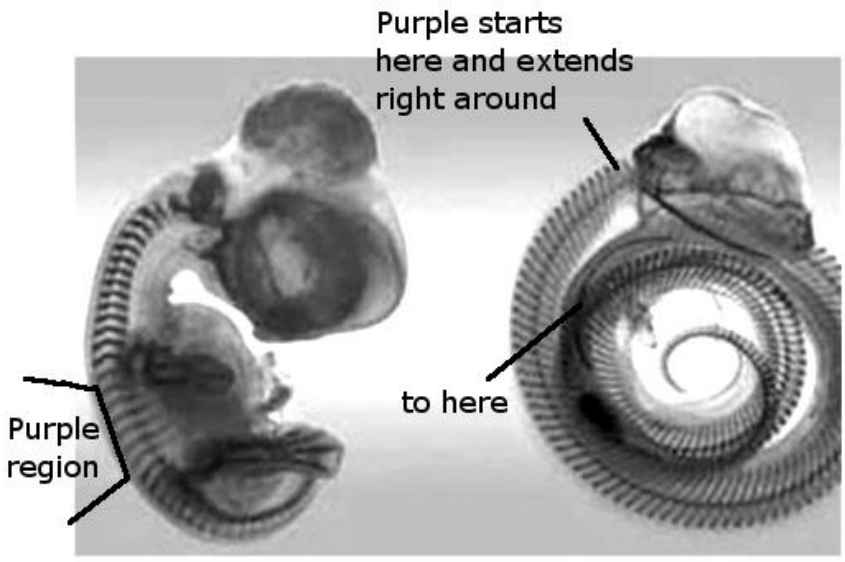

Fig 1 - *Hox* genes determine the form, number, and evolution of repeating parts, such as the number and type of vertebrae in animals with backbones. In the developing chick (left), the *Hoxc-6* gene controls the pattern of the seven thoracic vertebrae (highlighted in purple), all of which develop ribs. In the garter snake (right), the region controlled by the *Hoxc-6* gene (purple) is expanded dramatically forward to the head and rearward to the cloaca.[15]

The point is that both the chick and the garter snake body morphology develop from the same fundamental template through the alteration of the way that the *Hoxc-6* gene is expressed, and the expression is in turn determined by the activity of previously expressed genes, down through a hierarchical development of gene expression which takes place upon the basis of a fundamental animal 'template', a basic blueprint for sentient existence which Carroll refers to as 'ancient body plans'. As Carroll says:

> …it is now clear that most body-building genes were in place long before most kinds of animal body plans and complex organs emerged.[16]

The question which immediately arises, of course, is that of the origin of the 'ancient body plans'. Now a hardened believer in materialist evolution would probably want to say that the primordial template for animal existence itself must have evolved. However, this will not do because the evidence of the evo-devo paradigm clearly indicates, as Carroll points out, that evolution requires somewhere back in the distance mists of the primeval swamp there is a 'common ancestor' which provides the basic gene template, so somewhere back in the chain there must be some prototypical ultimate common ancestor.

The crucial issue, however, is whether or not we are to believe that there were at some point in the mists of the distant evolutionary past some kind of primal animal, swimming, roaming, slithering or, to employ an idiom instigated by Susan Blackmore, blobbing[17] around a primeval landscape. A good example to consider is the case of the *distal-less* gene complex which has a remarkable range of applications. Simon 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 evolution of such limbs: in a sense *distal-less* hitchhikes as a sensory protrusion and is subsequently transformed to allow an additional function such as a leg or an antenna.[18]

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, due 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. Carroll tells us that:

> 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.[19]

But such a dogmatic 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 so to speak, and also, 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?

For Carroll, however, the fact that the same gene complex is responsible for limbs, gills and wings indicates that the one must have somehow transformed into the other through a fully materialized process of animal transformation through intermediate stages, which clearly means that there must have been an animal around at some walking and flying with the same appendage (the bat, of course does cling with its wings, but that is hardly walking!):

> In addition to showing how evolution can change the number and kind of repeated body structures, evo-devo is shedding light on how novel structures and new patterns evolve. Bird feathers, for instance, are prominent examples of novelties that have emerged from changes in the ways tool-kit genes are expressed. So are the hands and feet of four-legged vertebrates, the insect wing, and the geometric color patterns on the wings of butterflies. It is easy to imagine that insects invented "wing" genes, or birds "feather" genes, or vertebrates "hand" and "finger" genes. But there is no evidence that such genes ever arose.

> On the contrary, innovation seems to be more a matter of teaching old genes new tricks.[20]

The notion here is that there was a first in the lineage of appendages, the original appendage whose 'genes' subsequently learnt 'new tricks.' If we accept the view then there ought to be a straight forward progression, and there are many suggestive snippets of clearly connected sequences such as the development of insect wings, supposedly from the 'gill-like appendages' of now extinct aquatic nymph forms, shown in fig 2 which is reproduced from *Endless Forms Most Beautiful*[21].

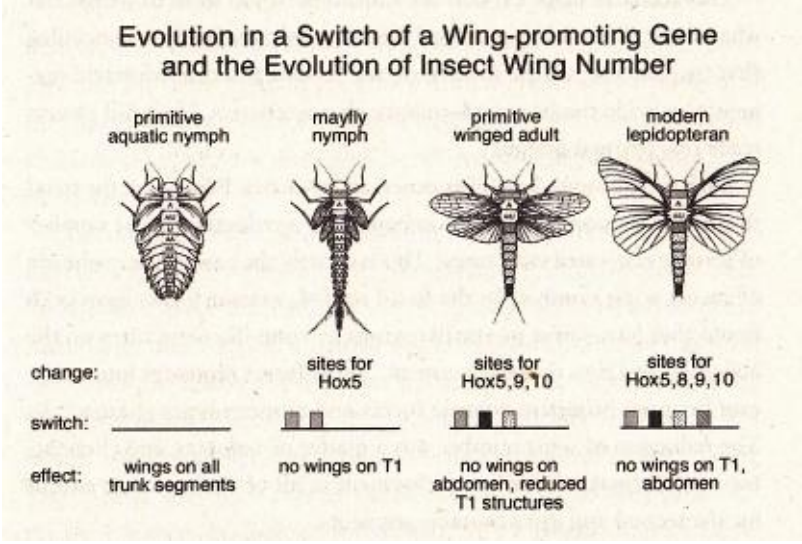

Fig 2

However, the view proposed by Carroll and other who wish to defend a thorough going materialist Darwinism is that it is the direct *material* interaction between the activity of the aquatic nymph form and its putative descendents and the environment which drives the purely *material* functioning of *material* gene structure underlying the entire process. Thus the sequence in fig 2 is considered to be an evolution over time which is taking place purely on a fully materialized level, somehow directly affecting the way in which a fundamental gene structure underlying all animal forms is expressed.

However, this one dimensional interpretation is not necessarily correct because it is clearly mediated by the desire to fit a mainstream Darwinian interpretation onto the evidence, ruling out other, *more plausible*, viewpoints. In fact we can detect here exactly the same determination to remain within the materialist Darwinian paradigm that led Mayr to confidently proclaim the 'many roads to Rome' view of genetic development which later turned out to be completely wrong. As Carroll says the evo-devo revolution 'vaporized many previous ideas about how animals differ from one another.'[22]

As we shall see it is far more likely that the morphogenetic template which underlies both the expression of wings or gills lies on a deeper intentional structure of reality perhaps residing at the quantum level as quantum 'probability structures' or 'implicate' organizational structures. The term 'implicate' was employed by the quantum physicist David Bohm who indicated that

the evidence of quantum theory suggests a deep, hidden quantum level of reality from which the life forms within the material world emerge. The quantum 'implicate' levels which contains traces of previous events and activities which occurs at the manifested 'explicate' level. In this case, rather than having to believe in a fantastic sequence of transformational animals each having a mixed appendage doing two jobs, the percentage devoted to one increasing whilst the percentage allocated to the other decreases, we consider that there may be a feature of the deeper organizational template, probably located within quantum 'implicate' orders, within which a protrusion appendage may be employed for various purposes, such as having an eye at the end or, on the other hand so to speak, walking. This multipurpose template is then 'expressed' in the appropriate form depending upon the animal and the particular part of the animal being expressed. Such a viewpoint does not rule out evolution across time but it does not dogmatically assert this aspect to be the only or even primary cause. The evo-devo evidence fits this scenario far more closely (see my article *Quantum Evo-Devo Universe: Quantum Evolution and the Evidence of Evolutionary-Developmental Biology* in DNA Decipher Journal, Vol 1, No 2 (2011)); however there seems to be an in built desire, perhaps a product of evolution itself, within the practitioners of the biological sciences to keep the evolutionary perspective fully materialistic and mechanistic in demeanor.

This tendency is nicely illustrated by Carroll's discussion of the transition from 'many gills to a pair of wings'. The origin of insect wings, Carroll tells us, had for a long time been a 'contentious mystery,' there were a couple of proposals but no consensus and no clinching evidence. But then, apparently, evo-devo came to the rescue with the discovery of the proteins involved in producing wings: Apterous and Nubbin:

> In order to test the theory that wings might be derived from the gill branches of crustaceans, Michalis Averof and Stephen Cohen traced how the Apterous and Nubbin proteins were expressed in the appendage of other arthropods, especially crustaceans. They found, quite strikingly, that *apterous* and *nubbin* were selectively expressed in the respiratory lobe of the outer branch of crustacean limbs. The best explanation for this observation is that the respiratory lobe and insect wing are homologous-that is, the same body part in different forms in the two animals. … The most probably scenario is that Apterous and Nubbin were used in making respiratory lobes in an aquatic crustacean ancestor of insects and have stayed on the job ever since…[23]

But the fact that the respiratory lobe of the crustacean and the insect wing are homologous as Carroll describes does not necessarily prove that crustaceans are ancestors of insects, it more plausibly suggests that there is an 'implicate', or quantum level (or somewhere between the deepest quantum level and full materiality), animal template which can vary according various factors including environment, the particular animal forms which end up in various environments over vast tracks of time will obviously depend upon environment. So over long time periods it would appear as if a purely linear materialist type of evolution were taking place where in reality a lot happens to be going on at deeper, hidden, perhaps quantum implicate levels.

It is intriguing to note the way in which current evo-devo enthusiasts are desperately trying to fit the new evo-devo evidence, evidence which by Carroll's own admission contradicts the

hardcore or 'ultra-Darwinian' perspective (although it does not contradict Darwin's fundamental insights, only the hardcore interpretation of these), into the Darwinian paradigm. Thus Carroll tells us that:

> Advances in the new science of evolutionary developmental biology—dubbed "evo-devo" for short—have enabled biologists to see beyond the external beauty of organic forms into the mechanisms that shape their diversity. Much of what has been learned, about animal forms in particular, has been so stunning and unexpected that it has profoundly expanded and reshaped the picture of how evolution works. In the same stroke, evo-devo delivers some crushing blows against the outdated rhetoric of those who doubt that complex structures and organisms arise through natural selection.[24]

In other words the dogmatic beliefs that were foisted onto the simple Darwinian insight into the *appearance* of a purely materialist type evolution of species *apparently* driven by (selfish!) genes as ultimate units of existence (although such a view was never very plausible, despite its popular appeal) have clearly been shown to be what they always were, mistaken assumptions based on the prior acceptance of a materialist-mechanist worldview. But, Carroll is quick to point out that the new insight, having demolished the mistakes of the old style Darwinism, still, he thinks, delivers a 'crushing blow' to those who disbelieve 'natural selection.' The question he fails to address, however, is how different the evo-devo 'natural selection' is from the old, Dawkins style, perspective. In particular do the new insights allow room, or even suggest, that the operation of some kind of intelligence at work in the process of evolution.

The most plausible and coherent explanation of the evo-devo phenomenon is that the primordial template was never a fully materialized animal but, rather, resided as what Rupert Sheldrake calls quantum 'virtual' morphogenetic field within what quantum physicist David Bohm called a quantum implicate order. 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…[25]

Thus the development of the embryo is controlled by a nested hierarchy of morphogenetic fields, which are, according to Sheldrake, 'quantum probability fields'[26] akin to Bohm's implicate orders. This 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.

A crucial implication of this viewpoint is that we should expect to find that aspects of animal morphology should anticipate what is to 'evolve' later, a situation which throws the entire materialist evolutionary paradigm into a questionable light. According to Conway Morris this is exactly what we can find when we look without the blinkers of a presupposed materialist-evolutionary perspective:

> To give one example: the central nervous system of amphioxus is really rather simple. It consists of an elongate nerve chord stretching back along the body, above the precursor of the vertebral column (our backbone, consisting of a row of vertebrae) and a so called brain. The brain can only be described as a disappointment. It is little more than an anterior swelling … and has no obvious sign in terms of its morphology of even the characteristic threefold division seen in the vertebrate brain of hind-, mid-, and fore-sections. Yet the molecular evidence, which is also backed up by some exquisitely fine studies of microanatomy, suggests that, cryptically, the brain of amphioxus has regions equivalent to the tripartite division seen in the vertebrates.
>
> The clear implication of this is that folded within the simple brain of amphioxus is what can almost be described as a template for the equivalent organ of the vertebrates: in some sense amphioxus carries the inherent potential for intelligence.[27]

This insight, that it is 'molecular evidence' that indicates a tripartite division within the brain of the amphioxus is precisely what one would expect on the basis of Bohm's implicate order hypothesis, which is the notion that seeds of future development would be 'enfolded', which is the term Bohm used, into the quantum level, which resides, as it were, just beneath the molecular. So, here, as Conway Morris suggests, we can see 'the foundations of the molecular architecture which underpins our brains and sentience'[28] Intriguingly the amphioxus-like animals were extant during the Cambrian period so may perhaps be considered to be one of the earliest fully materialized manifestations of a pre-Cambrian virtual 'common ancestor'. Indeed, in the same way that aquatic crustaceans are suggested as beings 'ancestors', or 'predecessors' of insects, amphioxus is assumed to be the beginning of a line of evolution leading to the vertebrates.[29] However, as we have see, the notion that such a development is purely and simply a matter of a materialist-mechanistic accidental random continuous rearrangement of essentially lifeless material stuff is wearing thin, there is significant evidence that there are deeper levels of life-giving dimensions.

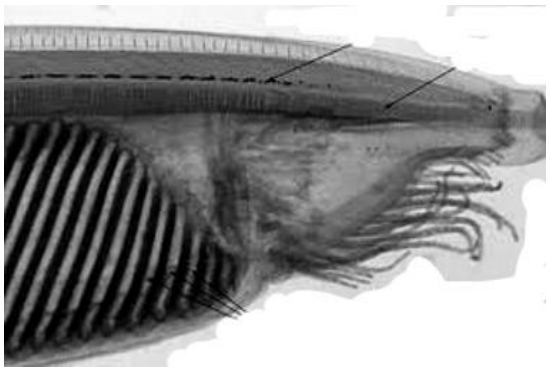

Fig 3 – The amphioxus animal

At this point it is worth considering the issue of what kind of 'stuff' the evolutionary process is made of so to speak. Daniel Dennett, possibly the monarch of materialist thought, tells us that:

> The prevailing wisdom, variously expressed and argued for, is *materialism*: there is only one sort of stuff, namely *matter* – the physical stuff of physics, chemistry and physiology – and the mind is somehow nothing but a physical phenomenon. In short the mind is the brain.[30]

The notion that 'the mind is the brain' will find a willing believer in Ramachandran, but if Dennett really believes that the stuff of physics is 'matter', as the term is generally conceived of is incorrect. In his recent book *Quantum Reality: Theory and Philosophy* Jonathan Allday, in a section he entitles 'Substance Abuse', tells us that within quantum field theory, at the lowest level so to speak, there is no substance, the quantum field is actually 'empty' of substance. He writes:

> Now, from a philosophical point of view, this is rather big stuff. Our whole manner of speech … rather naturally makes us think that there is some stuff or *substance* on which properties can, in a sense, be glued. It encourages us to imagine taking a particle and removing its properties one by one until we are left with a featureless 'thing' devoid of properties, made from the essential material that had the properties in the first place. Philosophers have been debating the correctness of such arguments for a long time. Now, it seems, experimental science has come along and shown that, at least at the quantum level, the objects we study have no substance to them independent of their properties.[31]

Because there is no substantiality (and here Allday is using the term 'substance' to indicate 'matter' as physicists and philosophers have generally understood the term) within quantum field theory the term 'particle' is dropped and the term 'quanta' is used, and these are 'objects which have properties but not substances'.[32]

Another fundamental feature of quantum field theory is that fields are said to capable of creating and destroying quantum states; mathematically this is represented by creation and destruction operators. But can we give some indication of what is *really* going on? What is actually doing the creating or destroying? According to the recent 'quantum Darwinism' perspective:

> …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.[33]

In other words the quantum 'dream stuff' of reality, which is the non-substantial quantum field, is capable of producing the seeming solidity of the material world and the processes within it from out of 'epiontic' (epistemology creates ontology) acts of quantum perception. According to the quantum Darwinism perspective:

> …focuses on the fact that proliferation of certain information throughout the environment makes its further proliferation more likely.[34]

According to this interpretation the more often a quantum event becomes manifest the more likely it is to proliferate throughout the environment. This new quantum perspective indicates that:

> … the appearance of the classical reality can be viewed as the result of the emergence of the preferred states from within the quantum substrate through the Darwinian paradigm, once the survival of the fittest quantum states and selective proliferation of the information about them throughout the universe are properly taken into account.[35]

The 'classical reality' is the appearance of the everyday 'material' world and its apparent processes, *including evolution*; it therefore would seem to be the case that the appearance of classical level Darwinian evolution is 'the result of the emergence of the preferred states from within the quantum substrate through' the *quantum Darwinian* paradigm, a paradigm which requires the recognition of a minimalist intentionality capable of driving the epiontic process which creates the emergence of the classical realm from out of the quantum field of potentiality. This is a dramatic conclusion because it means that the confident assertions of materialist philosophers such as Dennett are shown to be false. Thus Dennett's strange glorification of mindlessness:

> 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.[36]

Cannot be taken seriously, physics clearly shows us that there is at least a minimalist epiontic intentionality driving the process of evolution.

The influential physicist John Wheeler anticipated the quantum Darwinian epiontic paradigm when he wrote that he could only conclude from the evidence of quantum theory that:

> 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.[37]

So for Wheeler:

> … the universe is fundamentally an information-processing system from which the appearance of matter emerges at a higher level of reality.[38]

And the ubiquity with which significant physicists support this kind of view is impressive. Here's Martin Rees, Cambridge University professor and Astronomer Royal:

> In the beginning there were only probabilities. The universe could only come into existence if someone observed it. … The universe exists because we are aware of it.[39]

And Henry Stapp, who in his early career worked and discussed these ideas with Werner Heisenberg:

> We live in an *idealike* world, not a matterlike world.' The material aspects are exhausted in certain mathematical properties, and these mathematical features can be understood just as well (and in fact better) as characteristics of an evolving idealike structure. There is, in fact, in the quantum universe no natural place for matter. This conclusion, curiously, is the exact reverse of the circum-stances that in the classical physical universe there was no natural place for mind.[40]

At the beginning of his scientific career Planck thought that 'matter' was the solid, continuous and independent material 'stuff' of reality, whereas at the end of his quantum investigation of the matter of the stuff of reality he came to the conclusion that:

> I regard consciousness as fundamental. I regard matter as derivative from consciousness.[41]

He also said:

> 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.[42]

And Schrödinger can to a similar conclusion:

> Mind has erected the objective outside world … out of its own stuff.[43]

More recently the physicists Bruce Rosenblum and Fred Kuttner, in their important book *Quantum Enigma: Physics encounters consciousness*, are clearly making a parallel claim regarding the far reaching implications of quantum theory:

> The physical reality of an object depends on how you choose to look at it. Physics had encountered consciousness but did not yet realize it.[44]

And:

> Consciousness and the quantum enigma are not just two mysteries; they are *the* two mysteries; … … Quantum mechanics seems to connect the two.[45]

In their recent book *The Grand Design* Stephen Hawking and Leonard Mlodinow also indicate the necessary entanglement of consciousness at the quantum level. They present their conclusion is as follows:

> Quantum physics tells us that no matter how thorough our observation of the present, the (unobserved) past, like the future, is indefinite and exists only as a spectrum of possibilities. The universe, according to quantum physics, has no single past, or history.
>
> The fact that the past takes no definite form means that observations you make on a system in the present affect its past. [p82]

And they press the point home with a description of the Wheeler cosmic delayed choice experiment which shows the reality of determination of the past on the quantum level and conclude:

> …the universe doesn't have just a single history, but every possible history, each with its own probability; and our observations of its current state affect its past and determine the different histories of the universe, just as the observations of the particles in the double-slit experiment affect the particles' past.

In the light of all this, one can only wonder how anyone can possibly still maintain a naïve version of materialism as Ramachandran certainly appears to do. Indeed Henry Stapp displays a modicum of exasperation with the situation when he observes that:

> The only objections I know to applying the basic orthodox principles of physics to brain dynamics are, first, the forcefully expressed opinions of some non-physicists that the classical approximation provides an entirely adequate foundation for understanding brain dynamics, in spite of the physics calculations that indicate the opposite; and, second, the opinions of some physicists that the hugely successful orthodox quantum theory … should, for philosophical reasons, be replaced by some theory that re-converts human consciousness into a causally inert witness to the mindless dance of atoms. Neither of these opinions has any rational scientific basis.[46]

This is not to say that understanding brain structure and functioning at the classical level has no validity or use, such a claim would be ridiculous. Ramachandran's research and work, for instance, clearly has a great deal of use and has helped many people. However, at several points in his recent book *The Tell-Tale Brain* he indicates that he thinks that his classical level (as opposed to quantum level) investigations, together with anthropomorphic ('the brain just gives up…') and metaphoric explanations or descriptions of brain functioning, will solve the deepest mysteries of the universe:

> I recount my investigations of various aspects of our inner mental life that we are naturally curious about. How do we perceive the world? What is the so-called mind-body connection? … What is consciousness? How can we account for all those mysterious faculties that are so quintessentially human, such as art, language, metaphor, creativity, self-awareness, and even religious sensibilities?[47]

But most of Ramachandran's questions, such as 'What is consciousness?', require ultimate answers, and if we assume, as has generally been assumed in our academic culture, that ultimate scientific answers as to the ultimate nature of reality is the realm of physics, then

Ramachandran, who investigates the structure and functioning of the brain, seemingly assuming with Dennett that the brain somehow *is*, or at least generates, consciousness, is surely starting out down an evolutionary dead-end, for from an ultimate quantum point of view, 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.[48]

Furthermore, one would have expected Ramachandran to be aware of these issues because in his introduction he writes that:

> The past two hundred years saw breathtaking progress in many areas of science. In physics, just when the late nineteenth-century intelligentsia were declaring that physical theory was all but complete, Einstein showed that space and time were infinitely stranger than anything dreamed of in our philosophy, and Heisenberg that at the sub atomic level even our most basic notions of cause and effect break down. As soon as we moved past our dismay, we were rewarded by the revelations of black holes, quantum entanglement and a hundred mysteries that will keep stoking our sense of wonder for centuries to come. Who would have thought the universe is made up of strings vibrating in tune with "God's music"?[49]

And in his epilogue he writes in a similar vein:

> Many of the greatest physicists of this century-Werner Heisenberg, Erwin Schrodinger, Wolfgang Pauli, Arthur Eddington, and James Jeans-have pointed out that the basic constituents of matter, such as quanta, are themselves deeply mysterious if not downright spooky, with properties bordering on the metaphysical. So we need not fear that the self might be any less wonderful or awe inspiring for being made of atoms. You can call this sense of awe and perpetual astonishment God, if you like.[50]

But, although Ramachandran is prepared to allow the use of the term 'God' to merely indicate a sense of awe in the face of what he mistakenly describes as a 'self' which 'made of atoms' (quantum physics tells us that ultimately atoms are not independent of mind – they are, as he himself says, 'downright spooky'), he is keen to try and debunk the debunkers who propound 'intelligent design':

> Many complex, interwoven systems in biology have been held up by would be debunkers of evolutionary theory to argue for intelligent design – the idea that the complexities of life could only occur through divine intervention or the hand of God.[51]

But it is clear that he identifies 'intelligent design' with 'creationism', which means that he seems to operate within the confines of two dogmatic extreme views when considering issue of the ultimate nature of reality: either an independent creator 'God' or a naïve materialism, and, remarkably, this naïve materialism seems to be maintained despite an awareness of the remarkably subtle insights into the ultimate nature of reality offered us by modern physics.

According to Ramachandran, in line with the outmoded views of all materialist minded proponents of the orthodox Darwinian perspective, the evolutionary process is totally blind - a

dark, mindless, random churning of molecular machinery which in essence is antithetical to life but by some mindless mystery creates mind and life. With regard to the development of the eye for instance Ramachandran asks:

> …how could a vertebrate eye evolve via natural selection? A lens and retina are mutually necessary, so each would be useless without the other. Yet by definition the mechanism of natural selection has no foresight so it couldn't have created one in preparation for the other.[52]

The answer, we are told, is supplied by Richard Dawkins who has, apparently, shown that there is a 'logical evolutionary sequence that leads from the simplest possible light-sensing mechanism-a patch of light-sensitive cells on the outer skin-to the exquisite optical organ we enjoy today.'[53] But the existence of a logical progression of steps is beside the point, it would be truly, truly amazing if there were not such a progression, the issue is why on earth 'mindless' matter, which by definition should have absolutely no desire to see, feel, walk around, eat, reproduce, produce consciousness and language, or survive in any form whatsoever, should suddenly become desperate to survive in various formations. The materialist paradigm offered us by Ramachandran, Dawkins and Dennett and others requires us to conceive of the ultimate bits of reality to consist of 'mindless little scraps of molecular machinery' which when accidentally and randomly happen to conglomerate into certain formations suddenly and magically become desperate to survive. Not only is such a view incoherent, it is also contrary to the evidence of quantum physics which indicates that there is at least a minimalist 'epiontic' intentionality operating within the quantum field of reality.

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 …[54]

Woolfson's, strangely haunting, suggestion is that there must have been some kind of field of potentiality at the inception of the universe. This field can only be the quantum field of potentiality that contains:

> …all possible histories … through which the universe could have evolved to its present state…[55]

In the beginning, of course, the quantum field of the universe would contain the templates for all the future evolutionary possibilities:

> The information sea is thus a quantum mechanical sea, composed from infinite repertoires of entangled quantum descriptions.[56]

Within this all encompassing wavefunction all possibilities for evolutionary manifestation are encoded. From out of the vast entangled web of infinite possibilities for manifestation only certain privileged members will actually make it into reality, so to speak:

> An information space of this sort would furnish a complete description of all potentially living and unrealizable creatures…[57]

It therefore follows that there must be a sort of design woven into the potentialities for evolution; it is a vast complex design of all possible manifestations written into the quantum wavefunction of the universe standing on the very edge of time.

But such a field of potentiality is not sufficient to explain the origin of life; in addition there must be the internal 'epiontic' intentionality to unfold the potentialities into actualities. In Buddhist Dzogchen (Great Perfection) thought this is referred to an innate 'excitatory intelligence' or 'pristine cognitiveness' which operates to unfold fields of meaning and apparent materiality. The following is from Herbert V. Guenther's translation and explanations, in his brilliant although metaphysically challenging book *The Matrix of Mystery: Scientific and Humanistic Aspects of rDzogs-chen Thought,* of the Dzogchen writings of the remarkable Tibetan philosopher-meditator Longchenpa:

> 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. [58]

Here we find a description of the metaphysically early virtual energetic manifestations of 'dynamically pulsating' 'pristine cognition fields' which radiate out from the 'point-instant virtual singularity' due to its innate 'excitatory intelligence (*rigpa*) whose high energy is termed sheer lucency'. And it is this kind of account of the origins of the astonishing variety of life, which includes a field of quantum potentiality together with an epiontic 'excitatory cognitive intelligence', which accords with both evidence of quantum physics and the discoveries of evo-devo.

The following is Conway Morris' brilliant parody of the kind of image that is regularly resorted to by television programmes devoted to expounding the origin of life:

> …images of warm ponds, seething volcanic springs, and massive thunderstorms rumbling across a deserted yet pregnant landscape are used to feed the imagination. At this stage, life has yet to exercise its peculiarly specific grip, its spinning of the genetic code, its weaving of biochemical complexities; but no matter: despite the vast pot-pourri of resultant chemicals, the nascent processes of Darwinian selection are already winnowing and reaping, the inappropriate is steadily devoured in chemical competition with the winners. Metaphorically the molecules slug it out by tooth and claw. Cycles develop, life emerges, and four billion years later one species invokes the marvels of autocatalysis and emergent properties to cap the argument. These ideas are the bread and butter, so to speak, of a substantial part of the origin-of-1ife industry.[59]

And 'feeding the imagination' is precisely correct, the materialist paradigm relies heavily on the technique of lacing their descriptions and explanations with words and phrases indicating intentionality where there should be nothing but blank mechanism, and because materialism is still, despite the weight of contrary evidence, the dominant cultural and academic

paradigm, often very weak arguments and analogies pass muster for want of clear philosophical analysis.

We shall find examples of such during the course of Ramachandran's account of his theory of the evolution of 'language competence':

> This competence is controlled by genes that were selected for by the evolutionary process. Our questions in the rest of this chapter are, Why were these genes selected, and how did this highly sophisticated competence evolve? Is it modular? How did it get started? And how did we make the evolutionary transition from the grunts and growls of our apelike ancestors to the transcendent lyricism of Shakespeare?[60]

The usual materialist assumption that evolution is a process of the accidental transformation of absolute meaninglessness into a world of 'transcendent' meaning, and this is the paradigm which Ramachandran operates within. However, it must be pointed out that in this introductory snippet the picture offered is one of a transition from a 'lower' level and much reduced field of meaning-awareness to a much 'higher' one. Admittedly the difference is dramatic; the ability to use the abstractions inherent within language competence apparently confers a remarkably heightened degree of self-awareness and awareness of the complexity of reality, but that does not mitigate the fact that the majority of the grunts and growls of our apelike ancestors are not 'meaningless'. We are dealing, rather, with a more immediate non-abstract realm of meaning. Ramachandran, however, is able to rely upon the fact that he has been 'feeding the imaginations' of his readers a rich diet of materialist metaphors on his way to his current point three-quarters of the way through the book so the implication that some way back in the evolutionary process there was absolutely no meaning of any kind around in the universe. A universe which has no intelligence within its design can hardly have any kind of in-built meaningfulness.

As a point of contrast consider the conclusion drawn from quantum theory by David Bohm who is adamant that 'meaning is fundamental to what life actually is', and, furthermore, this insight can be extended:

> …to the cosmos as a whole. 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 and cosmology 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 forms 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 a creative unfoldment of generalized meaning. 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. [61]

Thus we see that the conclusion that Bohm draws from the quantum evidence is that the 'big bang' was not a meaningless explosion so to speak, rather it could only have been accompanied by an 'unfoldment of generalized meaning'. Furthermore, it can only follow that the 'evolution of new forms of life' was in essence also a 'creative unfoldment of further meanings. Therefore we see that, in the same way that the quantum evidence clearly undermines the notion that mind somehow emerges from mindlessness, it also clearly shows that meaning does not magically emerge from meaninglessness, the universe itself emerges from a quantum ground of pure undiluted meaningfulness which explodes into the infinite play of the meanings of the experiential world.

This view is also suggested by John Wheeler's assertion concerning the evolution of the universe:

> 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.[62]

Laws do not emerge from meaninglessness, but they can emerge from potentiality through the development of 'epiontic' 'observer participancy'. The term 'epiontic' indicates, as does 'observer participancy', that epistemological acts, which are acts of knowing, acts of intentionality, which are also acts of meaning, give rise to ontology.

Bohm, therefore, concludes that 'meaning' can be considered to be *the* ultimate constituent of the process of the universe because it 'enfolds' the other primary aspects of 'matter' and 'energy' (fig 4 – reproduced from Bohm's essay *Soma Significance and the Activity of Meaning*):

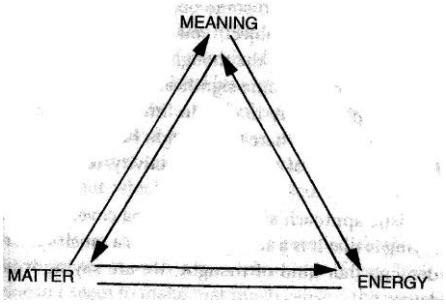

Fig 4

> However, in some sense the enfoldment by meaning seems to be more fundamental … meaning refers to itself directly, and this is in fact the basis of the possibility of that intelligence which can comprehend the whole, including itself. … if there is a generalized kind of meaning intrinsic to the universe, including our own bodies and minds, then the way may be opened to understanding the whole as self-referential through its "meaning for itself" …[63]

For both Bohm and Wheeler, then, the universe can be considered to be a self-referential, thereby self-creating process within which infinite meaningful acts of internal cognition create a multitudinous field of dualistic experience within an overall field of pure undifferentiated meaning, which we may identify with the quantum ground. It is truly remarkable how this quantum perspective maps precisely onto the Buddhist Dzogchen view that the ultimate source of the process of reality is a 'meaning-saturated field as pristine cognitiveness' (see above).

The materialist view on the matter, however, starts with a meaning-unsaturated field; in fact it is difficult to figure out what kind of field can possibly form the basis for any kind of materialism because the quantum field, as we have seen, is devoid of substantiality. However, in order to pursue the matter let us grant Ramachandran's apparent and mistaken belief in ultimately existent, spooky yet devoid of meaning, atoms of the material kind which manage to club together to produce brains housed in various sentient creatures. We now await the generation of meaning from the meaningless.

Ramachandran's 'framework for thinking about language evolution' is called 'synesthetic bootstrapping theory'[64] . This framework, we are told:

> …provides a valuable clue to understanding the origins of not only language, but also a host of other uniquely human traits such as metaphorical thinking and abstraction. In particular, I'll argue that language and many aspects of abstract thought evolved through exaptations whose fortuitous combination yielded novel solutions.[65]

The notion that language evolved through the process of 'exaptations' is an extraordinary, and as we shall see, ridiculous, claim. An exaptation is 'a feature that performs a function that was not produced by natural selection for its current use.'[66] The idea here is that some feature of an organism which, according to current mainstream evolution theory, has developed for some particular purpose, a purpose so necessary for survival that evolution, supposedly utilizing fortuitous random gene mutations, quickly gets on the job of supplying it, is later 'coopted' to do something completely different. This wildly counter intuitive notion, that evolution is to a large degree 'happenstantial' – seeing if it's got anything already evolved that it can press into service in a new niche as it were, gets a rave review from Ramachandran:

> You will see me arguing that many of our unique mental traits seem to have evolved through the novel deployment of brain structures that originally evolved for other reasons. This happens all the time in evolution. Feathers evolved from scales whose original role was insulation rather than flight. The wings of bats and pterodactyls are modifications of forelimbs originally designed for walking. Our lungs developed from swim bladders of fish which evolved for buoyancy control.

> … I argue that the same principle applies with even greater force to the evolution of the human brain. Evolution found ways to radically repurpose many functions of the ape brain to create entirely new functions. Some of them – language comes to mind – are so powerful that I would go so far as to argue they have produced a species that transcends apehood to the same degree by which life transcends mundane chemistry and physics.[67]

The notions that feathers *directly* evolved from scales or human lungs from fish bladders with intermediate stages, and others like them, must be some of the most bizarre, if not absurd, notions within the dismal story of the appropriation of Darwin's original insights by the mechanistic-materialist academic cadre still operating to mislead the public as to the nature of reality (I hasten to add I am *not* a creationist). When Darwin started on his musings as to the manner in which the diversity of life took the various courses that they did the notion that there might be a deep level of reality completely at variance with the apparently material structures and processes of the 'classical' realm was roughly a hundred years in the future. The idea that the edifice of the material world would dissolve into quantum emptiness (which is not nothingness but 'empty' potentiality) would have been incomprehensible to the scientists of his day. Indeed many scientists of the early twentieth century had great difficulty understanding it. Given the evidence Darwin had access to, and the state of science at his time, his work was indeed brilliant and Darwin is deservedly considered to have been a genius.

The situation today, however, is very different and scientists and philosophers should know better. Stapp has pointed out that:

> Philosophers of mind appear to have arrived, today, at less-than-satisfactory solutions to the mind-brain and free will problems, and the difficulties seem, at least prima facie, very closely connected with their acceptance of a known-to-be-false understanding of the nature of the physical world, and of the causal role of our conscious thoughts within it.[68]

The crucial phrase here is, of course, '*known-to-be-false*'. The astonishing fact is that, for some incomprehensible reason, the academic community has decided to allow some of its members, some of them neuroscientists, to flagrantly misrepresent the truth of contemporary physics in order to defend obviously incorrect, 'classical' positions which are redolent of the worldview of the late nineteenth century. As Stapp points out:

> …the re-bonding [between mind and matter] achieved by physicists during the first half of the twentieth century must be seen as a momentous development: a lifting of the veil. Ignoring this huge and enormously pertinent development in basic science, and proclaiming the validity of materialism on the basis of an inapplicable-in-this-context nineteenth century science is an irrational act.[69]

Stapp refers to a re-bonding between mind and matter which occurs precisely because within quantum theory 'matter' becomes an aspect of mind. We can also quantumly re-bond 'life' and 'mundane chemistry and physics' so that we come to see the truth of the fact that these two are not dramatically at variance, as Ramachandran seems to think, a variance which requires that life 'transcends' the 'mundane' machinations of the 'mindless molecules' of chemistry and physics. The 'lifting of the veil' reveals to us that the processes described by chemistry and physics are the processes through which the deep, up until the twentieth

century hidden, field of fecund, life-producing, epiontic quantum intentionality or teleology, acting upon an infinite pool of potentiality for the production of sentient beings of manifold varieties, activates the evo-devo 'implicate' templates of life which must lie within the field of potentiality.

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.[70]

And it is now to the quantum level that we must turn for the secrets of life. It has been discovered, for instance, that photosynthesis employs a quantum 'look-ahead' technique for choosing the most efficient possible pathway for energy exchange[71]. It seems that many biological processes which involve the conversion of energy into forms that are usable for chemical transformations are quantum mechanical in nature; it would be remarkable if evolution ignored quantum efficiency enhancing techniques and decided (so to speak) to stick to nuts and bolts 'classical' mechanisms. In particular a quantum understanding of the evo-devo phenomenon indicates that the connection between feathers and scales lies at a deep, implicate quantum 'template' level, not a fully materialized transformation with intermediate animal types between dinosaurs and birds. The notion of 'exaptation' will be shown to be as mythological as the notion that genes in differing species must be wildly different, a mistaken notion that Mayr confidently asserted, on the basis of a materialist preconception rather than any evidence, in his 'many roads to Rome' fiasco.

It is now time to turn our attention to the details of Ramachandran's 'synesthetic bootstrapping theory' of the evolution of language competence. Synesthesia is a condition in which perceptual or sensation modes become in some way mixed. Examples are specific colors being clearly seen when certain tones are heard or when specific numbers or letters are perceived. According to Ramachandran the most common form of synesthesia is letter or number to color form (grapheme-color). Ramachandran, with his associate E. M. Hubbard have proposed that this phenomenon can be explained by the fact that the brain areas responsible for processing graphemes and colors are adjacent:

> The key insight comes from anatomical, physiological and imaging studies in both humans and monkeys, which show that colour areas in the brain … are in the fusiform gyrus. We were struck by the fact that, remarkably, the visual grapheme area is *also* in the fusiform … Can it be a coincidence that the most common form of synaesthesia involves graphemes and colours *and* the brain areas corresponding

> to these are right next to each other? We propose, therefore, that synaesthesia is caused by cross-wiring between these two areas, in a manner analogous to the cross-activation of the hand area by the face in amputees with phantom limbs…[72]

This is the 'hyperconnectivity' theory of synesthesia, although a few pages on in their paper, *Synaesthesia – Perception, Thought and Language*, Ramachandran and Hubbard say that they are using the term 'cross-wiring' 'somewhat loosely' and that the term 'cross-activation' might be more appropriate. Such 'cross-activation' may come about through several mechanisms; (1) cross-wiring, (2) disinhibition, (3) increased feedback, (4) excess activity. The actual nature of the cross-activation is not directly relevant to our discussion.

Ramachandran's musings on this phenomenon led him to consider a possible link between synesthesia and 'some of the high-level thought processes that humans alone are capable of.'[73] His own thought process of this issue centrally involves the 'bouba-kiki effect'. When people at large are asked to look at the two shapes shown in fig. 5 (without the 'bouba' and 'kiki' labels of course) and asked to say which one is 'bouba' and which 'kiki' it turns out that about 98 percent match up the shapes and labels as shown. This phenomenon occurs whether the experiment is carried out even in 'non-English-speaking people in India and China'. As Ramachandran indicates this matching is due to the fact that:

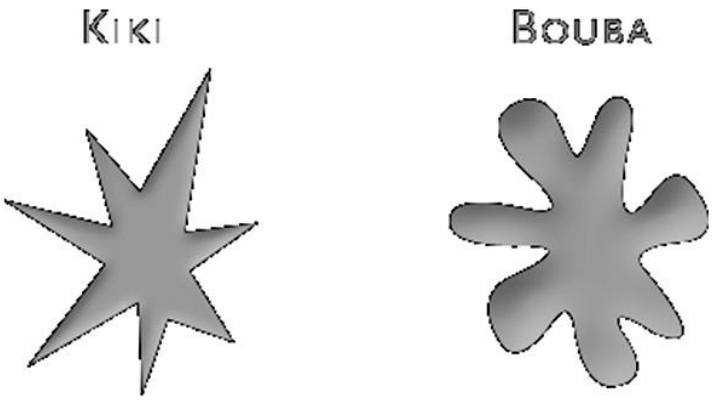

Fig. 5

> …the gentle curves and undulations of contour on the amoeba-like figure metaphorically (one might say) mimic the gentle undulations of the sound *bouba*, as represented in the hearing centers in the brain and the smooth rounding and relaxing of the lips for producing the *booo-baaa* sound. On the other hand, the sharp wave forms of the sound *kee-kee* and the sharp inflection of the tongue on the palate mimic the sudden changes in the visual shape.[74]

This phenomenon, Ramachandran suggests indicates that 'there is a sense in which at some level we are all "synesthetes," and, furthermore, he considers that this fact 'might hold the key

to understanding many of the most mysterious aspects of our minds, such as the evolution of metaphor, language and abstract thought.'

So, with a deft sleight of mind, somewhat analogous to the tricks with mirrors that he performs in order to relieve the pains in phantom limbs, Ramachandran thinks he has reduced the 'mysterious aspects' of the evolution of metaphor, language and abstract thought to nothing more than the material resonance generated cross-wiring or cross-activations within adjacent regions of the brain. By ignoring the quantum realm beneath the appearance of the material world Ramachandran is able to adopt a thoroughly materialist idiom which gives the impression that the brain is the ultimate and final source of the mysterious aspects of mind. But, of course, this is not true.

In order to get a clearer understanding of the situation it is useful to have an understanding of the central Buddhist Mahayana-Madhyamaka presentation of the ontological/metaphysical structure of reality as being comprised of the 'two truths'. According to this doctrine the appearance of the 'conventional,' or 'seeming' realm of the everyday world is an 'illusion,' an illusion which conceals the true 'ultimate' nature of reality. Buddhist scholar Jeffrey Hopkins, refers to a *samvrti satya*, a 'conventional truth', as a 'concealer of suchness,'[75] a misleading mode of 'reality' which covers the true 'ultimate' reality, which is *tathata* or 'suchness,' the direct and pure nondual experiential essence of reality.

Thus the metaphysical structure of the Buddhist worldview asserts two interpenetrating but radically different perspectives within reality, the 'seeming' and the 'ultimate.' This viewpoint indicates a metaphysical structure of reality within which the dualistic world is a deceptive veil hiding the ultimate nondual nature of reality. The physicist and Buddhist practitioner Victor Mansfield has clearly indicated that modern quantum physics constitutes an 'experimental metaphysics[76]' precisely because *quantum physics has penetrated the veil of the material world to what lies beyond.* In fact quantum physics has clearly shown the significance of the notion of 'the two truths,' precisely because it turns out that the 'material' world, as it was conceived of in the era of 'classical' physics, *is an illusion because it is generated from the quantum level by the internal epiontic operation of a deep non-individual level of consciousness.*

The notion of 'metaphysics' as a philosophical endeavor within the Western tradition had as its central concern the determination of the 'ultimate' nature of the seemingly external world of materiality; at its most basic the core issue was that of the ultimate nature of the world: 'Matter', 'Mind' or both? In the time when this question was central for Western philosophical thought physics was what is now called 'classical' physics, the investigation and description of the Newtonian edifice of reality. So when quantum mechanics first discovered a mode of existence radically at variance with the 'billiard ball' Newtonian façade of materiality physics had penetrated through the surface of the material world to see a more 'ultimate' nature which lies 'beyond'. Thus Victor Mansfield tells us:

> We can now demonstrate that 'quantum moons' do not exist when unobserved. Such 'experimental metaphysics' has an extraordinary resonance with the Middle Way Buddhist principle of emptiness…[77]

Mansfield uses the term 'quantum moons' here in reference to a question that Einstein once posed to the a colleague as to whether the moon existed when no one was looking at it. The point is that it has been shown quite clearly that quantum 'entities' do not 'exist' when not being observed in some fashion. Furthermore quantum physics has now shown that consciousness is an essential factor in 'creating' existence out of an indeterminate realm of quantum potentiality, a realm which can be shown to be equivalent in ontological nature to the Buddhist concept of 'emptiness' (*shunyata*).

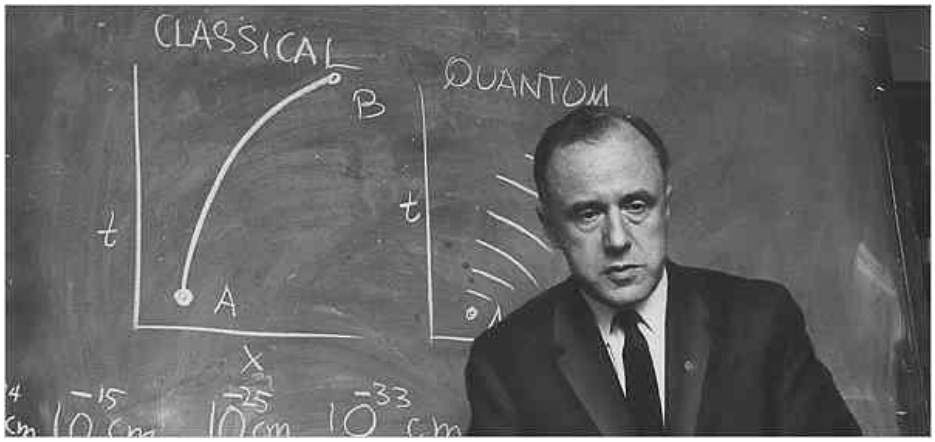

Fig 6. - The 'two truths' according to John Wheeler

The photo shows Professor John Wheeler in mid flow of explaining the 'two truths' as discovered by quantum theory: the 'classical' realm and the 'quantum' realm. On the left of the photo the blackboard drawing shows a 'classical' size object moving between two points. At every point in time it has a definite position and it therefore seems to follow a definite trajectory between the points. In other words it behaves like an everyday object. The section of the blackboard drawing behind Wheeler's head indicates the situation at the quantum level; quantum 'entities' behave in a completely different and counter-intuitive manner; they spread out or 'smear out' over increasingly large areas and fade into a ghostly semi-existence of potentiality. Such 'entities' only recover their full entity-ness when they are observed. When unobserved quantum entities really are not 'entities,' they are a 'smeared out' potentiality fields of possible entity experience.

Henry Stapp, who is one of the few physicists still around who discussed such 'experimental metaphysical' issues with some of the 'founding fathers' of quantum theory, says that the central distinguishing feature between these two physical 'truths' is that on the 'classical' level motions are 'apparently independent of our human observations of them.'[78] The important word in this observation is '*apparently*', a word we could equally replace with 'seemingly', so the 'classical' level, or 'truth', has been clearly established by physics as a 'seeming' reality. It is a 'seeming' appearance of an independent material world of Newtonian objects, an appearance which, when analyzed from the perspective of quantum theory, is found to emerge from a deeper, more 'ultimate', quantum level through the operation of consciousness, although not necessarily individual consciousness. It follows from this discussion that to ascribe ultimate validity to the brain as *ultimate* cause of mental

phenomena is clearly false and, as we shall see, adopting such a 'known-to-be-false' perspective, to quote Stapp again, leads to bizarre, if not absurd, proposals.

In his explanation of the way in which the magical 'mirror neurons', neurons whose primary job is to internally mirror other members of the species actions but which also apparently get utilized for more abstract tasks through 'exaptation', underpin the bouba-kiki effect he tells us that:

> The main computation done by mirror neurons is to transform a map in one dimension, such as the visual appearance of someone else's movement, into another dimension, such as the motor maps in the observer's brain, which contain programs for muscle movements (including tongue and lip movements). Your brain is performing an impressive feat of abstraction in linking your visual and auditory maps. The two inputs are entirely dissimilar in every way except one – the abstract properties of jaggedness or curviness – and your brain homes in on this common denominator very swiftly when you are asked to pair them up. I call this process "cross-model abstraction." This ability to compute similarities despite surface differences may have paved the way for more complex types of abstraction that our species takes great delight in. Mirror neurons may be the evolutionary conduit that allowed this to happen.[79]

And he then proceeds to make the following outlandish proposal of why the ability of 'cross-modal abstraction', a capacity which Ramachandran considers fundamental for the use and appreciation of metaphor, evolved 'in the first place':

> …it may have emerged in ancestral arboreal primates to allow them to negotiate and grasp tree branches. The vertical visual inputs of tree limbs and branches reaching the eye had to be matched with totally dissimilar inputs from joints and muscles and the body's felt sense of where it is in space – an ability that would have favoured the development of both canonical neurons and mirror neurons. The readjustments that were required in order to establish a congruence between sensory and motor may have initially been based on feedback, both at the genetic level of the species and at the experiential level of the individual.[80]

Thus the ability to form and understand metaphors reduces to the contingent requirement that animals which for some evolutionary reason took to the trees needed to develop (presumably very quickly) brain mechanisms for swinging form branch to branch:

> One also wonders about the evolutionary origin of metaphors. Once the cross-modal abstraction mechanism was set up between vision and touch … (originally for grasping branches), this mechanism could have paved the way for cross sensory metaphors ('stinging rebuke,' 'loud shirt') and eventually for metaphors in general.[81]

The notion that the presumed evolutionary necessity for our 'ancestral arboreal primates' to somehow match and co-ordinate together the 'totally dissimilar inputs' from 'vertical visual inputs of tree limbs and branches reaching the eye' and 'inputs from joints and muscles and the body's felt sense of where it is in space' is the origin of metaphor is dramatically counter intuitive, and must certainly must be included within the class of what Ramachandran himself describes as his 'wild intuitive hunches' with which he attempts to 'navigate the gaps' of his account of how the evolution of brain neuron circuitry accounts for 'mysterious faculties that

are so quintessentially human, such as art, language, metaphor, creativity, self-awareness, and even religious sensibilities.'[82]

The fundamental capacity of the metaphorical function of consciousness is clearly that of apprehending a significant similarity within two aspects of reality which are in all other respects different. Ramachandran, in an apparently ingenious employment of the very function of metaphorical cognition itself, tries to account for the phenomenon itself. This strategy, however, turns out to be disingenuous. Consider his account of the way in which the necessary 'congruence between sensory and motor' is supposed to be established by 'readjustments' which, we are told, are initially ' based on feedback, both at the genetic level of the species and at the experiential level of the individual'. The image which we are offered is one in which at some point in evolutionary history our 'ancestral arboreal primates' must have been making a bad job of co-ordinating their motor circuits with their visual circuits and, presumably, thereby constantly and frustratingly missing the branches they were aiming to swing from and therefore painfully falling onto the forest floor beneath them.

Some 'readjustments' are called for; but how exactly do these readjustments come about? Ramachandran tells us that that some kind of feedback mechanism is involved, elsewhere we are told that mirror neurons are possibly involved in a 'self-amplifying feedback loop', but the question posed by such a proposal is that as to upon what basis the feedback loop gets started. And the only significant answer can be that at some point there is some kind of proto-metaphoric recognition of similarity within dissimilarity which then gets amplified over time. In other words there must be some kind of glimmer of metaphoric capacity internal to brain functioning in order for any kind of amplification of metaphoric functioning to get off the ground, thereby enabling our 'ancestral arboreal primates' to also effectively get off the ground without risking skull fractures. So the account clearly fails to account for the metaphorical capacity of the human brain, unless perhaps, we accept it was just a fortuitous random mutation which just happened to connect up two regions of the brain which, fortunately for our 'ancestral arboreal primates' patiently awaiting a life amongst the branches, just happened (by random mutation?) to be adjacent. However such an account, leaving aside its massive improbability, simply makes no sense from the perspective of evo-devo which suggests that there would have been a kind of primordial gene 'template' underlying the evolution; Ramachandran's account relies on brain structure being a matter of random organization. The molecular investigation of the brain amphioxus seems to suggest otherwise, brain organization does seem to be there in potential.

In their paper *Synaesthesia – Perception, Thought and Language*, Ramachandran and Hubbard say that:

> The bouba/kiki effect example provides our first vital clue to understanding the origins of proto-language, for it suggests there might be natural constraints on the ways in which sounds map on to objects.

This, together with 'the existence of a kind of sensory-to-motor synaesthesia, which may have played a pivotal role in the evolution of language', leads to the:

> … conjecture that the representation of certain lip and tongue movements in motor brain maps may be mapped in non-arbitrary ways onto certain sound inflections and phonemic representations in auditory regions and the latter in turn

> may have non-arbitrary links to the external object's visual appearance (as in bouba and kiki). The stage has been set for a sort of 'resonance' or bootstrapping in the co-evolution of these factors, thereby making the origin of proto-language seem much less mysterious than people have assumed.[83]

In order to press the point home various examples are provided, such as:

> …words referring to something small often involve making a synaesthetic small /i/ with the lips and a narrowing of the vocal tract (e.g. words such as 'little', 'petite, 'teeny' and 'diminutive') whereas the opposite is true for word denoting large or enormous.[84]

And it all does seem to 'resonate' magnificently, until, that is, one considers that in this account the organization of the brain which allows such a wonderful cross-modal interactive material resonance came into existence for other purposes (swinging from branch to branch being one of them). In other words for Ramachandran there is absolutely no glimmer of inner teleology to produce the most effective means of communication appropriate for any particular level of conscious awareness within the process of evolution itself, and therefore language is considered a remarkably fortuitous unintentional, and random-exaptational result of the mindless machinations, which are supposed to be completely disinterested as to survival (why would inert 'matter' 'think' that survival matters), little lumps of 'matter'. But such a view, besides its cartoon like preposterousness in places, ignores both the crucial evidence of evo-devo and quantum theory which, taken together, suggest that organic structure, 'meaning' and at least a minimalist intentionality or teleology are an inherent aspect of the universe.

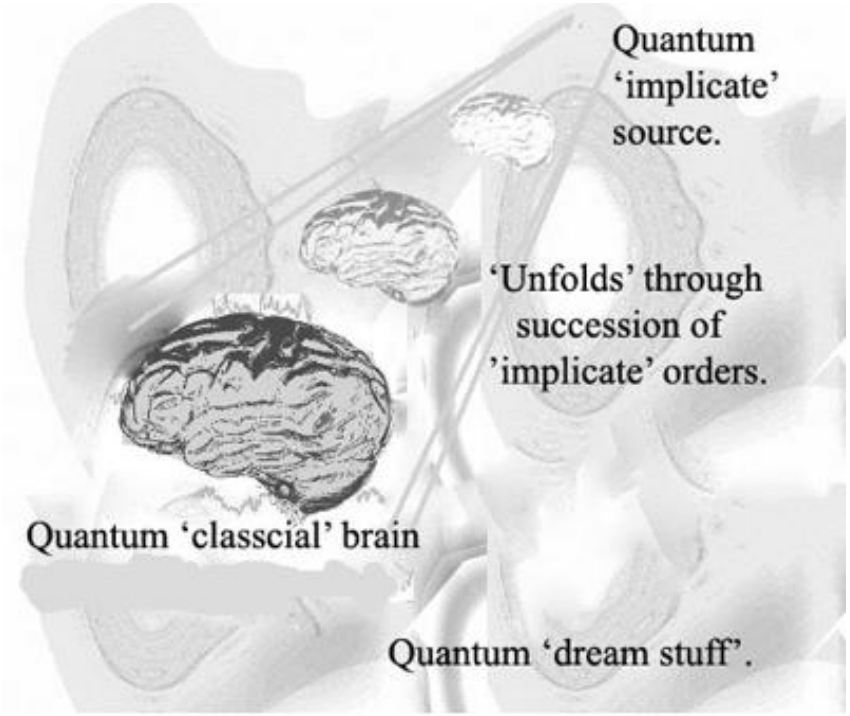

Fig 7

A 'Quantum Epiontic Evo-Devo Mindnature' understanding of the process of evolution, however, indicates that individuated structures of embodied consciousnesses emerge from a deeper realm of quantum information processes, a view which clearly means that the 'stuff' of quantum reality must be some form of non-individuated consciousness or awareness. And this perspective also suggests that brains are intermediate level material constructions, constructed from the deeper level of quantum informational awareness-consciousness precisely in order to individuate consciousness. This process takes place through a sequence of what the physicist David Bohm called 'implicate orders' which emerge from the fundamental ground quantum 'implicate' source and thereby manifest the 'explicate' dualistic world of experience (fig 7). As the founding father of quantum physics Erwin Schrödinger said:

> Mind has erected the objective outside world … out of its own stuff.[85]

And it also seems that the fundamental quantum Mindnature creates individuated consciousness by organizing its own 'stuff' into the apparently 'material' stuff of the brain.

In his important work *Wholeness and the Implicate Order* Bohm indicates that reality encompasses both the objective aspects and the subjective aspects of what is essentially an interconnected and undivided 'wholeness'; Bohm calls this totality the 'holomovement':

> …what carries the implicate order is the *holomovement*, which is unbroken and undivided totality. In certain cases we can abstract particular aspects of the holomovement …, but more generally, all forms of the holomovement merge and are inseparable.[86]

In an interview for Omni magazine Bohm explained:

> I propose something like this: Imagine an infinite sea of energy filling empty space, with waves moving around in there, occasionally coming together and producing an intense pulse. Let's say one particular pulse comes together and expands, creating our universe of space-time and matter. But there could well be other such pulses. To us, that pulse looks like a big bang; in a greater context, it's a little ripple. Everything emerges by unfoldment from the holomovement, then enfolds back into the implicate order. I call the enfolding process "implicating," and the unfolding "explicating." The implicate and explicate together are a flowing, undivided wholeness. Every part of the universe is related to every other part but in different degrees.[87]

The assertion that the *ultimate* source of individuated consciousness is a deeper level of non-individuated consciousness-awareness does not mean that Ramachandran's account of brain anatomy has no value. It quite clearly does have significance; it indicates the structure that the quantum level of awareness has produced in order for individuated consciousness to function as it does. A problem arises, however, because Ramachandran suggests, sometimes directly but on many occasions by more insidious methods, that the matter which makes up the brain is the ultimate source of consciousness and the mental realm. And on the basis of this mistaken conception he aligns himself with a modern movement which seemingly seeks to deny any spiritual dimension do the universe by embracing a 'known-to-be-false' materialism:

> As a scientist, I am one with Darwin, Gould, Pinker, and Dawkins. I have no patience with those who champion intelligent design, at least not in the sense that

> most people would use that phrase. No one who has watched a woman in labor or a dying child in a leukemia ward could possibly believe that the world was custom crafted for our benefit. Yet as human beings we have to accept - with humility - that the question of ultimate origins, will always remain with us, no matter how deeply we understand the brain and the cosmos that it creates.[88]

It is clear that the notion of 'intelligent design' that Ramachandran has in mind is an unintelligent one, a fundamentalist view of an anthropomorphized loving independent creator, which it must be admitted more than a few people embrace. However, to counter such a dogmatic fundamentalist theistic view with an equally unintelligent, and clearly incorrect, view that the process of the universe is nothing other than mindless matter mutely mattering to itself and consciousness has no ultimate significance is counter-productive. To counter one dogmatic false view with an equally false dogmatic view (does the brain create the cosmos?!) simply produces animosity and conflict.

The evidence of quantum theory and evo-devo, however, now clearly suggests that the source of the realms of 'matter' and 'mind' must derive from a unified quantum Mindnature which may be considered as a 'transcendent' source which is of the nature of awareness-consciousness. This ultimate source produces the multifarious dualistic realms of individualized experience within the continuums of all sentient beings in order to explore and discover its own possibilities. As Rupert Sheldrake indicates one possible interpretation of this view:

> 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.[89]

And Henry Stapp has remarked concerning the spiritual implications of quantum theory as follows:

> This situation is concordant with the idea of a powerful God that creates the universe and its laws to get things started, but then bequeaths part of this power to beings created in his own image, at least with regard to their power to make physically efficacious decisions on the basis of reasons and evaluations.[90]

Such views are concordant with the 'Quantum Epiontic Mindnature' metaphysical perspective which embraces the evo-devo evidence within a quantum context. This viewpoint will be further elucidated in a future article which will be made available shortly: *The Quantum Epiontic Metaphysics of Symbolic Forms*, which will deal primarily with the philosophy of Ernst Cassirer (*The Philosophy of Symbolic Forms*) in the context of the Quantum Epiontic Mindnature paradigm.

[1] Ramachandran – The Tell-Tale Brain p46
[2] Ramachandran – The Tell-Tale Brain p47
[3] Ramachandran – The Tell-Tale Brain p34
[4] Ramachandran – The Tell-Tale Brain p104
[5] Ramachandran – The Tell-Tale Brain p121
[6] ibid
[7] Ramachandran – The Tell-Tale Brain p124
[8] Ramachandran – The Tell-Tale Brain p125
[9] Ramachandran – The Tell-Tale Brain p106
[10] Ramachandran – The Tell-Tale Brain p164
[11] Carroll, Sean B. (2006) p72
[12] Carroll, Sean B. (2006) p9
[13] Carroll, Sean B. The Origins of Form
[14] Carroll, Sean B. The Origins of Form
[15] http://www.naturalhistorymag.com/features/061488/the-origins-of-form
[16] ibid
[17] In a talk given at a conference Blackmore suggests that we might call the original primal creature a 'blobbie'.
[18] Conway Morris, Simon (2003) p242
[19] Carroll, Sean B. (2006) p176
[20] Carroll, Sean B. The Origins of Form
[21] Carroll, Sean B. (2006) p177
[22] Carroll, Sean B. The Origins of Form
[23] Carroll, Sean B. (2006) p175-176
[24] Carroll, Sean B. The Origins of Form
[25] Sheldrake, Rupert (2009) p136
[26] Sheldrake, Rupert (2009) p104
[27] Life's Solution p6
[28] Life's Solution p7
[29] Life's Solution p180
[30] Dennett, Daniel (1991) p33
[31] Allday, Jonathan (2009) p493
[32] Allday, Jonathan (2009) p496
[33] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p136 – Wojciech H. Zurek: 'Quantum Darwinism and envariance.'
[34] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p129 – Wojciech H. Zurek: 'Quantum Darwinism and envariance.'
[35] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p121 – Wojciech H. Zurek: 'Quantum Darwinism and envariance.'
[36] Dennett, Daniel (1996) p27
[37] 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.
[38] Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p10 – Paul C. W. Davies: 'John Archibald Wheeler and the clash of ideas.'
[39] Rosenblum, Bruce and Kuttner, Fred (2006) p
[40] Stapp, Henry (2004) p223
[41] *The Observer* (January 25th, 1931)

[42] 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)
[43] Schrödinger, E. (1944) p121.
[44] Rosenblum, Bruce and Kuttner, Fred (2006) p67
[45] Rosenblum, Bruce and Kuttner, Fred (2006) p179
[46] Stapp, Henry: 'Quantum Interactive Dualism: An Alternative to Dualism' p18
[47] Ramachandran – The Tell-Tale Brain - introduction
[48] Stapp, Henry (2007) p139
[49] Ramachandran – The Tell-Tale Brain – introduction x
[50] Ramachandran – The Tell-Tale Brain p292
[51] Ramachandran – The Tell-Tale Brain p164
[52] Ramachandran – The Tell-Tale Brain p164
[53] Ramachandran – The Tell-Tale Brain p165
[54] Woolfson, Adrian (2000) p74
[55] Barrow, D. John & Tipler, Frank J. (1986) p105
[56] Woolfson, Adrian (2000) p83
[57] Woolfson, Adrian (2000) p76
[58] Guenther, Herbert V. (1984). p52
[59] Life's Solution p46
[60] Ramachandran – The Tell-Tale Brain p171
[61] Bohm, David (2003)p180
[62] Wheeler quoted in Barrow, John D., Davies, Paul C. W., Harper, Charles L. (eds) (2004) p73 – Freeman J. Dyson: 'Thought-experiments in honor of John Archibald Wheeler.'
[63] Bohm, David (2003)p175-176
[64] Ramachandran – The Tell-Tale Brain p168
[65] ibid
[66] http://evolution.berkekey.edu/evosite/evo10/IIIE5cExaptations.shtml
[67] Ramachandran – The Tell-Tale Brain pxii-xiii
[68] Stapp, Henry: 'Philosophy of Mind and the Problem of Free Will in the Light of Quantum Mechanics' p19
[69] Stapp, Henry: 'Quantum Interactive Dualism' p18
[70] Fodor, Jerry – 'Why Pigs Don't Fly', New York Review of Books
[71] http://www.scientificamerican.com/article.cfm?id=when-it-comes-to-photosynthesis-plants-perform-quantum-computation
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[73] Ramachandran – The Tell-Tale Brain p109
[74] ibid
[75] Hopkins, Jeffrey (1996) p405
[76] www.namgyal.org
[77] www.namgyal.org
[78] MMQM p233
[79] Ramachandran – The Tell-Tale Brain p129
[80] Ramachandran – The Tell-Tale Brain p129-130
[81] Ramachandran – The Tell-Tale Brain p131
[82] Ramachandran – The Tell-Tale Brain - Introduction
[83] Sythaesthesia – Perception, Thought and Language, V. S. Ramachandran and Hubbard, p20
[84] ibid
[85] Schrödinger, E. (1944).
[86] Bohm, David (2003) p131

[87] Interview with David Bohm, conducted by F. David Peat and John Briggs, was originally published in Omni, January 1987
[88] Ramachandran – The Tell-Tale Brain p293
[89] Sheldrake, Rupert (2009) p244
[90] Stapp, H. P. (2010). 'Minds and Values in the Quantum Universe' in *Information and the Nature of Reality*, Davies, Paul & Gregersen, Niels Henrik (eds), Cambridge University Press, p117.