Two or Three Things I Know About [It] [1]

An Examination of Dark Matter

By Karen Wendy Gilbert

When it gained access to domains that are not naturally given to man--to astronomical spaces or microphysical realities - the more inventiveness in the wielding of algorithm science has exhibited, the more conservative it has shown itself to be in what concerns theory of knowledge.
. . .
The considerations regarding scale, for example, if they are really taken seriously, should not relegate all the truths of physics to the side of the "subjective"--a move that would maintain the rights of the idea of an inaccessible "objectivity"--but they should contest the very principle of this cleavage and make the contact between the observer and the observed enter into the definition of the "real." Maurice Merleau-Ponty, *The Visible and the Invisible.*

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And so the call goes out for dark matter candidates:
black holes, snowballs, gas clouds, low mass stars, or planets.
But we quickly hit a snag because galaxy formation
requires too much structure in the background radiation
if there's only baryons and adiabatic fluctuations. [2]

One view of the universe is that it is "atoms and void," material stuff such as stars, planets, gas clouds and the "space" between them. Another view is that the universe is "all of a piece," an enormous "field," sometimes likened to a rubber sheet, that can bend and fold and have thicker and thinner spots. Whatever the nature of the universe, it is expanding, that is, the matter we can perceive and measure is moving away from us in all directions. Though expanding, the stuff the universe is made of (or the point particle manifestations of the universal field) deform the shape of space-time and this gravitational deformation -- formerly called "gravitational attraction" -- balances the flying apart of the universe. [3]

The eschatological question of cosmology is: What is the tension between the flying-apartness and the drawing-togetherness of the universe? Like the porridge of the three bears, there are three possible outcomes for the universe; if it is "too hot," the universe might snap back into itself. This would be like a video of the big bang played in reverse, until the world ended in a minuscule hot dense implosion -- known as the "big crunch." Another possibility is that the universe might be "too cold," it might expand forever until there is only the thinnest gruel of vacuum fluctuations. Finally, the universe might be "just right," with the forces of expansion and containment forever balanced. The current crisis in cosmology is that we haven't been able to find enough "stuff" in the universe to balance the rate of expansion.

The density of the universe is measured by the cosmic density parameter "omega." If omega equals the value of one, the universe is at critical (meaning "good") density. The material that we can see (or hear) is called "bright" matter and it only makes up one percent of the critical value. Matter that we can't telescopically see or hear (referred to as "dark" matter) has been found through its gravitational lensing effect. [4] This detected "dark" matter is estimated to make up an additional 9 percent of the total matter needed to stop, or reverse, the universe from forever expanding. Where and, more to the point, what is the "missing" 90 percent of matter? The possibility exists that the "bright" matter we can see/hear accounts for more of the critical density of the universe than we realize, but, if so, this would mean that we have been "weighing and measuring" it incorrectly. This would challenge all our current assumptions of the nature of matter. As a rule, scientists are unlikely to deconstruct a system that works "well," by which I mean that one can predict the results of events from it. Also, any one can see the night sky is "dark". Rather than assign a greater value to that which we can see, the most "simple" solution is to suppose that something "else" is out there, something that we could measure if we could only perceive it. To "find" this "missing" matter we must know whether we are looking for exotic particles, imperceptible (i.e., "dark") to our current scanning tools, or a phenomenon (such as the dimensionality of space) of an entirely different order. [5]

This paper looks at two realms of knowledge: What dark matter is? And, what sorts of answers are permissible to this question? The answer, suggested only semi-facetiously, that the missing gravity that holds our universe in its present configuration can be accounted for by the mass of all the missing single socks lost over time, is funny precisely because it approximates the form of the answer we are looking for. The answer that "God" is the undetected ninety percent of the universe is not funny, because it suggests an answer outside of the currently defined realm of "science."

In physics, as in metaphysics, one always comes up against the "hard question:" Does the material Universe exist? Before one sets out to look for the "missing" dark matter one must identify what it is that one seeks. Is dark matter "stuff" that exists whether or not we ever think of it, find it, measure it and/or know it? Is it created by our search for it, having been "called forth" from the ineffable, undifferentiated depths in which it had only existed in *potentia*, or as a Formless Ideal? [6] Does it both exist and not exist until we "collapse" its infinite superposition by finding it, registering it, or measuring it? Or, is dark matter an intersection of two sets, the "set" of actual material reality (i.e., enacted, corporeal matter, manifest in ontological Being) and the set of phenomenologically constructed, socio-historically situated, knowledge? [7]

To look at what it means to know "about" dark matter, this paper will consider ideas concerning the construction of perception and construction of knowledge. To this end, I am guided, in part, by ideas put forward by Feyerabend (1975):

> **Such an attempt involves much more than a prolonged 'critical discussion' ... . One must be able to *produce* and to *grasp* new perceptual and conceptual relations, including relations which are not immediately apparent (covert relations ...) and *that* cannot be achieved by a critical discussion alone. The orthodox accounts, of course, are restricted to (physical) theories ... , they neglect the covert relations that**

> **contribute to their meaning, disregard perceptual changes and treat the rest in a rigidly standardized way so that any debate of unusual ideas is at once stopped by a series of routine responses. But now this whole array of responses is in doubt. Every concept that occurs in it is suspect, especially 'fundamental' concepts such as 'observation', 'test', and, of course, the concept 'theory' itself. And as regard the word 'truth' we can at this stage only say that it certainly has people in a tizzy, but has not achieved much else. The best way to proceed in such circumstances is to use examples which are outside the range of the routine responses.** [8]

Taking Feyerabend's advice to heart, this paper will examine theories put forth both within the context of "science" and the context of "fiction," in a consideration of dark matter. In addition, I will look at some ideas concerning the relationship of consciousness to matter that might more properly be considered paraphysics, metaphysics or philosophy.

Possibility One: Dark Matter is Something that is Added

Is dark matter **something** or **nothing** (i.e., the lack, or absence of something)? The perhaps apocryphal example of the "empty" gasoline tanks, whose contents -- "nothing"-- ignited, blowing up the train that carried them is to the point. The "nothing" in the "empty" tanks was gas fumes that were as incendiary, if not more so, than their original liquid contents. Revisiting the debate of plenum and vacuum,[9] dark matterists must ask themselves if dark matter is stuff that travels through (across? or along?) the fabric of space-time as does complementary "bright" (or electromagnetically observable) matter; or whether dark matter **is** the very fabric of space-time that the stuff of bright matter moves along. To gain historical perspective on this question, we can revisit the phlogiston problem.[10] Phlogiston was a gas that could be precipitated out of the air, or burned out of metal. Eventually, phlogiston was "discovered" to be hydrogen.

I present the phlogiston theory not as an example of "old," or "wrong," or "primitive" science, but as an example of a theory whose "facts" have since been "disproved" yet whose world-view might prove useful to conceptualize a new genre of facts (facts about dark matter, rather than about chemistry).

> **Phlogiston was tentatively identified with the gas we call hydrogen. The chemists of the eighteenth century knew how to prepare this gas but their conception of its properties and behaviour was very different to ours. They believed, for example, that phlogiston would be absorbed by a substance they called ' minium' or 'lead calx' - or what we would call 'lead oxide.' Furthermore they believed that when it absorbed phlogiston the minium would turn into lead.**
>
> **Joseph Priestley was able to provide a convincing demonstration of this theory. He took an inverted gas jar filled with phlogiston which was trapped over water. Floating on the water was a crucible containing some minium. This was heated by using the sun's rays concentrated by a burning glass. The result was exactly what he expected. The minium turned into lead, and as an indication that it had absorbed the phlogiston the water level in the gas jar rose dramatically. Here surely was a demonstration that the theory corresponded with reality.**
>
> **An empiricist would rightly point out that we can see the water level rise but we do not actually see the phlogiston absorbed into the minium. There is no experience of seeing the gas rush into tiny pores or crevices in its surface, as we might see bath**

> **water rush down a plug-hole. So the reality that the theory postulates is not visibly in accord with the theory. *We do not have access to this area of the physical world so we cannot see the correspondence with the theory. ...***
>
> **It is interesting to compare Priestley's analysis of this experiment with our version, because as far as we are concerned his theory ... does not correspond with reality at all. We do not say that the phlogiston was absorbed into the minium ... . We say that the gas in the jar is hydrogen and that the minium is lead oxide. On heating, the oxygen comes out of the oxide leaving the lead. This oxygen then combines with the hydrogen to form water. During this formation gas is used up and so the level of ... water in the gas jar rises.**
>
> **We see exactly what Priestley saw but conceive it theoretically in a quite different way. We, no more than Priestly, have been permitted access to the hidden aspect of reality, so our view is just as much a theory.** [11]

In this first case, the phlogiston theory postulated that the (lead calx) minium absorbed the gas and was transformed into a different sort of metal (lead). The absorption of the phlogiston allowed the water to "expand" to fill up more of the jar. If the existence of phlogiston had not been "disproved," or if we had been proposing a model of dark matter while phlogiston theory held sway, our theory of dark matter might have been as follows: The Universe consists of perceptible (i.e., bright) matter in insufficient amounts to account for its shape and size. Therefore, we must presume the existence of imperceptible (i.e., dark) matter. In seeking to define of what this dark matter consists we must imagine it to be the cosmic equivalent of phlogiston, that is, the (imperceptible) dark matter is absorbed by (perceptible) matter, changing the nature of perceptible matter and, at the same time, allowing the universe to expand. This theory accounts for 1) the axiomatic existence of dark matter, 2) the (observable and confirmable) transformation of bright matter, and 3) the (observable and confirmable) expansion of the universe.

This theory merely tells us that dark matter is something that can be added to perceptible matter and which can transform it. It might be dubbed the "dark-matter-as-yeast" theory. However, it fails to address the questions: a) what does dark matter consist of? b) In what way does dark matter differ from, or is the same as, perceptible matter? And, c) where (in space) and when (in time) does dark matter come from?

Gravity may be the least understood of the four elemental "forces" within the quantum paradigm. No mediating particle (graviton, gravitino, graviphoton, etc.) has as yet been experimentally found, and so its role in catalyzing the baryonic "soup" is least clearly articulated. However, gravity is fully understood within the relativity paradigm as expressed by general relativity.

One suggestion of how gravity may have "catalyzed" the creation of dark matter was reviewed in a recent edition of New Scientist. Edward Kolb of Fermilab suggests, "that the dark matter sprang into being as superheavy particles moments after the Universe formed." The inflationary period was characterized by huge negative pressure. This pressure was equivalent to gravity as a "field" from which virtual matter and anti-matter could briefly "emerge" and then mutually annihilate back into. At the juncture that marked the "end" of the inflationary period gravity (pressure) shifted abruptly. It is at this moment that "superheavy" particles could have been created.[12]

Possibility Two: Dark Matter is Something that is Subtracted

A second case study of phlogiston research involves the phlogiston theory of combustion.

> **On this theory ... what we now call an oxide was thought, to begin with, to be a simple substance which was called a 'calx'. The theory preceded on the assumption that: METAL = CALX + PHLOGISTON. When a metal was burned, and turned into a calx, then the phlogiston was removed from it. It was known however that the calx was heavier than the metal. The removal or extraction of the phlogiston resulted in an increase in weight. How can something be taken away and yet cause an increase? It is tempting here to think of the subtraction of a negative number, for this is equivalent to adding, thus: -(-a) = +a. It is therefore easy to believe that the logical conclusion to draw from the experimental result is that phlogiston must have a 'negative weight'. ... In fact most of those who adhered to this theory did not feel compelled to draw this conclusion. Rather, as good followers of Newton, they felt compelled not to entertain the notion of negative weight.**
>
> **What they said instead was very simple. When phlogiston leaves a metal another substance steps in and takes its place. ... Water was the candidate chosen because it seemed to be implicated in a number of reactions involving phlogiston and its precise role was at that time rather obscure. ...**
>
> **To those who are determined to see the worst in this venerable old theory such an elaboration will appear to be nothing but a display of perverse ingenuity. It will be greeted with exasperation, as if it is a mere attempt to evade the true but damning logical conclusion that phlogiston has a negative weight. In reality it is a quite standard move in elaborating a scientific theory. ...** [13]

While it may be experientially true within certain paradigms that certain elements, forces, or measurements can exist only along one half of an imagined axis (example, only positive and not negative weight), there are other paradigms that points us to complementary manifestations of that which we study. Imagine how inexplicable our world would be if we forbade the search for Southern magnetic poles, or perceived only the discharge of electricity and not its absorption. The proponents of phlogiston may have rejected the notion of “negative” weight, but the notion of "anti" particles is at the heart of our current (scientific) understanding of the origin of the universe. In his chapter on broken symmetries, Barrow (1991) comments that the two most obvious facts of the universe are the preponderance of matter (rather than antimatter), and the quantity of photons.

> **Since every time a proton meets an antiproton and annihilates, two photons of light are produced, we can see that a universe such as ours, possessing about two billion photons for every proton, needs to have arisen from a hot dense state in which there were on average a billion and one protons for every billion antiprotons. A billion antiprotons knock out a billion protons producing two billion photons for every left-over proton.** [14]

Barrow wonders whether the bias toward protons over antiprotons (billion-and-one / billion) is one of the initial conditions of the universe, given axiomatically as it were, or if it is a consequence of "some random symmetry-breaking process that is sensitive to the local physical conditions of density and temperature." If the later, it could be that we live

in a "pocket" of "positive" (rather than "negative") space, but the Universe as a whole may be equally divided between matter and anti-matter neighborhoods -- or, even, antimatter may predominate overall. Might dark matter be in some way related to either the antimatter that no longer exists in our part of the universe, or, to some attribute of the antimatter that exists elsewhere?

Another current theory of the creation of the universe (including dark matter) makes use of "reverse" gravity. In this theory, at the moment after the Big Bang when discrete particles arose, their first relationship was one of repulsion, not attraction.[15]

A final possibility is that there exist not only matter that we cannot perceive, but "forces" (i.e., laws of relationship between matter/energy) that we can't perceive.

> **... this ghost-force problem arises in some of the string theories . ... Of the two special symmetries that these theories pick out for the world, one looks like the product of two identical patterns. As the Universe cools, the known forces of Nature can arise naturally from one of the copies of the pattern. But what happens to the other copy? There appears to be no reason why it should necessarily split up into a collection of different forces as well, although it could. Instead, it seems most natural that it remains in force as a sort of shadow world, where shadow images of all the known particles of matter interact very weakly, as though feeling only a feeble edition of the force of gravity. Such shadow matter could be threading its way around us all the time. The limits upon its presence and influence are rather weak and they display the vulnerability of our tidy world-view to influences that are not within the relatively small domain of strength and range that we can detect either directly or indirectly. [16]**

All physics (cosmology) is written in translation, the reality of the cosmos is first approximated into mathematical structures (topology, quadratic equations, etc.) and then into English. Transforming these ideas into English is no more a guarantee of comprehension than extracting them from a narrative, written originally in English. If the fundamental field of the Universe is Patterning, then the inherent pattern within narrative may be as elemental a field as any other.

Possibility Three: Dark Matter as "Dust" and Perhaps Consciousness Itself

Phillip Pullman, in his series *His Dark Materials*, treats the issues of cosmology and theology with all the novelistic seriousness of C. S. Lewis or J. R. R. Tolkein. The title of the series comes from book two of Milton's *Paradise Lost*.

> **Into this wild abyss,**
> **The womb of nature and perhaps her grace,**
> **Of neither sea, nor shore, nor air, nor fire,**
> **But all of these in their pregnant causes mixed**
> **Confusedly, and which thus must ever fight,**
> **Unless the almighty maker them ordain**
> **His dark materials to create more worlds,**
> **Into this wild abyss the wary fiend**

Stood on the brink of hell and looked a while,
Pondering his voyage...

Pullman offers us an alternative world, where the split between science and religion never took place, and the study of elemental particles and the possibility that many worlds coexist unknown to each other are variously contested doctrines of the Church. In this world, scientists and clerics struggle to understand a new elemental particle, the Ruskakov particle -- known collegially as "Dust" -- which had only recently become visible through modern technology. This new substance seems to be related to Original Sin. Pullman is advancing the theory, cloaked in fiction, that some form of spiritual matter or consciousness is present in the universe. It is intimately related to human life and perhaps also to alternate realities. As you read the portions of the novel below, substitute "dark matter" for "Dust".

The story of the first book of the series, *The Golden Compass*, opens in Oxford. A young girl, Lyra, is spying on a presentation made by an explorer to the fellows of his college. Lord Asriel presents a "lantern" show of "photograms," the first of which depicts a member of an arctic expedition in moonlight. He then shows a second photogram of the same scene, "taken from the same spot only a minute later, with a new specially prepared emulsion."

He lifted out the first slide and dropped another into the frame. ... But the man has altogether changed: he was bathed in light, and a fountain of glowing particles seemed to be steaming from his upraised hand.

"That light," said the Chaplain, "is it going up or coming down?"

"It's coming down," said Lord Asriel, "but it isn't light. It's Dust."

Something in the way he said it made Lyra imagine dust with a capital letter, as if this wasn't ordinary dust. [17]

A later slide, taken with the same special film, shows the towers of a distant city, flickering in the Aurora Borealis. The next reference to these matters takes place between the Master of the College and the Librarian. The explorer, Lord Asriel, wants the College to finance an expedition to the North to further explore these matters. The Master is concerned that the College not be seen as underwriting heretical expeditions.

"The Palmerian Professor mentioned a name," [the Librarian] said after a minute or so. "Barnard-Stokes? What was the Barnard-Stokes business?"

"Ah, it's not our field, Charles. As I understand it, the Holy Church teaches that there are two worlds: the world of everything we can see and hear and touch, and another world, the spiritual world of heaven and hell. Bernard and Stokes were two -- how shall I put it -- renegade theologians who postulated the existence of numerous other worlds like this one, neither heaven nor hell, but material and sinful. They are there, close by, but invisible and unreachable. The Holy Church naturally disapproved of this abominable heresy, and Barnard and Stokes were silenced. ..."

"And now Lord Asriel has taken a picture of one of these other worlds," the Librarian said. "And we have funded him to go and look for it. I see." [18]

The charismatic Mrs. Coulture, who introduces her to London society, then takes Lyra from Oxford. At a party, Lyra overhears a further reference to the mysterious "Dust."

> **"It was discovered by a Muscovite -- stop me if you know this already -- " a middle-aged man was saying, as the young woman gazed at him in admiration, "a man called Rusakov, and they're usually called Rusakov Particles after him. Elementary particles that don't interact in any way with other - very hard to detect, but the extraordinary thing is that they seem to be attracted to human beings."**
>
> **"Really?" said the young woman, wide-eyed.**
>
> **"And even more extraordinary," he went on, "some human beings more than others. Adults attract it, but not children. At least, not much, and not until adolescence."** [19]

At the party Lyra also discovers that her benefactress, Mrs. Coulter, is a founding member of the General Oblation Board, an arm of the Church involved in the sinister business of certain unspecified experiments on children and Dust. Lyra resolves to run away, but before she does she gleans one more useful bit of information.

> **A man in bishop's purple was saying: ...**
>
> **"The last experiments have confirmed what I always believed -- that Dust is an emanation from the dark principle itself, and--"**
>
> **"Do I detect the Zoroastrian heresy?"**
>
> **"What used to be a heresy --"**
>
> **"And if we could isolate the dark principle --"** [20]

This reference is lost on eleven-year-old Lyra, safely pre-pubescent and so free of Dust whatever it may be, but the reader understands we are in the middle of the Gnostic debate. If an Ineffable Prime Mover created the world, using original unblemished matter, then from whence, in this perfect creation of a Perfect Creator, came evil?

Surely the simplest solution to this paradox is to postulate a less perfect Demiurge,[21] responsible for this material manifestation; or even twin Demiurges, Good and Evil who brought forth pure and corrupt matter, respectively. The other possibility is that God suffered someone, somewhere, to somehow cause a fall from Grace. This was Milton's suggestion.

It is interesting to consider, in this vein, the terminology we use to describe the elemental material of the universe; matter and anti-matter, bright and dark matter. The terms "anti" and "dark" are not innocent of theological connotations.

The terminology we use to describe the elemental material of the universe, bright and dark matter, is based on their visibility. However, it would be naive not to consider the theological connotations of "bright" and "dark". Science and religion are linked in our world, as well as in Lyra's.

Dust "falls" from the heavens, perhaps having come from one of these alternate universes. The explorer, Lord Asriel, upon whom Lyra spied, has now come to the far North to build a bridge to the city beyond the Aurora Borealis. Lyra meets him there.

> **"I want to go to the source of Dust itself."**
> **"The source? Where's it come from then?"**
> **"From the other universe we can see through the Aurora."**
> **...**
> **"What is that other universe?" she said.**
> **"One of uncountable billions of parallel worlds. ... And I'm going to that world beyond the Aurora," he said, "because I think that's where all the Dust in the universe comes from."** [22]

In Lyra's world people have symbiotic "daemons", animals of the opposite gender that are a combination of their anima (or animus) and avatar. These "daemons" can change form until their "host" human reaches puberty, then they "settle" into their "true" being. It is at this point that dust begins to settle on the person. Lyra has the following conversation with a sailor as they travel to the far North. The sailor's "daemon," Belisaria, is a seagull.

> **"Why do daemons have to settle?" Lyra said. "I want Pantelaimon to be able to change forever. So does he."**
> **"... There'll come a time when you'll be tired of his changing about, and you'll want a settled kind of form for him."**
> **"I never will."**
> **"... there's compensations for a settled form."**
> **"What are they?"**
> **"Knowing what kind of person you are. Take old Belisaria. She's a seagull, and that means I'm a kind of seagull too. I'm not grand and splendid nor beautiful, but I'm a tough old thing and I can survive anywhere and always find a bit of food and company. That's worth knowing, that is. And when your daemon settles, you'll know the sort of person you are."** [23]

It is Lord Asriel who makes the connection between the settling of ones daemon, Dust, and original sin. He instructs Lyra to read the forbidden fruit scene from Genesis. Paradise, in this world, consisted of a place where child-like Adam and Eve had daemons who could switch form at will.

> **"... she took of the fruit thereof, and did eat, and gave also unto her husband with her; and he did eat.**
> **"And the eyes of them both were opened and they saw the true form of their daemons, and spoke with them.**
> **"But when the man and woman knew their own daemons, they knew that a great change had come upon them, for until that moment it had seemed that they were at one with all the creatures of the earth and the air, and there was no difference between them. ..."**
> **He closed the book.**
> **"And that was how sin came into the world," he said, "sin and shame and death. It came the moment their daemons became fixed."** [24]

The colloquialism "Dust" comes from this passage, the cosmic Dust is named for the "dust from whence you came" and the "dust into which you shall return."

Taking the ideas expressed in this book metaphorically, let us turn our attention to current (scientific) theories of the origin of sex and death, both occurring at the moment when primordial protoplasmic "biota " took on a definite form, exchanging the "immortality" of asexual (clonic) reproduction-through-division, for the exchange of genetic material possible through sexual reproduction. Death came with sex (way before taxes), for once the next generation was an amalgam of two parents, rather than a clone of the mother, and immortality was lost. The mother passed on half her genetic stock (through) sex, and then at the end of her life, she died. [25]

Using this to guide our question we look back to the moment that the hot, dense, undifferentiated universe began to "settle" into distinct forms of energy and then matter. The four forces separated out into their "true" forms (strong, weak, electromagnetic and gravity), each manifest as their complementary particle (quark, W, photon, and graviton). Was there something else that settled into a "dark" field (should we be developing a "DFT," dark field theory), and what is (are) its particle(s)?

Back in the novel, not everyone agrees that Dust is evil, the "savage" Tartars "trepan" themselves to absorb even more Dust. This part of Pullman's alternate world is in exact agreement with ours, where we have evidence of trepanning -- to allow "cosmic consciousness" or to "open" the "third eye," or highest shakra -- going back to neolithic times. And, Lyra suspects that the aleitheometer, or "truth teller," that she alone can read is also powered by Dust.

Lyra follows Lord Asriel over the bridge to the alternate universe beyond the Aurora, and the story continues in book two, *The Subtle Knife*. Lyra now finds herself in our world, in our Oxford, seeking a theological Scholar (known in our world as a theoretical physicist) to answer her questions. She finds her way to the "Dark Matter Research Unit."

> **"What's dark matter?" said Lyra. ...**
>
> **[Dr. Malone] said, "Dark matter is what my research team is looking for. No one knows what it is. There's more stuff out there in the universe than we can see, that's the point. ... But no one can detect it. ... Normally they put detectors very deep underground, but what we've done instead is to set up an electromagnetic field around the detector that shuts out the things we don't want and lets through the ones we do. Then we amplify the signal and put it through a computer. ...**
>
> **"... We call them shadow particles, Shadows. ... You know what? They're conscious. That's right. Shadows are particles of consciousness. ... And here goes the crazy part: you can't see them unless you expect to. Unless you put your mind in a certain state. You have to be confident and relaxed at the same time. You have to be 'capable of being in uncertainties, mysteries, doubt, without any irritable reaching after fact and reason.' You have to get into that state of mind. That's from the poet Keats, by the way." [26]**

Lyra is familiar with that state of mind, it's the one she must enter to "read" the aleitheometer, and she convinces Dr. Malone to hook her up to the computer. The pattern of the Shadows on the computer screen form "a stream of dancing lights, for all the world like the ... aurora." Dr. Malone is simply impressed that "the Shadows are responding to the attention that you pay them. That's revolutionary enough; it's our consciousness that they respond to, you see." But Lyra quickly figures out that these patterns hold information and suggests to Dr. Malone that she "could fix this so it put words on the screen." Dr. Malone agrees to this and Lyra plans to return the next day.

Lyra never gets her chance. The various bad guys pursuing her intervene. Dr. Malone tries to convince her research partner of the significance of what she's learned.

> **"But suppose something happened thirty, forty thousand years ago. There were shadow particles around before then, obviously -- they've been around since the Big Bang -- but there was no physical way of amplifying their effects at our level, the anthropic level. The level of human beings. And then something happened, I can't imagine what, but it involved evolution. ... What I'm saying is that around that time, the human brain became the ideal vehicle for this amplification process. Suddenly we became conscious."** [27]

Dr. Malone's research partner is co-opted by Lyra's enemies, who are interested in finding ways they can use Shadows to control people's consciousness and to gain access to alternate worlds. Dr. Malone is "removed" from the project, but she manages to sneak back into her laboratory one last time to configure the computer to use a word processing program.

> **"Before she had even finished the sentence, the cursor raced across to the right side of the screen and printed: ASK A QUESTION.**
> **... When she did, the answers lashed themselves across the right of the screen almost before she had finished.**
> **Are you Shadows? YES.**
> **Are you the same as Lyra's Dust? YES.**
> **And is that dark matter? YES.**
> **Dark matter is conscious? EVIDENTLY.**
> **... my idea about human evolution... CORRECT.** [28]

As his initial quote from Milton foretold, Pullman imbeds his science fiction in a moral tale of the fall from Grace, not Adam and Eve's, but Lucifer's. Whatever else Dust is, the computer goes on to reveal that it's also angels, an "angel-dust" designed to bring humans to (self) consciousness, to awaken them to their manifest destiny - in this case to join the long deferred angelic rebellion against the deity, ironically referred to in the novel as "Authority." Leaving aside Pullman's Miltonian plot and examining his "science," we are left with the interesting question, is dark matter consciousness?

Possibility Four: Dark Matter is Memory, Dreams and Reflections[29]

The notion that there exists a pattern or relationship inherent [30] within the universe, and that humans [31] are in some way part of it, has been treated by many thinkers.

Working from the big toward the small, the anthropic principle reflects the statistical improbability of the initial (and subsequent) conditions giving rise to cognizant observers. [32] Working up from the minute we have models described by Roger Penrose and others of quantum indeterminacy being the mechanism of human mental self consciousness. [33] In the first case we can posit that (our human) mind is (an evolution of cosmic) matter; in the second that quantumly indeterminate "matter" is what we experience as (our) mind. In either case, what ever it is that mediates these "fields," "forces,"or "energies" is not an already named entity. "Implicate order" and "morphic field" [34] are names of concepts at this point, in contra-distinction to "invariance structures" or "electromagnetic field." The first two may "prove" as "real" as the latter, but as of this writing they have yet to be documented to the satisfaction of the scientific-community-at-large.

One possible scenario is that the universe originated [35] as a quantum fluctuation. [36] Think of the old Donovan Leitch song, "First there is a mountain, then there is no mountain, then there is," if we only substitute "vacuum fluctuation" for "mountain." The vacuum fluctuation is often referred to as "foam," which is a useful metaphor if we take a minute to examine the nature of the "bubbles" in the "foam." There are two kinds of bubbles, ones with two surfaces and ones with only one surface. The first kind is more common in the macrosphere. Soap bubbles for instance have both an "inside" surface that holds the air inside the bubble and an "outside" surface that holds out the outside air. This surface may be infinitely thin while the stuff inside and the stuff outside may both be air, but they are different air. The inside and outside of the surface are two things. A different type of bubble is like the bubble of carbonation in a glass of seltzer. There is only surface, the surface of gas against water. There is nothing "inside" the bubble, because the bubble is not a membrane, it is a tiny bit of something else temporarily extant within something.

If the "bubbles" within the quantum "foam" of a vacuum fluctuation are of the second sort, not membranes between two discrete forms of matter (energy), but a bit of something within something, then what is "inside" them? Suppose for a minute that the content of the bubbles was scalar fields. The "force" fields that are associated with each of the four forces are "vector" fields, which is to say that they have both a magnitude and a direction at each point in the field. A scalar field has only magnitude. In a vector field (such as electricity) there is a difference between a particle that is at rest in relation to the field and one that is moving through it. This is not the case with scalar fields. That is why vector fields determine force and scalar fields determine mass.

It was the action of the scalar fields that broke the symmetry and separated the initially combined (vector) forces (for example, the weak and the electromagnetic forces from the electro-weak force). The change from a symmetric state to a state of broken symmetry is a phase transition. We are familiar with phase transitions such as the shift from isotropic homogenous water into directionally oriented, discretely structured ice crystals. [37]

Penrose uses this same metaphor of crystallization when speaking about the quantum nature of consciousness.

> **He notes that as the various superposed states of a quantum-level system evolve over time, the distribution of matter and energy with them begins to diverge. At some level ... the differences between the supposed state become gravitationally significant; the states then collapse into the single state that a physicist can measure. ... Penrose proposes that the physiological process underlying a given thought may initially involve a number of superposed quantum states, ... When the differences in the distribution of mass and energy ... reach a gravitationally significant level, the states collapse into a single state, causing measurable and possibly nonlocal changes in the neural structure of the brain.** [38]

It is important in looking at the similarities between quantum indeterminacy in cosmic foam and in human mentation to remember that a hypothesis that these may be two manifestations of the same process is not to suggest that they are teleologically related. The belief that the universe is a phenomenon that has as it's goal self-consciousness and that humans are its mechanism for so doing is worth considering. However, one must be leery of slipping into a line of thinking such as "the universe wanted to be able to smell, so it evolved beings with noses." It is equally possible that certain structures of being (ontologies) are suitable both for biologic (i.e., human) and non-biologic (i.e., universe) systems. If this is true, then the study of one may draw our attention to what to look for in the study of the other. An example of this is the effect scale might play in both systems. The field of consciousness research has moved to examining smaller and smaller phenomena, perhaps the answer to the issues of "large" space will also be very small.

The quantum dynamics of consciousness involves both chaos and scale. Chaos becomes possible once one has moved down to the level of individual cells.

> **Such architecture permits a two-way relation between large-scale neurosystems dynamics and that of single cells, which both enables large-scale bifurcations to alter the stability of single cells and for single cells to precipitate bifurcations at the neurosystems level. ... The occurrence of either chaotic sensitivity or self-organized criticality at the neurosystems level could then enable a small subpopulation or even a single critical cell to precipitate global bifurcation.** [39]

The "single critical cell" is presumed to have quantum-mechanical action through the conduit of the synaptic vesicle or ion channel level.

> **Eddington (1935) and Eccles (1970) discussed the possibility of quantum-mechanical action of the vesicle and pointed out that the uncertainty of position of a vesicle ... is comparable with the thickness of the membrane. Because of this, the vesicle can be regarded as a quantum object ... .** [40]

King and others have presented models where the quantum fluctuations of the neurochemistry of the brain are consciousness. Matti Pitkänen has developed a "theory of consciousness of the brain [that] relies on [the] assumption that the moments of consciousness correspond to quantum jumps." [41]

One coincidental factor of Pitkänen's proposed "quantum antenna hypothesis," and the presumed origin of dark matter is the dependence on the structure of space-time. Pitkänen suggests that "linear structures such as microtubules, DNA, etc. are associated with ... massless extremals." Without getting too technical, "massless extremals" are "electromagnetic and weak force gauge fields propagating with the velocity of light and with non-vanishing vacuum gauge current." [42]

Using these quantum antennae Pitkänen "constructs a geometric model for thought," in which "this kind of vacuum space-time surface interact[s] with matter. ... Some energy flows to vacuum surface and deforms it: it ceases to be [a] vacuum. ... What is essential [is] that *interaction with external world codes some properties of the external world to the properties of the deformed vacuum* ... [italics in the original]. Pitkänen's point being that "[t]his is what cognitive systems do all the time: they construct representations."

Interestingly, this sounds very close in logical structure to the work of the "Grand Challenge Cosmology Consortium (GC^3)" in their attempts to construct a computer model of "X-Ray Clusters in a Cold + Hot Dark Matter Universe." [43] The members of the consortium make computer models of discernable x-rays in the gaseous halos that surround galaxies. At great magnification it is possible to see the formation of structures, as small fluctuations grow and cluster into larger coherent structures, structurally reminiscent of the quantum fluctuations of synaptic tubulin "triggering" larger coherent structures (i.e., "thoughts). Similarity of form does not guarantee similarity of function, as Stephan Jay Gould has often reminded us. Just because I "smell" with a knob in the center of my face, doesn't mean that other creatures use the same sort of "nose" with which to smell. Snakes, for instance, use their tongues. Nevertheless, in comparing systems it is a reasonable strategy to look for what structure may serve a same (or analogous) function. The behavior of the cosmic gas is "caused by gravity," [44] just as the quantum superposition of mental activity may be collapsed as "soon as a significant amount of space-time curvature is introduced. ... What do I mean by a 'significant' amount of curvature? ... about the scale of one graviton." [45]

With the aid of "massively parallel computers," the GC^3 has been able to simulate a three dimensional cube of the universe within which they "solve the equations of hydrodynamics to predict the behavior of the gas density, pressure, temperature and velocity." Their model predicts "50 million dark matter particles which evolved in very much the same way as the [particles of visible] gas. One-third of the dark matter particles are cold and the remaining two-thirds are massive neutrinos with an assumed mass of 7 eV." [46]

In the June 13, 1998 edition of *New Scientist*, Charles Seite reviews the world of Dharam Ahluwalia, a physicist at Los Alamos National Laboratory.

> **Ahluwalia put gravity into the Schrodinger equation, which is normally used to describe the quantum behavior of a particle in different electromagnetic potentials. He found there is a gravitational analogue of the solenoid effect: particles can "feel" their gravitational potential. ... this effect would influence the way neutrinos flip from one type to another. ... If confirmed, the new idea would ... suggest that distant**

> **galaxies affect the properties of nearby particles by contributing enormous potential. The ... dark matter that make[s] up the "Great Attractor" ... would change how ... neutrinos oscillate near the Earth."** [47]

One final note. The nature of consciousness -- and of the universe -- both exhibit fractal features. Fractal patterns are self-repeating, sensitive to scale, and contain bifurcation nodes. The fractal structure of the brain allows it the flexibility inherent in instability:

> **The fractal algorithm (Penrose 1989, Dewdney 1989), which in addition to parallelism, features fractal task assignment, shares significant features with biological processing. Including attractor dynamics with chaotic regimes in such a scheme provides additional features of sensitive dependence, phase space exploration, continuous resolution of instabilities, and the capacity to form new symbolic structures thorough bifurcation. ... The complementary unstable component may continue to hunt through chaotic states, either bifurcating to stability, or forming a fractal instability which could in turn be perturbed by quantum instabilities.** [48]

Timothy Ferris, in *The Whole Shebang*, writes "Mandlebrot created a stir in cosmology in the 1970s by arguing that galaxies on the superstructure scale are organized as if generated by a fractal geometry of 1.23 dimensions, which on larger scales (where homogeneity takes over) they resolve into a classical 3D picture." [49]

If both the mind and the universe are systems poised on the brink of a fractal-patterned phase shift, then perhaps all that is needed is the presence of enough "dark matter" to effect the first ripple of the "butterfly wing" effect. Readers interested in a detailed look at the notion of temporal properties affecting the nature of consciousness are invited to look at the author's work, "Running Backwards Into the Future: Some Considerations About the Nature of Time and Memory." [50]

Here, I am more concerned with the cosmic manifestations of this effect. Something is counteracting the explosive outward expansion of the universe, but rather than looking for some *thing*, as in a particle of matter or a field of force, perhaps we should be looking at the structure of the universe. This is the lesson we can learn from current research that "mind" may be inherent in the structure of the brain. Dark matter may be an "attitude," not a particle.

Possibility Five: The Fifth Dimension

Dark matter as consciousness may not seem like a "scientific" possibility. It may be true or not, demonstrable and/or falsifiable or not, but it clearly belongs in the realm of myth, mysticism, psychology, philosophy or religion. But "science," as we define it, and the boundaries between science and these other fields, are historical constructions. As recently as 1928, it was valid science to debate "whether incubi are capable of producing offspring or whether they are forced to use the seeds of men for that purpose." [51]

In his rebuttal of the notion of scientific "progress," Feyerabend offers instead a theory of the incommensurability of successive, or parallel, world-views. He suggests

that not just the contents of what it is permissible for "science" to study may change, but the very notion of what constitutes "science" may and has changed as well. For example, under classical physics one could study the trajectory of electrons in an interference pattern, whereas in quantum theory electron "trajectories" not only can't be studied, but they don't even exist -- any more than incubi.

Feyerabend compares the world-view that stretched from the Neolithic era to approximately the 7th century B.C. with the one that arose in Greece at that time. The earlier world-view ("archaic cosmology") conceptualizes objects, entities and events as a "complete enumeration of its parts and peculiarities." [52] Therefore, it is possible to say "laughing Aphrodite is weeping" without contradiction since it is equally true that Aphrodite is "the laughing goddess," and that she is at this moment, crying. Feyerabend compares this archaic world-view to classical physics where we could describe the particle-like behavior of a light "wave," or the wave-like behavior of a photon, without feeling compelled to re-examine the nature of "light."

In the world-view that arose between 7th and 5th century B.C., "[the] concept of an object has changed from the concept of an aggregate of equally important perceptible parts to the concept of an imperceptible essence underlying a multitude of deceptive phenomena." [53] Now Aphrodite, whomever or whatever she was, could appear to be laughing or crying, but these were descriptions of her appearance not essential attributes of her being.

In just such a way, the theory of general relativity conceptualizes "that inherent properties of ... shapes, masses, time intervals are relations between physical objects and co-ordinate systems" [54] rather than the assumption of classical physics that these attributes "inhere in objects." Feyerabend points out that "The new conceptual system that arises in this way does not just deny the existence of classical states of affairs, it does not even permit us to formulate statements expressing such state of affairs." [55]

Might it not be possible that the answer to the question of the balance between the flying-apartness and the holding-togetherness of the universe lies not with a particle (or its field), [56] but within the structure of the universe?

The unspoken assumption in all theories of dark matter is that it is a substance (material or force) that exists within the four-dimensional universe we have presumed. On a daily basis, humans perceive three spatial dimensions and one temporal one, but within the world of physics/astronomy/cosmology this 4-D world may be considered a "special case" of a higher-dimensional "reality." This is parallel to Newtonian mechanics remaining useful as a special case of Einsteinian relative space-time. Instruments that allow us to perceive the edges of our universe are routinely used to "see" the past, a notion that would be laughable in any other context, while the various string theories postulate multiple dimensions, which rolled up like tiny hedgehogs in the interval after the big bang.

Mysteries are not necessarily related. The questions "Where do babies come from?" and "Where does all my time go?" regrettably, don't often share the same answer. James Beichler finds more fertile ground in comparing the problematic points of relativity and quantum theory. "The infinite masses of elementary particles which resulted in QED [quantum electrodynamics] and QCD [quantum chromodynamics] before renormalization can be effectively compared to the singularity problems of GR [general relativity]. However, such a comparison had not been common within either physics or the philosophy of science." [57]

I wonder if this area may also prove relevant to the problem of dark matter. If the universe is indeed five-dimensional (or more), then the energy (forces) that balances attraction and repulsion may reside "elsewhere." Think of the model of the tesseract, the geometric shape "folded" into additional dimensions. Like the two-dimensional creatures in Edwin Abbott's *Flatland* who mistook the cube for a square, what we perceive as the cube may be that part of a four-dimensional shape whose other "sides" are invisible to us -- just as dark matter is invisible to us. If other dimensions exist, it might also be possible that forces, fields and/or particles exist within them. These forces and other things might only be "visible" to us by the effect they have on our perceptible dimensions. One is put in mind of the nursery rhyme: "Who has seen the wind, neither you nor I, but when the trees bow down their heads, the wind is passing by." Dark matter may be small potatoes when compared with spooky action-at-a-distance, to the fifth power.

Beichler begins with the five-dimensional theory of Theodor Kaluza, a contemporary of Albert Einstein. Kaluza thought, "that both gravitation and electromagnetism should arise from a single geometric structure, the 'unitary' or unified field, but [that] general relativity did not fully represent that field. ... Kaluza suggested that a fifth dimension could be added to the space-time continuum to account for both fields simultaneously." [58] Using Riemannian mathematics, "Kaluza [saw] ... a possible answer to the problem of developing a unified field structure. Both electromagnetism and gravitation could exist on an equal footing within the geometric structure of a four-dimensional space-time continuum embedded in a fifth dimension." [59]

The devil in the details within this theory was of two natures, mathematical (which won't be treated in this paper) and the conundrum of the dimension "that didn't bark in the night." The fifth dimension had to be constructed so as to offer both proof of its existence, and "an explanation of the absence of evidence that the fifth dimension exists." [60]

Kaluza's original math [see Beichler's paper for this] postulated a five-dimensional "hyper-field" within which we could only perceive our "normal" four dimensions of space-time. He effectively correlated gravity and electromagnetism within this metric, but was unable (or uninterested) in incorporating quantum theory. This fell to Oskar Klein in 1926.

Klein sought to use the five-dimensional structure of Kaluza's space-time to reconcile the discrete nature of quanta with the continuous nature of space-time, in

particular the "atomicity" of electric charge. He related the "shape" of the fifth dimension (its geodesic) to both the periodicity of electric potential and its (positive or negative) charge. Over the next thirty years Klein derived various measures of the physical aspects of quantum particles, charges, wave functions, et cetera, all that satisfied the second principle of extra-dimensionality -- that it permit the outcomes without requiring visibility.

Since the 1980s, theories of supergravity, supersymmetry and string theory have all made use of Kaluza and Klein's calculations of extra-dimensionality. In a section titled "Philosophical arguments for an extra dimension," Beichler argues that the concept of a fifth dimension "should be considered independent of these or any single physical theory." [61] He makes the distinction between "real," i.e., corporeal geometric units, and "abstract," i.e., theoretical ones.

> **... a mathematical point has no dimensions. A line is one-dimensional, a surface is two-dimensional and a solid is three-dimensional. However, these geometrical figures are mathematical abstractions. A real point is not dimensionless just as a real physical line is not one-dimension. A real physical line must have a thickness so it is at least a two-dimensional object. ... Physical reality has at least one more dimension than the corresponding mathematical model of reality. Real physical objects are represented mathematically by three-dimensional geometries. Therefore, by extrapolation, a real physical object must have another dimension to be physical. Real physical bodies must be four-dimensional, they must have four spatial dimensions.[62]**

The divergence between the number of dimensions needed for a mathematical entity and that number-plus-one needed for its actual physical materialization becomes a problem at the moment of the collapse of the [quantum] wave function, when the entity ceases to exist in "mathematical" space and "collapses" into corporeal reality.

> **But the collapse of the wave function must occur at a real extended position in space, so the collapse of the wave function marks a deterioration from a mathematical continuity to a discrete physical reality. Dimensions have been created out of non-dimensions to replace non-extended mathematical points with extended three-dimensional physical points. ... The mathematical continuity of the probability distribution merely overlaps the physical continuity of the wave function, they are not the same thing. ... [The wave function] must have a real physical interpretation since it 'collapses' to a real physical point in space. ... This demand coincides with the need for another dimension of space. [63]**

After documenting other logical arguments for a fifth dimension, Beichler then asks: "But does this mean that hyper-dimensional theories are more expedient for the theorist or does it mean that there are real directions of space other than length, breadth and width that are perpendicular to all three at the same time?" [64]

It is at this point that Beichler reminds us that he means to look at the convergence of quantum theory and relativity theory, the singularity. "There is a strange parallel between the problems raised by singularities within gravitational field and the convergent infinites at the point location of particles in quantum mechanics." [65] Beichler then

compares the singularity within the nucleus of a single atom, and the singularity that is a black hole, the upshot of which concerns the curvature of space-time, as postulated by general relativity. If space-time's curvature is actual, Beichler uses the term "extrinsic," then into where do very densely packed, highly curved "events" such as singularities curve? We are back at the pencil line on paper having depth, even if only one graphite atom thick. The convention of where or what a black hole curves into has always been the fourth dimension, but that fourth dimension has always been presumed to be "time," since there were only three spatial dimensions. This is the origin of the time-bridging "worm hole" popular with science fiction writers. But these theories treat space and time as discrete metrics, as if one could move along a time vector while remaining fixed in space *a la* H. G. Wells' time machine. However, "space" and "time" don't exist separately in general relativity, having been subsumed into indivisible space-time. The fifth dimension must exist in some way as "ground" or "field" for the four we can perceive. This structure is postulated as a five-dimensional Riemannian sphere within which our perceivable four dimensions are manifest. This part of the definition deals with the "shape" of the space-time continuum of the fifth dimension.

> **The fifth dimension has no material reality, the key word being 'material' referring to the existence of matter, but is a perfectly continuous field of varying densities. The 'effective width' of the sheet consists of the densest portion of the field which effectively constitutes the four-dimensional continuum. The portion of the five-dimensional field outside of the sheet is quite rarefied and becomes considerably rarer the farther away from the sheet [one travels] ... ." [66]**

What, one may ask, happens to the various quantum fields and particles within this 5-space? Every four-dimensional point (particle) has an extension in 5-space; these extensions, called "A-lines" are orthogonal to the sheet at every point.

> **The A-lines can be seen as 'propensities' in Karl Popper's sense of the word or perhaps a better analogy could be found in Faraday's 'lines of force.' They are not physical lines, just as mathematical points have no physical reality. Light waves lay along the A-lines in their fifth component extension. ... The wave/particle duality of light waves thus reduces to which portion ... is interacting with the rest of the world. The portion of the light wave which is particulate, the photon, is just that part of the light wave (or A-line) which cuts across the 'effective width' of the sheet while the portion of light (along the A-line) which extends across the rest of the fifth dimension, outside of the sheet, is pure wave and exhibits wave interactions with the rest of the world. [67]**

It is linkages along the A-lines that supply a structural solution to the mechanism of quantum entanglement.

Possible Conclusions: How We Know?

The question of what the fifth dimension has to do with the missing dark matter must be understood in terms of the possibility of a solution framed in terms of geometry rather than forces. The traditional articulation of the question as to whether the universe is "open" or "closed," i.e., will fly apart or crunch back down, is framed within the metaphor of 'atoms and void.' If one posits "empty" space within which stars, planets and

et cetera are expanding apart, then one asks if the gravity between them will be enough to balance, or reverse, this trend? To have 'enough' gravity necessitates there being enough 'stuff,' leading to the search for dark matter that can produce gravitational deformation even if it fails to emit electromagnetic radiation.

However, if we think of the universe as being like one of those little geodesic tension toys made of wires and joints that can fold in into a tiny closed shape, or fold out into a large closed shape, then we can re-form the question to ask what is the shape of the unfolding universe, rather than making this shape the result of speed and attraction.

There are patterns and correspondences within and between things that we have difficulty discussing in languages other than mathematics. Language is a complex packet. A word comes embedded within assumptions, and studded, like a piece of a child's pop-together toy, with prongs and receptacles that allow it a better fit with some companion concepts than with others. Gregory Bateson complained that the language of physical science was being used to discuss human/social interactions, allowing corollary assumptions that were not accurate. To speak of "culture" "creating" gender roles, for instance, reifies "culture," which is not a thing but a collection of just those sorts of roles (i.e., gender, class, race, geography) that people claim it "creates." To speak of "culture" creating a role is as if one said the "web" created the role of spinning for spiders. Furthermore, to speak of "creating" quantized action with a moment of starting and a moment of stopping as a discrete quantity, as if it was a switch one flicked, is to mis-speak "being" for "becoming." The process of creation that cultures engage in with the members whose ongoing creation they are is more akin to an ecosystem than a piece of machinery. The practitioners of social science got into trouble by borrowing the language of "hard" science (e.g., force, cause, determine, precipitate, trigger) and then were saved by the introduction of a language "created" for an even newer science -- cybernetics -- for an even more up to date "machine," -- the computer. It is ironic that the very word "cybernetics" and its companion terms (e.g., dynamic, feedback, synergistic, chaotic) come from the vocabulary of the human action of steering a boat along the currents and eddies of a waterway. The swirling vortices of Lucretius afford a better metaphor than the atoms and voids of Democritus. [68]

Now, as we search for "meaning," "pattern" and "cause" in the swirling vortices of quantum field theory and vibrating string theory, we encounter scientists who borrow the language of philosophy, psychology and theology to talk about the physical universe. To claim to be an atheist and then talk about the Universe having "Cosmic Consciousness" or of "evolving," is to split semantic hairs. Any language that attributes "will," "intent," "purpose," "goal," "consciousness," "cause" or "intelligence" to quarks, photons, monopoles or black holes is a faulty borrowing. And yet, when faced with the mathematical "evidence" that led to the various strengths of the Anthropic Principle, or the mystery of quantum entanglement, the language of physics fails us, just at the moment when people who don't speak "calculus" begin to speak about the "field" and English words are needed. The spate of "Zen physics" books that began to appear in the 1970s were an attempt to look beyond the language of Western religion to find non-personified intentional vocabulary to discuss these elements. In the ways that the varying

thickness of tree's rings imply a "knowledge" of weather, or a "pattern" or growth, perhaps even a weak Arboric Principle, we oft confuse *the pattern that we see*, with *the pattern that we're shown*. "Who" "knows" to grow a thicker bark this winter? The tree, the bark, the winter? Beware reification. Einstein's realization that "gravity" was the warping of the "fabric of space-time," still is not understood in our culture. We still speak of the "force" of gravity or of gravitational "attraction." This is like speaking of the "force" of cold or the "attraction" of heat within a glass-lined thermos bottle.

Three old men sat on a porch discussing their plans for the turning of the century. Talk turned to the high and low points of the 20th century, and all agreed that in terms of technology it rivaled all other periods of history.

"What you think is the greatest invention of the 20th century?" Jake asked the others.

Samuel rocked a bit and then decided. "Space travel," he claimed decisively. "First the airplane take you anywhere you want to go, then the jet plane, and now the rocket ship. Pretty soon we be going out to them other planets as easy as we once rode into town."

The others considered this for a minute but then Zeke stopped chewin' on a straw and offered, "Television."

The others considered and nodded as Zeke explicated, "Television lets you see all over the world and all through history. It's like space travel and time travel rolled into one."

Zeke and Samuel turned toward Jake to hear what he'd come up with.

Jake reached into the battered old cooler and pulled out a bottle of pop. "Consider this cooler, or the 'frigerator inside, they keep your cold things cold."

The men nodded.

"And then you got your various warming pans, ovens and microwaves that keeps hot things hot."

Again they agreed.

"But the miracle of the thermos," concluded Jake, "is that it keeps hot things hot, *and* it keeps cool things cool."

"Yup," agreed Zeke, but you could tell by his tone that he didn't think this held a candle to television.

"Well," explained Jake, "what I want to know is: how it know?"

Let us consider two realms of knowledge, the topology of space and the emergence of attributes within systems of increased complexity. Lynn Margulis documents how even single cell entities, beings without sense organs, metabolizing organs, or reproductive organs, may exhibit "excitability" flagellating their way towards areas of greater incandescence, or patches of the primordial sea richer in nutrients. At each level of greater complexity of biology, attributes emerge, eating, breathing, reproducing, sensory responsiveness, memory, will, intention, self-consciousness. This is also true about shapes. Different shapes have different attributes. Consider the difference between a Frisbee and a ball. If you drop a Frisbee chances are it will fall flat on one of its faces. A smaller probability exists that it will fall on its edge, but if so, it will most likely be at an angle that quickly overbalances and falls flat. If it should fall on its edge and balance there then it might stand still, it might spin around itself (like a top), or it might roll along its edge in one of only two directions. The ball, on the other hand will undoubtedly roll a bit in any one of 360 degrees of direction. The topology of the sphere affords it a greater probability of rolling motions than the topology of the frisbee. This is an ontological

distinction, a sphere -- by definition -- is that which can roll in any direction, a frisbee -- by definition -- is a disk with two faces and an edge. If you drop them both a hundred times, the sphere will almost always roll, and the Frisbee will usually drop.

This is not to be confused with an epistemological question, "how the sphere know?" The sphere no more *knows* to drop and roll than culture *creates* roles, or webs *spin* spiders. The sphere *is* that which can roll in any direction. In such a manner, I suggest that the "consciousness" of the universe *is* its topology. Some scientists look for "dark matter" as more of the *same sort of stuff* that the universe is known to be made of, dark(er) stars or heavier particles. These things may exist, but "nickel-and-diming" up micron-volts of energy to equal 90% of the universe is hardly an elegant or beautiful solution. One is tempted to disdain it on the grounds that "God doesn't like odds and ends." Other scientists seek a solution in stuff which is *different from* what the current universe is known to be made of, "bubbles" of "inflation" that exhibit "shadow" matter or "anti" forces. Still others notice the similarity between the quantum nature of biotic systems and the quantum nature of matter and look for consciousness as dark matter. However, while "dark matter" may well prove to be in an analogous relationship to "the universe" that "consciousness" is to "living systems," that does not mean mind is the same thing as dark matter. We begin to suspect that we are looking for the wrong sort of answer. Perhaps dark "matter" is neither "matter," "force" nor "field" at all, but rather the shape of the universe. Imagine a third kind of bubble, one shaped like a Klein bottle, which is a three-dimensional Möbius strip. The Klein bottle only has one surface, its inside *is* its outside. Suppose "dark matter" is merely the *other side* of bright matter, then ask the sorts of questions and conduct the sorts of inquiries that such a supposition leads you toward.

End Notes

1. The title of this paper is borrowed from the film by Jean-Luc Godard, *Two or Three Things I Know About Her*, 1996.

2. Verse from *The Dark Matter Rap*, Timothy Ferris in *The Whole Shebang.* New York: Simon & Schuster, 1997.

3. According to the "big bang" theory, the universe is composed of particles formed from *prima materia* known as "baryons." As this elemental matter cooled, it differentiated and combined into all forms of matter known today. Current candidates for dark matter include:

- **"Brown dwarves" -- stars that aren't massive enough to be luminous.**
- **Neutrinos -- a plentiful particle currently thought to be massless, but which, with a mass of even one five-thousandth of an electron would account for all the missing baryonic matter.**
- **WIMPs -- Weakly Interacting Massive Particles which have not yet been discovered.**
- **Gravity -- there are no "missing" particles, the configuration of the universe is due to variations in the gravitational relations of the particles we already know.**

4. On its way to earth, the light from distant galaxies passes through large clusters of galaxies and surrounding dark matter. The dark matter's gravity acts like a lens, bending the incoming light. Observers on earth therefore see multiple distorted images of the distant galaxy. *The Universe as*

***Telescope*, *The New York Times*, "Science Section."**

Studies of lensing clusters are particularly useful in dark matter research, because the lens indexes all the mass inside the lens, which typically is found farther from the center of the cluster than are the outermost galaxies used in dynamical analysis and the hot gas clouds studied in x-ray observations. So gravitational lenses also suggest that at least some galaxy clusters are more than 90 percent dark matter. Ferris, *op. cit.*, p.131

5. Bright matter amounts to an omega of only 1 percent of the critical value. Adding in all the dark matter inferred on scales up to that of galaxy clusters still gives us an omega of no more than 10 percent. Ferris, *op. cit.*, p.132.

6. "And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the depths." *The Holy Bible*, *Genesis* 1:1-3.

7. Writing of "phenomenologically constructed, socio-historically situated knowledge" reminded me of the role of the "True Witness," in Robert Heinlein's novel *Stranger in a Strange Land*. A "True Witness" would report exactly, and only, what s/he perceived. No assumptions, generalizations nor extensions. "Anne was wearing her True Witness robe and Jubel asked her, "What color is that house up on the hill?" Anne responded, "From where I stand the side I see appears to be green." (paraphrase)

8. Paul Feyerabend, *Against Method*. New York: Verso, 1975, pp.229-30

9. "Nature abhors a vacuum." Spinoza, *Ethics*, 1677. The notion of a true state of nothingness (i.e., a "vacuum") was abhorrent, not only to nature, but to most scientists and religionists alike. Since God exists everywhere, even in the far reaches of "empty" space, the relevant question was not whether or not something existed between matter, but what the nature of this imperceptible medium was. When Robert Boyle and others were able to demonstrate the creation of a vacuum - void of breathable air - this simply shifted the debate to a more exotic etheric medium. For a discussion of the philosophical implications of early research in vacuums, see Steven Shapin and Simon Schaffer, *Leviathan and the Air-pump: Hobbes, Boyle, and the Experimental Life*. Princeton, New Jersey: Princeton University Press, 1985.

10. Priestley published a six-volume account of his work, Experiments and Observations of Different Kinds of Air, between 1774 and 1786.

11. David Bloor, *Knowledge and Social Imagery,* (2nd ed.). Chicago: University of Chicago Press, 1976, pp. 37-9.

12. D. Marcus Chown, "Dark Secrets." *New Scientist*, Mar 1998. http://matu1.math.auckland.ac.nz/~king/Preprints/book/quantcos/grav.htm.

13. Bloor, *op. cit.*, pp.143-4.

14. John D. Barrow, *Theories of Everything*. New York: Clarendon Press, p.134.

15. "The riddle of why empty space has an antigravity effect may not be such a big mystery. ... [Robert Matthews], a British physicist has shown that the cosmic repulsion of space could be linked to the time soon after the big bang when quarks ceased being free and bunched together to make protons and neutrons. ... The theory of inflation says that in the first split second after the big bang, a so-called phase transition occurred, in which the strong and electroweak forces went their separate ways. Scientists now believe this transition would have dumped a huge amount of energy into the vacuum of empty space, making the Universe expand at an enormous rate. ... Matthews points out

that there were other phase transitions in the Universe, the last one being the quark-hadron phase transition, when free quarks grouped into protons and neutrons. Matthews calculated how large the cosmic repulsion effect should be if it happened because the Universe had retained some of the vacuum energy from this transition. Sure enough, the effect was exactly the right size to explain the increasing rate of expansion that the supernovae studies found." Marcus Chown, "Curious correlation." *New Scientist* 12, December 1998.

16. Barrow, *op.cit.*, p.85.

17. Phillip Pullman, *The Golden Compass*. New York: Knopf, 1995, p.20.

18. *Ibid*., pp.30-1.

19. *Ibid.,* pp.88-9.

20. *Ibid*., pp.95-6.

21. The concept of an Ineffable, Incorporeal Godhead who delegates the construction of the Earth and the creation of humankind to an Active Principal is common in Indian (Hindu) and Persian (Zoroastrianism) religions. In Judaism and Christianity, the notion of a God who could splinter himself was considered heresy which is not to say it wasn't considered by mystical sects.

22. *Ibid*., pp.

23. *Ibid*., p. 167.

24. *Ibid*., p. 372.

25. Lynn Margulis, "Early Life: The Microbes Have Priority." William Irwin Thompson, ed., *Gaia, A Way of Knowing*. Great Barrington, Massachusetts: Lindisfarne Press, 1987.

26. Phillip Pullman, *The Subtle Knife*. New York: Knopf, 1997, p. 88.

27. *Ibid*., p.238.

28. *Ibid*., p.248.

29. See C. G. Jung, *Memories, Dreams, and Reflections*, for notions of synchronicity and syncretism.

30. Or "implicate." See David Bohm, *Wholeness and the Implicate Order*. New York: Routledge, 1996.

31. And perhaps all sentient or even living beings. See "Daisyworld," M. Bjornerud, J. Hughs, A. Baldwin, *Guide to the Blue Planet*. 1995. Included in Dr. James Lovelock & Dr. Lynn Margulis, "The *Gaia* Hypothesis." http://magna.com.au/~prfbrown/gaia_jim.html.

32. See Brandon Carter, "Large Number Coincidences and the Anthropic Principle in Cosmology," in John Leslie, ed. *Modern Cosmology & Philosophy*, Amherst, New York: Prometheus Books, 1998.

33. see Roger Penrose, *Shadows of the Mind: A Search for the Missing Science of Consciousness*. Oxford: Oxford University Press, 1994; And, Antonio Damasio, *Descartes' Error*. New York: Putnam, 1994.

34. See Rupert Sheldrake, *A New Science of Life: The Hypothesis of Morphic Resonance.* Inner Traditions International, 1995. Also see "Comparison of TGD based theory of self-organization with the ideas of Rupert Sheldrake," http://blues.helsinki,fi/~matpitka/sheld.html.

35. "Originated," not was "created." See Adolf Grunbaum, "The Pseudo-Problem of Creation in Physical Cosmology," in Leslie, *op.cit.*

36. See Edward P. Tryon, "Is the Universe a Vacuum Fluctuation?" in Leslie, *op. cit.*

37. See Andrei Linde, "The Universe: Inflation Out of Chaos," in Leslie, *op. cit.*

38. John Horgan, "Quantum Consciousness." *Scientific American*, November 1989. http://www.mat.auckland.ac.nz/~kin...nts/book/quantcos/penrose/penr.html.

39. Chris King, "Fractal Neurodyamics and Quantum Chaos." http://www.mat.auckland.ac.nz/~kin...prints/book /paps/consc/brcons2.htm.

40. *Ibid*.

41. Matti Pitkänen, "Two-dimensional illustrations related to Topological Geometrodynamics (TGD) inspired theory of conscious brain." http://blues.helsinki.fi/~matpitka/illub.html.

42. *Ibid.*

43. Greg L. Bryan and Michael L. Norman, "Computing the Universe: X-Ray Clusters in a Cold + Hot Dark Matter Universe." http://zeus.ncsa.uiuc.edu:8080/chdm_script.html.

44. *Ibid.*

45. King, *op. cit.*, "Roger Penrose and Quantum Consciousness."

46. GC^3, *op.cit*. An electron volt (eV) is the amount of energy required to move one electron through one volt of potential difference, i.e., a very small amount. Small amounts of mass are sometimes given in measurements of energy.

47. King, *op. cit.*, "Dark Forces... ."

48. King, *op. cit.*, Fractal Neurodynamics and Quantum Chaos. 2, p. 4.

49. Ferris, *op. cit.*, p.156.

50. Gilbert, "Running Backwards into the Future... ." http://home.fireplug.net/~rshand/streams/science/runframe.html.

51. Feyerabend, *op. cit.*, p. 274.

52. An example of how this earlier world-view is still used as part of the discussion concerning cosmology is evidenced in Paul Edwards' "Critique of the Cosmological Argument," in *Traditional Arguments for the Existence of God*. Edwards writes, "The demand to find the cause of the series [of phenomenal causes of objects] as a whole rests on the erroneous assumption that the series is something over and above the members of which it is composed. ... But reflection shows this to be an error. If we have explained the individual members there is nothing additional left to be explained." I would posit just the opposite, that it is only by looking at the *emergent* phenomenal causes of the *class* of objects that we will get anywhere.

53. Feyerabend, *op. cit.*, p. 264.

54. *Ibid*., p. 275.

55. *Ibid*., p. 276.

56. Quantum field theories consider "particles" to be temporary "manifestations" of "fields" that are always present. For example, an "electron" is a calling-forth into beingness of quantum electrodynamic "field.."

57. Beichler, James E. *Yggdrasil: The Journal of Paraphysics*, 1998, p. 4

58. *Ibid*., p. 4.

59. *Ibid*., p. 5.

60. *Ibid*., p. 5.

61. *Ibid*., p. 15.

62. *Ibid*., p. 15.

63. *Ibid*., p. 16.

64. *Ibid*., p. 18.

65. *Ibid*., p. 18.

66. *Ibid*., p. 23.

67. *Ibid*., p. 24.

68. "By convention--color; by convention--sweetness; by convention--bitterness; in reality--atoms and void." Fragment 125.

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