A personal note

We seem to be living in a world full of contradictions. As a species, we consider this to be our world and thus treat it accordingly, while often lacking the foresight to fully understand the consequences of our actions. The much talked about and argued over topic of 'global warming' is perhaps the ultimate legacy of man's impact on a small, beautiful blue planet that he has been 'co-habiting' since his appearance some two or three million years ago. What is frequently regarded as progress, more often than not requires sacrifice and this has resulted in a worrying catalogue of (recent) extinction events that have decimated both plant and animal kingdoms over an alarmingly short period of time.

We measure our esteem by land and the mineral wealth therein and the root of our economy is based on the perceived value of just a single element. The first contradiction is that it isn't just *our* world and up until even very recent times, we have looked at our environment and the life thereon with greed and indifference. In what we often regard as now more 'enlightened' times, we may at last be learning the error of our ways and thankfully, the overall consensus is slowly changing towards what could be called a 'greener' philosophy. If we are to survive with minimal impact on our surroundings, perhaps we should regard ourselves as simply caretakers, responsible for the well being of our ecosystem; for if we do change our perspectives *and soon*, there may still be hope for us yet. We should bear in mind that the history of our planet, written in the very rocks that we strive to own, infers a cyclic pattern to the rise and fall of species over time and there can be little doubt that the good old earth will still be here a long time after we too have been assigned to the fossil record.

Our history as a species has been marked by what are actually quite normal preconceptions of our own importance within the scheme of things. We are perhaps unique in the universe at the moment, because evolution seems to have gifted us with the perception of self, in which we have become sentient observers of our environment and can thus ponder as to our place within it. Of course, we cannot be completely sure that we are the only species that has this capacity and we may instead be at an upper (earthly bound) limit of a self-conscious gradient that affects species to a greater or lesser extent. Intelligence itself may be simply a matter of perspectives. To qualify the comment within the parentheses; there may indeed be comparable intelligences elsewhere in the universe, but on the other hand; we may simply be the first.

It is also quite natural for an observer to consider himself at the centre of things, as he or she becomes the hub of a great wheel, whose spokes represent the information reaching the senses from every direction. Mankind's early opinion of his immediate surroundings would have reflected this and coupled with the fact that he would not have been able to feel the earth rotating at his feet, he would deduce that the ground on which he was standing might not only be flat; but quite obviously at the very centre of the heavens as sun, moon, wanders and stars performed their celestial ballet around him. Without the possibility of any further information at hand, this was in itself, an intelligent hypothesis. The observer's concept of the universe around him can be described in terms of that individual's perspective and this has been shown to be dependent on many different factors. This may be the result of social, theological, cultural, psychological and scientific influences and combinations thereof - and it would be safe to say that this view of his surroundings will change from one person to the next. There can be little doubt however, that the scientific and especially the mathematical influences available, help one lean towards a more (logically) truthful perspective and this has the luxury of being able to detach itself from many of those very human influences that can introduce bias into our reasoning. In the case of say a Neolithic observer however, these influencing factors could only be based on his or her own experiences and those around him and as such, would not be quite as comprehensive a perspective as we seem to enjoy today.

More often than not, mankind's earliest

descriptions of the world around him have included a deity of one kind or another and this too, would be quite a natural deduction in itself. Our forefathers were no different to ourselves in seeking what we would call 'cause and effect' and once again, these conclusions can only be based on experience. Without the appropriate tools with which to explore the micro and the macro, it would be difficult to appreciate the truth when one is still oblivious to the apparent complexities of the microcosm - or indeed, the dynamics of the stars above. Slowly though, man's experiences broadened as knowledge began to accumulate. It was soon passed from generation to generation and the invention of the written word in its many forms was perhaps the medium that really started this ball rolling. Our perspectives change over time - as they should - for the more we learn about our surroundings, the closer to the truth must we surely be drawn. It has not been the easiest of paths to tread however; as old doctrines seldom go quietly and there has always been an uneasy association between power and convention. New ideas can be uncomfortable for those who hold the reins and woe betide any who dare upset the *status quo*. Our history is peppered with calls of heresy; disbelief, ridicule or worse and more than just a few have paid the ultimate price for trying to communicate their new ideas. Thankfully, it's a little easier now, but we should spare a moment to remember that there still remain corners of our world, where new ideas can *still* seriously damage your health.

There are dangers with new ideas too and this has everything to do with the way we try to define the world in the first place. Convention can and does work for the most part, for it can provide the 'yard-stick' by which logic and common-sense are nurtured and encouraged to prevail. What may be called 'the scientific approach' in very simple terms clearly has its merits and one need only look at our progress since the days of Galileo to realise that this particular philosophy is perhaps the best approach we currently have. New ideas must be open to criticism, but by the same token, so too should the convention they are attempting to replace and literal (and often verbal) games of ping-pong frequently banter the arguments to-and-fro, for and against; in a battle of wills that often stalls our ultimate search for the truth. We must be careful however and try to let common sense as well as logic win through in the end. Mathematical argument is still perhaps the best way of describing our world, but there are clear dangers here too. There can be little argument as to its power within our every day lives, as the complexity of our twenty-first century clearly demonstrates. Our society's dependence on science and technology is so obviously based on the description and the manipulation of natural laws and mathematics is - and will always remain, one of our most powerful of tools. This is fine for the real world around us, for in every day terms it is this manipulation, mainly through experimentation and observation; that has provided us with the means to harness some of nature's natural wonders and use them to our own advantage. The electro-magnetic spectrum is a good example of this, for without *its* experimentation and manipulation, it is difficult to imagine a modern technological society existing at all.

Moving a little further a field, out into the realm of the planets, stars and the galaxies we observe in our night sky, mathematics still triumphs; as even in the opening decades of the twenty-first century, Newton's laws still hold firm (although there has always been a problem trying to apply his laws to multiple systems) and Einstein's relativity is still something else. Both are still taught in schools and colleges around the world, even though the youngest of these stalwarts is now more or less a hundred years old; a tribute surely, to two giant intellects. Within the realm of the macro then, we seem to have inherited what can only be described as simple, elegant and often beautiful mathematical terms with which to describe the world around us and it is often the relationship between the components that make up these descriptions, that is both simple, elegant and very profound - as Einstein's $E=mc^2$ surely testifies. It would not seem unreasonable to make the assumption that the very nature of our universe can indeed be described with mathematical insight and it also seems that the closer to the truth that any particular theory gets,

the more simplistic and elegant is the mathematical result. The relationship between described phenomena seems to be all-important. This assumption begins to break down however, when smaller and smaller scales are invoked. One of the most annoying consequences of this, is that the smaller the scale, the more difficult the observation and thus experimentation. It is here that things start to get complicated.

The real problem with smaller and smaller scales is that we end up not being able to see what we are trying to look at in the first place and this obviously makes our descriptive efforts difficult to say the least. All isn't quite lost however, because we are often able to examine by inference, as certain interactions between such tiny bodies often produce measurable phenomena in their own right and this is frequently, the only form of examination we have. The trick here is in trying to determine just how these interactions (such as particle collisions within cloud chambers or particle accelerators), can help us in our description of such minute subjects and this has sometimes required a bit of educated guess-work.

As if trying to examine the atom wasn't bad enough, attempts at probing its nucleus must have seemed nigh-on impossible to early researchers, when they eventually realised that such an entity was probably located at the atom's core. There were however, some brilliant minds already working on possible solutions to these headaches and it must have seemed inevitable that new descriptive tools were required when probing at such unbelievably tiny scales. It was certainly new territory. Then, at the turn of the last century, along came Max Planck *et al* - and the rest as they say, is history.

Mathematics was thus able to triumph again and quantum theory and its now many branches, evolved to become the new descriptive tool in our examination of the very small. You still couldn't actually see what you were trying to examine, but it was now possible to speculate about what might be going on there. It more or less became a whole new science unto itself as this evolution matured over the years. There were some unforeseen repercussions however, because on the one hand you had quite adequate descriptions of the very large; encompassing classical, Newtonian and Einsteinian physics; while on the other, you now had the quantum - and 'ne'er the twain shall meet'. There appeared a dividing line between the visible and the invisible scales of nature and this would prove difficult to overcome. Much has been written on the subject of quantum theory and by better and more qualified authors than this one, so its history will not be dwelt upon here. Suffice to say, that while its descriptive powers are phenomenal, it enters a virtual world of virtual particles and virtual interactions, which are themselves a simulation of the real world around us. Proof by experimentation is still difficult, but again by inference, some breathtaking insights into the tiny world of the quantum have been realised, as observation has been seen to confirm certain predictions made by quantum models of the nucleus and its believed component parts. It is still difficult however, to reconcile what quantum theory believes to be the nature of the very small, with those that still quite beautifully describe the very large and this has produced more than just a little conflict over the years.

This takes us to string theory, which was probably another natural progression in our quest to better define the world of the very small; while at the same time, attempting to reconcile this view with gravity and relativity. This too, has matured over the years, evolving into super string and later M-theory, which are again, slightly different perspectives in that they try to look at the world in terms of vibrating, fundamental strings instead of quantum theory's wave functions. The conflict still remains however and the much sought-after goal that is 'the theory of everything', still seems as illusive as ever.

Both quantum physics and the many string theories that now abound all have a certain commonality - and this is their complexity. When all is said and done, mathematics seems to have an in-built ability that allows it the tendency to over complicate and this is due at least in part, to its abstract nature. This is its power of course, and

it allows us to invent logically feasible 'other worlds', which are themselves, virtualities. This has given rise to such concepts as Heisenberg's Uncertainty Principle, the 'many worlds' interpretation of Hugh Everett and the multi-dimensional universe that is central to string theory.

This is not to say that these approaches do not work most of the time - because they clearly do, but there would seem to be some applications that appear to lead us into blind alleys, unless a certain amount of juggling is involved. The most elegant of theories are frequently the simplest (mathematically speaking); while it is often difficult to see the wood for the trees when we have to rely purely on abstract concepts that are approximations of the real world. In our search for the truth, is complexity a uniquely human trait and are we complicating matters simply because we have this in-built ability to do so?

As I sit here writing what will be the final chapter of this modest submission; 'Thompson' our four month old ginger tom, sits on what has become my 'cat and mouse' mat, chasing the cursor all over the monitor's screen. He's a bit of a wild thing that's for sure and his play is instinctively fine-tuning his hunting abilities that will soon turn him into a perfectly adapted carnivore. He may be just a domestic kitten, but he has all the same traits, skills and instincts of the big cats and my hands still show the teeth and claw marks to prove it.

As I sit here pondering the world and the universe around me, Thompson is doing exactly the same thing; testing out his environment and chasing everything that moves. He doesn't care that he's blocking my view of the monitor as I try to peer round him to check my spelling; he is more interested in whether or not he can catch that damn cursor and more importantly, whether or not he can eat it. He is oblivious to what we would call the more abstract concepts of the universe and our place in the scheme of things. His universe consists of his immediate surroundings and the prospective prey he tries to catch within it.

It is of course, all a matter of perspective. Thompson cannot possibly understand even the simplest abstract concept and nor should he be expected to. Evolution has gifted him with perfect adaptability for the (original) environment within which nature has placed him. Watching him play does however, make one wonder about our own abilities and whether or not we as a species have been gifted 'enough' to be able to fathom the mysteries of the universe around us. Thompson cannot possibly understand the complexities of our world and perhaps we too are not quite high enough up the evolutionary ladder to understand the finer working of the wider universe. Our grasp on this understanding has often been likened to the difference between us and the ants that seem to fascinate many a child while playing in the back garden. They can be seen scurry about their business, seemingly unaware that we are studying them at all and their understanding of us, is often used as the analogy to describe our own relationship with that big wide universe out there beyond our atmosphere. I would somewhat disagree with this however.

Evolution (accidental as it appears to be in our case), has provided us with the abilities of imagination, self consciousness and abstract thought and we are not only acutely aware of our surroundings, we can also recognise physical processes for what they are - and of course, their apparent cause and effect. This is what seems to separate us from the other animal species with which we share our world and we seem to try to find order in everything we examine. The realization that nature obeys specific physical laws is perhaps our most outstanding achievement and this has provided the impetus that has resulted in a catalogue of undeniably outstanding discoveries over the years. As a species we are however, extremely complex and this is reflected in our society and in our behaviour. We need only look to our politicians and our governments to see that if there is even the slightest possibility of complicating matters, then we will surely do so.

Our quest to unravel these natural laws has on the most part been successful, but this uniquely human trait of over-complication makes its

presence felt here too. We look at the universe around us and witness what appear to be overtly complex systems at work and in response; we tend to invent overtly complex explanations in our attempt to fully understand what is going on. As discussed at the beginning of this submission, there is little doubt that the route to such an understanding will be mathematical, as this wondrous invention of ours has all the scope and the power with which to paint the best possible descriptive picture of the world around us. We notice however that certain theories (that have themselves been proven time and time again), do not seem to 'fit' elsewhere within this overall descriptive endeavour. Surely, if a theory such as 'General Relativity' is really that good at being able to predict the effects of 'the very large' and similarly if 'Quantum Theory' is successful in its description of the 'very small'; then why, do they still appear to be at odds with each other for most of the time. This has become a real and serious headache within the scientific community and it was a headache that just didn't want to go away. 'String Theory' on the other hand, was rather like a side-step; a new perspective that attempted to reconcile two very different trains of thought. It was aiming in the right direction; a slightly different way of looking at things, but it has become even more complex than the ideas it was trying to replace.

We shouldn't forget that although we try to emotionally detach ourselves from our theories and claim that it is the non-biased logic of our descriptions that determine success or failure; our quest is still a very human one and is fraught with human frailties. The very theories that attempt to describe the world are also part of the individual or group that devised them and therefore firmly attached to personalities - and personalities often clash (and in public too) as theories slog it out to gain supremacy. There is another important factor that cannot be overlooked and this is the question of 'funding'. We live in a world run by accountants and financial implications are often an over-riding consideration, even in research. Vast sums of money are involved here and the possible incentives are difficult to ignore. There is little wonder then, that Peter Woit has been so 'graphic' with his criticism in his book *"Not Even Wrong"*, first mentioned on page 3 of this submission. The theories that win through in the end, may not necessarily be the best as far as our quest for the truth is concerned, for acceptance can often be more to do with who shouts the loudest and whose reputation is deemed to carry the most weight. We all think of our children as the best looking on the block and we will fight 'tooth and nail' rather than accept that our neighbour's kids are prettier. We are after all, complicated, emotional, fallible human beings whether we like the idea or not, although there will be many out there who will always disagree.

The 'quark model' has been with us for longer than I have and some would consider it blasphemy to question such a stalwart of particle physics. The evidence *'for'* however, is extremely sparse and is theoretical rather than experimental. The behaviour of these sub atomic particles is strange to say the least and their supposed characteristic of 'fractional' charge seems to contradict the 'whole number' philosophy of the quantum without offering any real justification. The complexity of the quark model is also compounded by the invention of the 'gluon' in order to explain some of the more uncomfortable traits that the quark seems to exhibit and one is reminded of that little ditty about those *'bigger fleas that have smaller fleas upon their backs to bite them'*. This is again, all a matter of perspective and the big question we should be asking ourselves, is whether or not we can be absolutely certain we are facing in the right direction to begin with as we attempt to formulate such descriptions of the world. If one's direction is wrong in the first place, this will inevitably lead down blind alleys and one's journey will be full of stops and turns and back-tracking, that get more and more complicated all the time. It should of course, be a simple route from 'a' to 'b', but it seems far easier to add new components to an existing theory than to throw it aside and start again; but beware, there is always this consequence of compounded complexity.

There is also the problem of convention to contend with and this can often be an

uncomfortable experience in its own right. What is frequently overlooked (and often for no good reason as it is brushed under the carpet), is the simple truth that *NOBODY* actually holds the exclusive monopoly in this endeavour, although to be fair, one is more likely to gets results with the support of individuals or institutions whose expertise lies within that particular field or discipline. This is not say however, that contributions cannot be made by those who are *not* members of what often seems to be an exclusive 'members only' club. To quote Lee Smolin in his book *"The Life of the Cosmos"*[1]:

"Of course, what is both wonderful and terrifying is that there is absolutely no reason that nature at its deepest level must have anything to do with mathematics. Like mathematics itself, the faith in this shared mysticism of the mathematical scientist is an invention of human beings. No matter that one may make all sorts of arguments for it. We especially like to tell each other stories of the times when a beautiful piece of mathematics was first explored simply because it was beautiful, but later was found to represent real phenomena. This is certainly the story of non-Euclidean geometry, and it is the story of the triumph of the gauge principle, from its discovery in Maxwell's theory of electrodynamics to its fruition in general relativity and the standard model. But in spite of the obvious effectiveness of mathematics in physics, I have never heard a good a priori argument that the world must be organized according to mathematical principles".

To be fair to Smolin, in his next paragraph, he does go on to say:

"Certainly, if one needs to believe that beyond the appearances of the world there lies a permanent and transcendent reality, there is no better choice than mathematics. No other conception of reality has led to so much success, in practical mastery of the world. And it is the only religion, so far as I know, that no one has ever killed for".

Here, here - but perhaps Smolin is just being gracious as far as the possibility of a non-mathematical explanation is concerned, although perhaps the truth of the matter is that such a mathematical solution to the riddle of nature need not be an overly complicated, abstract one.

This is '*The Dimensional Boundary Chord Model Of The Nucleus'* more or less in a nut-shell and if you have managed to stay with me; I would thank you for your patience. This journey has simply been a different way of looking at things and in what are basically very simple, mathematical terms - which by the way, also reflects my own obviously simple, mathematical expertise. You may have already concluded that many of my arguments seem to be based on a series of numerical or geometric coincidences and this at first sight may indeed be the case. However, who was it that said:

"There is no such thing as a coincidence".

I am certainly in total agreement with Smolin in that I too believe mathematics to be one of the best tools we have at our disposal in our continuing search for the perfect explanation of the universe, but I also strongly believe that it doesn't have to be the *only one* with which to gain an insight into the inner workings of this still wonderful world around us. I hope that mathematics will be able to refine and focus this perspective as it matures over time, but in our quest for the truth, we must continue to employ what is arguably *still* the most powerful and underrated of abstract tools at our disposal - and this is and will always continue to be our own imagination.