
~ Cathedral of Illusion ~
(On the Paradox of Mind and Experience)
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A Tale of Two Hunters

There was a primitive *jungle* hunter exploring the forest one day, who came upon a magical, miraculous apparition. But he had no words to describe its function, and only a precious few to describe its appearance:

"What did it look like?" his friends back in the village asked him.

"It was the size of a rhinoceros, and the color of the tail-feathers of the long-calling bird. It wore ornaments that shimmered like the water of the flowing river, and its stubby, dark legs had skin like an elephant."

"What did it feel like?" they asked him.

"Like the large, smooth stones at the side of the river."

"What did it smell like?"

"It had the breath of a bog ripe with hippo dung," he replied.

"What did it sound like?"

"It roared like the great waterfall. And on the beast's back was a little hut with hard walls made out of air like rock. In the hut was a place for sitting that was soft like the belly of a fresh-killed tapir. And all around me - though I saw no one - were the voices of spirits singing..."

"What *is* this great thing, and what does it *do*?" they queried with quivering excitement.

"I do not know, but it came from the gods," was all he could say.

There was a primitive *mountain* hunter exploring the jagged hills one day, who came upon a magical, miraculous apparition. But he had no words to describe its function, and only a precious few to describe its appearance:

"What did it look like?" his friends back in the village asked him.

"It was the size of a large boulder, and the color of the little blossoms on the rock-lichen. It wore ornaments that gleamed like the sun on rain-washed ice, and rested upon great skipping-stones made of the foot pads of a bear."

"What did it feel like?" they asked him.

"Smooth, like the small stones at the bottom of a stream."

"What did it smell like?"

"It had the breath of a forest ablaze in the valley of the burning water," he replied.

"What did it sound like?"

"It spoke with the voice of an avalanche. And on the beast's back was a little cave with hard walls made out of ice that was not cold. In the cave was a place for sitting that was soft like the belly of a fresh-killed deer. And all around me - though I saw no one - were the voices of spirits singing..."

"What *is* this great thing, and what does it *do*?" they queried with quivering excitement.

"I do not know, but it came from the gods," was all he could say.

We probably should not expect these two men - each the product of very different experience - to conjure even remotely similar descriptions of this same (imaginary but, in principle, possible) encounter. Their descriptions, while perfectly accurate within a limited context, are misguided and simply not sufficient to the task. Both men have experienced the same *real* object, but the frames of reference from which these men make their observations are so far apart that they are incapable of describing their perceptions in the same way. Because the reality of this apparition is external to their experience, these two hunters are obligated to bring their *own* experience *into* any description they endeavor to make. And so, they can communicate nothing of the essence of that object in any meaningful way; in the end, such attempts to describe a great unknown merely tell us a great deal about the observer, and nothing significant at all about the observed. These hunters are not stupid. Their observations are as accurate as their experience and tools of observation allow them to be. They simply don't know - can't know - what they're looking at. A pink, chrome-trimmed

Cadillac revving its engine while the radio plays a Palestrina Mass is simply to remote from the savage's spear. There is reason to wonder if anything has fundamentally changed since stone-age times. We see farther now, but how much further removed from mankind's tiny reckonings is the Great Unknown?

The opening parable illustrates two important points: one, that it is not surprising that our many descriptions of the mysterious dimensions of existence all sound different (and also eerily similar at the same time); and two, that many of those descriptions might actually be of something rather more mundane than we hope. Several thousand years of technological development is all that separates those hunters from the answers they sought about the heavenly Cadillac. Our history has demonstrated - in the unfortunate stories of Pizarro and Cortez - that sometimes it is only mere technology that separates men from the gods. Armed and powerful with the knowledge we once thought belonged exclusively to a transcendent power, it is now *we* who are the gods, remaking the cosmos in *our* image. We are no longer obliged to justify our ignorance of the world with wizard's tales; we've seen into the magician's bag and now know how many of the tricks were done. These two hunters, who were quick to ascribe some kind of supernatural authorship to the unexplainable phenomena, demonstrate a natural human inclination: we've be plugging the gaps in our understanding of the universe with divine mortar for a long time. In stone-age times, when we understood so little about the nature of things, the world seemed more gap than structure; now, in modern times, the mighty Enterprise of Scientific has left precious few holes in our knowledge for a god-of-the-gaps to fill. God is just about out of a job. Or so some like to think. But some of those pernicious remaining holes are really *rather large*...

What is everything made of?

Reductionism is a problem-solving method used very effectively by science to simplify complex problems. A problem is broken up into constituent categories of study, allowing researchers to solve comparatively little problems; some researchers will then assemble several smaller solutions into one larger solution, and others will break a small solution into even smaller problems. This method has been spectacularly successful. A good example of reductionism at work can be found in the study of medicine. When it first began to emerge as a legitimate, recognizably modern science in the mid 19th century, there was simply one kind of doctor who attempted to treat maladies of every kind. Soon thereafter developed the separate and distinct specialties of surgical and internal medicine. Over time, these disciplines fragmented into dozens and dozens of new specialties and sub-specialties, each one seeking greater depth of knowledge regarding a narrower range of inquiry. Neurology, cardiology, radiology, hematology, endocrinology, oncology, anesthesiology, etc., are just a tiny handful of the many disciplines found in medicine; there will soon be as many specialties in genetic science. We might even include in this list, other body-related concerns like nutrition, fitness, cosmetics, personal hygiene, etc. No one person could ever hope to understand even 1% of what we now know about our bodies, but a vast army of people working in concert has provided a truly impressive result: in the last 150 years, average human longevity has almost doubled. This is the miracle of the reductive method, and it works every bit as well in the other sciences. But there is a devil hiding in the details.

Many of the structures within the structures of the world are far more complicated than we originally thought (like that of a living cell) and many years of research will go into revealing merely some of the secrets therein. Researchers from one discipline may not concern themselves with the smaller

constituent parts of their study, but there will always be another discipline trying to understand the larger parts by examining ever smaller parts. Eventually, however, scientific inquiry is confronted with a fundamental unit that cannot be disassembled for further examination, and so there the scientific endeavor stops. There is a truly staggering amount we do not know about all the micro-structures of the world which are made of these fundamental units, an enormous of amount of useful science to be pursued where objectives might be realized. And so, with so many interesting sights along the way, there are comparatively few research-adventurers interested in taking the trip to the last stop, to find there the unsettling fact that dwells at the terminal end of the scientific path: down inside the heart of matter - in the domain of the quark and the electron - is the impenetrable boundary at the edge of the universe.

Quarks and electrons are considered to be *fundamental particles* (there are currently twelve different kinds of such quanta in the standard model); that is, they have no structure as we commonly understand the concept, and so they simply cannot be subjected to any kind of intrusive examination. They do not have interiors, they are not made of anything; they simply *are*. Current reckoning believes that quarks were bundled into indivisible clumps of 2 or 3, a tiny fraction of a second after the birth of the universe, and these infinitesimal bundles now form a broad variety of other subatomic particles in the universe - the most common of which are protons and neutrons. Positively charged protons and uncharged neutrons dwell in the nucleus of the atom, surrounded by orbiting swarms of another fundamental particle, the negatively charged electron. Scientific thinking about the quark is, perhaps, not all that advanced; we are not permitted to isolate one and easily evaluate its properties. But we know a great deal about the mighty electron: it is the humble spec upon which our entire civilization is based, the indefatigable Atlas that holds up the cosmos.

Surging rivers of them power our electric machines. The electron's associated force-particle, the photon, fills the heavens with light. The beautiful magic by which the 92 elements transform themselves into a near-infinite variety of different molecules is facilitated by the effervescent coupling of spherical electron clouds sharing common electrons to bind atoms into the material structures of the universe - and doing so with a potential for chemical diversity that is, seemingly, without limit. The strength of these electron bonds provides the structural integrity of matter, explaining why material objects, which are far, *far* more than 99.999% empty space, don't simply pass through one another when they come into contact. (If a hydrogen atom were enlarged such that its fuzzy electron-cloud shell was 100 feet in diameter - about the size of the Capitol Dome in Washington - then the proton in the center, the one and only lonely inhabitant of the complete and utter void therein, would be about the size of the period at the end of this sentence.) In fact, our entire experience of the universe - from the exterior data we collect with our five senses to our interior cognition of that information - is mediated by this infinitesimal Hercules. The electron is even more impressive than it seems because *it is not really there*...

The electron is very small: it is a dimensionless point, without volume or extension in any direction - it has no size whatsoever. It has been described as "nothing more than a region of spacetime where the field strength takes on extraordinarily high values." Nobel laureate Leon Lederman observed that this otherworldly absence of any spatial magnitude confronts us with four inescapable questions: "*What* has mass, *what* has charge, *what* spins, and can I get my money back?"

Modern theoreticians are currently playing with a concept called superstrings, suggesting that perhaps the fundamental particles are made of infinitesimal loops of multi-dimensional vibration. The hope is that the monstrously complex mathematics inherent to string theory will one day

explain away the serious problems that persist in the standard model of the sub-atomic domain. And superstrings, as the theory describes them, seem to be made of nothing at all other than pure mathematics. So this is where the materialist endeavor ends, with a universe made of *immaterial* mathematics. This sounds rather like the hunter bringing his own experience to the description, and not really describing the thing at all. One has to respect the physicists and mathematicians and their considerable prowess with numbers; their magic is powerful indeed. But if the theologian says the world is made of ethereal divinity, and the philosopher says the world is made of ethereal idea, and the artist says the world is made of ethereal poetry, then is it really that much different to say that the world is made of ethereal mathematics?

The foundation of the world is emptiness; the cosmos is *all* gaps.

Occam's Razor

Science often uses a simple maxim in its search for truth, a guiding logic, validated by centuries of observation, that nature prefers economy to ostentation, the easier rather than the more difficult way to achieve an end. This maxim is known as *Occam's Razor*: "Entities are not to be multiplied beyond necessity." That is, the *simplest* explanation of the available facts is *probably* true; complex and unwieldy explanations consisting of many factors are not as satisfactory because each additional factor also requires an explanation for its presence in the explanation.

An edifying, but somewhat non-scientific example might be the puzzle of the JFK assassination. There is here a mystery that requires an explanation, and there are two competing descriptions to explain it: 1) a lone gunman got a gun and took a few shots from a window, or 2) a vast conspiracy of CIA and DOD renegades, Dallas policemen, Cuban counter-revolutionaries, paramilitary homosexuals (!), shadowy underworld types, and mafia hit-men coordinated an intricate multi-pronged attack to eliminate JFK, lay the blame elsewhere, cover their tracks, otherwise achieve their mysterious goals which had been previously thwarted by Kennedy, and then protect the whole sprawling criminal endeavor with a vow of silence unequalled in the history of the world. William of Occam (who, curiously enough, never mentions his eponymous dictum in *any* of his extant works) would say that, with so many additional elements that also beg for explanation in the second version, the first, far more simple explanation is probably true (although cynical, conspiracy-minded types would, no doubt, remind him that the first explanation does not seem to explain all - or even most - of the available facts). It is important to remember that Occam's Razor is not a Law of Nature; it is, merely, a useful guide that recognizes a general tendency for nature to almost always achieve its astounding objectives by the most direct method possible, a statistically-informed, *conservation of energy*-minded rule-of-thumb, that does not solve the Kennedy assassination or any other enigma. It is certainly not logically impossible that a ludicrous hodgepodge of unstable malcontents devised, executed, and then erased their monumentally complicated campaign with absolute efficiency and eternal silence; Occam says only that it is *far more likely* that just one defective lunatic was responsible for the JFK assassination. Good science believes in numbers.

Which brings me to the *Anthropic Principle*, an expression that states the obvious fact that the universe is the way it is because if it were some other way we wouldn't be here to observe it. Science does not really like this principle, given its implication of teleological nature, or nature designed with humans in mind. And yet, it remains true that any explanation of the cosmos must explain why the physical constants of nature are what they are; it just so happens that these constants are fantastically *fine-tuned* to permit the kind of cosmos we actually see - one with galaxies and stars, worlds and *life*.

Values such as the relative strengths of the

four fundamental forces (electro-magnetism, the strong and weak nuclear forces, and gravity), or the energy of the excited state of the carbon 12 nucleus (a tricky stage in elemental evolution that allows for the creation of all heavier elements), must be very accurate and nothing other than what they are if we hope to see elements, molecules, and a living cosmos. One of the most important of these fine-tunings is the vacuum-energy of the universe, known as the *cosmological constant* (which can be thought of, crudely, as a measure of the viscosity of the cosmos). When the universe exploded into creation roughly 14 billion years ago, that big bang explosion had to finesse a mind-bogglingly accurate rate of growth: if the expansion had occurred to quickly, if the cosmos was *insufficiently* viscous, then clouds of hydrogen could never have accreted under their own mass into stars and galactic clusters of stars thus permitting the creation of the elements necessary for life; and on the other hand, if the expansion had occurred to slowly, if the cosmos was *too* viscous, then the whole universe would have collapsed into itself long before the first stars could evolve through even a single stellar cycle of elemental creation. Unless the vacuum-energy of the cosmos has a certain, very specific value, the universe experiences runaway exponential inflation or sudden collapse. According to Nobel laureate Steven Weinberg, the precision required for the exact negation of all contributions to the vacuum-energy must be accurate to *120 decimal places*! That is, the cosmological constant must be set with an accuracy that cannot deviate by more than one part in 10^{120} (10,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000,000,000,000,000, 000,000,000,000,000,000,000,000) or the universe as we see it is impossible. That kind of fanatically exact fine-tuning in the "nuts and bolts of natural processes" troubles people - a lot.

And so a solution to this conundrum has been proposed: *Inflationary Cosmology*. It does indeed shed light on some otherwise intractable problems with the standard model of cosmic evolution (including the cause of variations in the matter density of the early universe that allowed the subsequent formation of large scale structures like galaxies and stars), by proposing a variable vacuum-energy value that must have been very much higher in the first trillion-trillion-trillionth of a second after the big bang. Furthermore, it seems that this inflationary process is eternal, an unstoppable chain reaction of big bangs (driven by something called an unstable *false vacuum*) that is always happening…just somewhere else totally removed from and exterior to our universe. According to MIT professor Alan Guth, the principle architect of this increasingly accepted theory, "it seems far more plausible that our universe was the result of mass reproduction rather than one created from a unique cosmic event."

Inflationary cosmology neatly steps around the thorny issue of the anthropic principle by stating *there are an infinite number of universes*, each one consisting of unique physical constants very different from ours. The overwhelming majority of these universes would be incompatible with life. Our universe is *not* special or fine-tuned; it is merely one insignificant bubble in an endless effervescing ocean of infinitely many universes with every possible kind of tuning.

Science certainly cannot invoke an "ethereal poltergeist" to explain the precision of the cosmological constant, and yet this *multiverse* model of cosmic creation is also an "inquiry-ending notion" of the kind proper science rejects. These other universes, floating in a Swiss cheese-like domain of transcendeffervescence, are also, like the mystic spirit they sought to supplant, not subject to scrutiny or verification. Each universe is contained by the parameters of its own physical constants, sealed off from all others by a Barrier of Law through which nothing subject to such law - *anything physical* - can penetrate. As far as the physics of this universe is concerned, no other universes exist, and no events beyond the Barrier can ever have any effect or influ-

ence on events here. So this theory is conveniently non-testable, and thus sounds rather like the theist, invoking some *other* causal agent, in an effort to explain everything: "I can't prove any of it, but you can take it on faith that what I say is true." Inflationary Cosmology is indeed good science, a dramatic example of the daring thinking needed to explain the cosmos by entirely natural processes, but *it is poor ontology*. The inflationary model explains our *one* universe by positing an infinite number of other different universes into which our extraordinary uniqueness can meaninglessly disappear. The universe, it says, was created by a perpetual fountain of infinite universes; now *that* is a truly extravagant denial of economy. Another, more modestly "multiplied beyond necessity" explanation survives Occam's Razor less cut: the universe was created…by a *Creator*. "How then do you explain this creator?" the scientist is obliged to ask. Such explanations are unnecessary: if science cannot explain this transcendeffervescence out of which infinite universes emerge, then one is logically compelled to consider the self-recreating Multiversal Froth-Maker and the Creator as indistinguishable: both are beyond the cosmos, beyond knowledge, and *Sui Generis* - they are *one and the same*.

What is Time?

While it is indeed true that we have learned a great deal about the properties of matter and energy, and can predict and even manipulate a few of their innumerable tricks, it is important to remember that of the fundamental nature of this cosmic *stuff* we know nothing. We also know a little about space, the arena in which matter and energy perform their magic. In *Order and Chaos*, we discussed some of bizarre things science has learned about space in the last 100 years, and I'll return to this subject again later. There is another curious aspect of this cosmological opera-house, intimately bound up with space, that also exposes some serious limitations in our understanding of reality: *time*.

In Newton's day, we thought there was one universal clock ticking away the seconds equally in every part of the universe. Einstein showed us that, in fact, each of us actually carries around our own clock, and those clocks tick away at different rates according to such things as relative velocity and proximity to gravity. As strange as it sounds, thousands of experiments have proven that a stationary clock on earth ticks faster than a clock speeding away into space. If we could build a spaceship that could travel 99.99% light-speed, we could circumnavigate the observable universe in about 30 years - according to the *ship's* clock. When we returned to earth, however, *billions of years would have elapsed* - and the world we knew would have long since perished within the bloated red-giant our sun is to become in that distant future.

We don't notice these relativistic differences in the rate at which time elapses because this exponentially-growing effect is only noticeable at speeds beyond 90% light-speed - and only really dramatic at speeds beyond 99% light-speed. Time differences that we experience at everyday velocities are measured in *billionths* of a second - and who cares about distinctions that small?

But there is another way in which these relativistic time differences are experienced. If you are stationary on one side of a room, and I walk toward you, I am slightly compressing the amount of time it takes for information to travel from me to you; if I walk away from you I am slightly extending the information's travel time. We don't think about "information's travel time" because it is so infinitesimally brief in ordinary experience, although NASA engineers deal with this phenomenon every day because many things they communicate with are *very* far away. And the farther away something is, the greater the effect of relative motion. At the scale of the observable universe, relativistic time differences become enormous - even at very slow speeds.

If I have a good calculator, I can, using Einstein's equations, calculate the state of *My Universe Now*: I am experiencing now, *now*; information from the other side of the room traveling at light-speed takes a billionth of second to reach me, so *My Universe Now* includes the far side of the room as it will appear in a billionth of a second, the moon as it will appear in about 2 seconds, the sun as it will appear in 8 minutes, the nearest star as it appears 4 years hence, and so on. Relativistic effects at such distances are not impressive; at great distances of billions of light years, however, they are stunning. Imagine yourself out on a long highway stretching away to the horizon, and then imagine a real (but unknowable) point 10 billion light-years further beyond it. For the purposes of this explanation we are also going to imagine a stationary clock on that point (they might have clocks there), but it's not really necessary. Walk toward that distant point while performing your calculations of *My Universe Now*: you will find that the 10 billion light years-distant clock has leapt back in time more than 100 years! Walk away from that distant point; your calculations now indicate the distant clock has leapt 100 years forward! And the equations work both ways. Let's say you and your clock are stationary, and Zolg, another relativistic thinker10 billion light years away, is also calculating *My Universe Now*. If neither of you are moving, relative to each other, then calculations will agree that you both exist at the same time. But if Zolg merely walks toward you he then exists before your great-grandfather was born, or exists a century after your death by walking in the opposite direction. And the effect is even more astounding at spaceship speeds. According to a reckoning of *Now* one might calculate from the space-probe *Voyager*, Zolg won't be born for *thousands of years*.

If space is infinite, then this taffy-like temporal landscape - where any two separate and distinct moments in time can be stretched and pulled together by nothing more than mere movement - extends to include every point in time from the beginning of the universe to its end. And *everything is always moving*, on worlds spinning around stars spinning around galaxies hurtling through space, so relative motion is constantly pulling everything into the distant future or pushing it into the remote past. We are all not-yet-existing *and* long-ago-deceased, according to distant parts of the universe whose reckoning of time is every bit as valid as ours. *All time exists always*: every event in the history of the cosmos (every bad thing we've ever done, or even thought) is frozen forever in a universal timescape that never changes, like an eternal library of all moments, available to any observer beyond space-time wishing to review the facts.

The same science that sends data-gathering probes to the planets, powers our metropolises, annihilates our enemies from afar, and allows us to comprehend the celestial processes that built the cosmos also shows us that time as we experience it - *Now* is a rapid succession of continuously flowing moments that arrive and are instantly gone forever - is *impossible*. Something very strange is going here. If the entire history of the universe is an eternally existing thing, if the outcome of every event is already determined and merely waiting for inevitable discovery, if everything we will ever do is fixed and unchangeable in a 4-dimensional sculpture that limited consciousness encounters only slice by slice by slice, then what are the implications for the most intractable problem in philosophy – the sovereignty of mind and experience?

The Free Will Enigma

Can you make a *decision*? If the answer seems altogether too obvious, then perhaps the absurd simplicity of this question has not conveyed the subversion I intended. What I really mean is: can you think for yourself, or only as the chemistry of which you are made allows? Certainly most people *believe* that they can make a decision, but this article of faith does not survive logical scrutiny entirely intact; the proposition that

man has free will - that he can compel the chemistry in his brain to act in an *intentional* way - involves some conceptual paradoxes that cannot be explained away. Part of the difficulty lies in our incomplete understanding of just what, exactly, consciousness is; somehow, the activities of diverse and distinct regions in the brain, each responsible for significantly different kinds of tasks, are bound together into a single entity, one that thinks, feels, and has experience of the world. The current scientific view is that consciousness is an *emergent* property, mysteriously rising out of the transmission of vast amounts of data along neural pathways: *the mind is what the brain does*. And so our ability to choose one action rather than another must be, according to this view, the product of brain activity: the movement of atoms, molecules, brain cells, and very, *very* long trains of electrical impulses. A decision occurs…when the chemistry is right.

The existence of free will, our ability to choose one from among many possible options, is completely validated by experience; it is, however, utterly *invalidated* by the facts.

Part I – Who or What is Responsible?

We call something an act of free will if, by some inscrutable magic, we *decided* to do it. If we could not have done otherwise, if we have been compelled by some caprice of nature and not by our own sovereign volition, we do not call it free will; we call it cause and effect. Our human-made laws recognize this spectrum of culpability; they are a statement of our belief that there are degrees of responsibility. As an example, let us look at several different imaginary scenarios involving the death of a man who has been hit by my car:

1) If I am driving down the road and a man throws himself in front of my car, I am not held responsible for that action: it was beyond my control and I could not have done otherwise. In fact, in this case the man would be held responsible for his own demise.

2) If I am driving down the road and a psychopath leaps into my passenger seat while I am waiting at a red light and then subsequently orders me - at gunpoint - to crash into a man walking down the sidewalk, I am not held responsible for that action: it is the crazy man with the gun who is deemed to be responsible for the accident.

3) If I am driving down the road and a sudden blow-out causes a complete loss of control of my car which then veers into the man, we say that no one is responsible: as long as I have not been driving on dangerously worn and unsafe tires, we are inclined to say that the catastrophic failure of the tire at that unfortunate moment was beyond my control, and the cause-and-effect (or is it chaotic whim?) of natural law - in this case, inertia compelling the runaway vehicle - is responsible for the accident.

4) If I am driving down the road and have a sudden heart attack, lose consciousness, and my now un-piloted vehicle veers into the unfortunate man, we also say I am not responsible. It is unquestionably a defect in my nature, albeit a physiological rather than mental one, that has caused this accident, but the defect was beyond my power to control. And so again, it is nature that bears the responsibility for the pedestrian's death.

5) If I am driving down the road blind drunk and *unintentionally* swerve onto the sidewalk to strike the man, I *am* held responsible for this action, but my responsibility is somehow *diminished*: choosing to drive under the debilitating influence of alcohol was something within my control, even if drunkenly losing control of my vehicle was not. That I did not *intend* to strike the man is a mitigating factor. I may be charged with manslaughter in this case, but I will serve less time in prison than for other more serious offenses. Nature - in this case manifest as the consciousness-altering mixture of alcohol and human blood - seems to bear about 50% of the responsibility for this accident.

6) If I am driving down the road and sud-

denly and *intentionally* careen into the man, I will be held only *almost* fully responsible for that action. Why only "almost?" Because we accept the possibility that I may have been struck with a sudden and otherwise inexplicable mania; in the absence of any history to otherwise explain an isolated crime, we may choose to believe that the evil act in question was not necessarily caused by an irredeemably evil person. In this case, Nature - manifest as, *perhaps*, the mis-firing of motor neurons in the brain - still bears about 10% of the responsibility for the death.

7) It is only if I am driving down the road and I swerve - with malice of *forethought* - onto the sidewalk to strike that *particular* man, that I am held fully responsible for this action. My premeditation of this crime, my rejection of reason after careful and deliberate contemplation, places the entire burden of responsibility upon my shoulders; nature is off the hook for this one, and in this case I will suffer the harshest penalty provided for in the law.

In each case the man is just as dead, in each case killed by impact with my car, but I am said to be fully responsible only when I *consciously choose* - when it was my *free will* and nothing else that compelled me - to strike the man with my car. If I drove into the man purposely, then we are not able to blame a reckless pedestrian, a gun-wielding madman, unsafe tires, poor coronary health, impairing liquor, random brain activity, or any other factor that was beyond my control. It is precisely because I *was* in control - because I made a *decision* - that I am held fully culpable. But what kind of process is at work when we make a decision? What mechanism is it that produces *intention*? If we are unable to define this mechanism (and we shall see that we cannot), then how can we be sure that this process truly *is* something that is under our control? And if intention is not entirely under our control, where then does *true* responsibility lie?

No reasonable person would dispute the fact that such laws as the Prohibition Against Murder are fundamental to the existence of civilization. But our laws have no basis in the natural world; they are derived from a philosophy of ethics that is our own invention, designed to separate and protect us from the brutal world of nature whence we came, and make our ambition of a peaceful, stable, and organized society possible. Ethics are not facts; they are not science. And so, if we disregard the subjective ethics of the matter and examine the problem of free will analytically, we find that is considerably more difficult than we might originally suppose to find the agent (the causative thing that makes something happen) truly responsible for the pre-meditated crime...

When we say a decision has been made, we mean that a mind made a decision. And a mind is the product of two - and *only* two - things. The first is the genetic composition that we inherit, fully formed and utterly unchangeable, from our parents. This composition determines athletic, intellectual, and creative ability, emotional inclinations and temperamental dispositions, and in general a certain *potential* to achieve some things but not others. The second thing by which a mind is produced is the interaction of that inherited, interior nature with the vast exterior nature beyond our skins. This interaction with the world will determine many important features of our identity. It will be possible to meet many people who will significantly change our future development, and it will be impossible to meet many other people who might also have had a significant but different effect upon our subsequent experience. We will encounter certain teachers and certain books, and be affected to varying degrees by them; and we will be entirely oblivious to knowledge we never acquired that might have changed our thinking - and subsequent actions - dramatically. Good and bad things will happen to us, both altering the way we subsequently interpret the world. In general, we can see that there are a great number of events and opportunities that direct a life in one way, when other unrealized possibilities did not. And we must concede that there is a vast caprice in our experience of the world: any actual experience

might have been profoundly different if we had been somewhere five minutes earlier - or five minutes later - than we were. This experience of the world - collected and classified in the mind as memories, beliefs, and ideas - will combine with inclinations inherent in the psyche to form our *Identity*: that entity we refer to when we say "I".

This seems correct and not at all controversial, but there is a quiet problem in this two-part way we are made. The empty vessel given to us by our parents, and the contents the world outside pours into it, are both entirely beyond our control; we are in no way responsible for either. We are born empty shelves, waiting to be filled by books already written. "*That doesn't sound right*," we say, already getting agitated. We want to believe it is our *choice* that we become what we are; we choose what we learn, choose who we know, choose what we do. But is it choice to learn pre-existing facts, meet pre-existing people, or pursue pre-existing activities introduced to us by others? How do we make those kinds of choices? We have our innate inclinations, and our experience of the world, which combine into a personal identity. And that identity resonates positively with some things and not with others. We don't choose the way we are, we don't choose the way other people and things are, and we don't choose to have some kind of attraction to - or repulsion from - them. This holds true for every other kind of knowledge or experience we can have with the things of the world. A pre-existing fact of the exterior world resonates with some aspect of our pre-existing identity and then *that resonance makes a decision*. We don't choose to find something interesting; we have an affinity for something or we do not. We can develop new affinities, and we can deny existing affinities, but such actions are merely satisfying other different resonances within other regions of our complex identities. Choices do indeed seem to get made, but the question is, do we as individuals make choices, or is it fantastically long chains of causality, great histories of processes, that choose?

What part of us is it that chooses? What part of us is it - that is subject neither to the physical nature we inherit nor the empirical nature we inhabit - that is able to make a decision that is truly our own? We like to say, "*my decisions are subject to my will*." But if everything I am (including my will) is entirely created by my parents genes and the action of the world upon the incarnation of those genes - both antecedent facts which I am utterly powerless to change - how can I be anything other than *compelled by nature* in my thoughts and actions? We can confront a convicted criminal - the maniacal driver in example #7 - with the admonition, "*You could have chosen differently*." Ands so it seems. But to what responsible part of him are we appealing that is not determined by his innate potential - which is not his fault - nor compelled by his experience of the world - which is also not his fault? Are we correct to blame him for being the unfortunate end effect of a faulty causal chain? The question is not so much whether the criminal could have acted differently; the question is, rather, is it the criminal, or the vast chain of events that preceded that criminal moment, that is responsible for the crime? Is it correct to blame the cause or the cause of the cause? If what we are is beyond our control, and could not have been otherwise, then how can we be held responsible for what we do? We certainly do have the cognitive sense - we believe - that we are able to make a decision, that we could have done other than what we have done; but if we are not free to perform an act for which we are genuinely responsible, we are not free. When I make a decision, I hope it is me, and not just the random jumbled mixture of my parent's genes and a chaotic world that's doing the deciding. But where am I, if not in those things?

Think of a choice you believe you have made. How many hundreds, if not thousands, of entirely random events beyond your control precipitated the circumstances that presented you with the opportunity to make that decision? Whenever possible we make decisions in accord with our

character, and a specific biochemical orientation in the brain corresponding to our identity responds in a predictable way to a particular external stimulus. On those occasions when an in-character decision is not among the available options, when the situation is beyond all experience, we simply roll the cognitive dice. The fact that our interior nature (a pre-determined collection of genetic predispositions sculpted into a set of characteristic inclinations by events in a already-determined world) reacts to exterior nature in a particular way, sounds less like what we want free will to mean, and more like what we think a machine is: merely action and reaction, a certain initial cause will result in a certain inevitable effect.

Again, the question is not whether decisions are made - of course they are - the question is whether it is individuals or histories that make them. Of course, if we were to foolishly rewrite our laws so that responsibility did not lie with the individual, but rather with the chain of events that lead to that individual, that would introduce another causal effect into the chain, leading individuals to act in different, quite possibly uncivilized, ways…

Part II – How would a Mechanism of Intention work?

Our world is surprisingly predictable. The behavior of living things, especially humans, still presents some difficulties, but our mathematical models of the mechanical universe serve quite well for most other applications. One of the cornerstones of our mechanistic understanding of the world is causality. This model does not work quite so well in the quantum domain of the atom, but the random, probabilistic nature of the micro-world evaporates at scales larger than the atom. At the scales of our everyday perception, the world seems entirely deterministic: that is, the universe is a dynamical system that changes according to certain laws and principles, and events in the future are bound to events in the past by chains of causality. Two of the simplest things demanded by determinism are: 1) there are no *uncaused* events, and 2) there are no *random* events.

Before quantum mechanics dramatically changed our world-view, it was generally thought the world was entirely deterministic - a vast clockwork mechanism bound in a matrix of cause and effect that extended from the beginning of time to its end. We always understood that limitations in our scientific devices made measurements of infinite precision impossible, but we did not doubt that complete precision in the state of the world actually existed: even in apparently unpredictable processes like the weather or a role of the dice, some process of cause and effect invisible to human inquiry must determine the actions of things. We now believe, however, that infinite precision is - *in principle* - impossible; the world gets a bit fuzzy in the atomic domain, a chaotic and entangled world where the macroscopic rules of cause and effect do not seem to apply.

We still recognize, however, that systems can only be of these two kinds: random or deterministic. A simple example of the two can be found on a billiard table (for the sake of this example, we assume there are no flaws on the table surface or upon the balls which might adversely affect the results). Classical determinism says that if a pool ball strikes the cushion at an angle of 45 degrees, it will bounce away at an angle of 45 degrees. The ball has no choice in this matter; it can only follow a path that has been predetermined by the initial trajectory. If we know with precision all of the initial conditions (velocity, spin, friction, air pressure, altitude, elasticity, position of other balls, etc.), we can calculate the exact path of that ball from beginning to end. The entire subsequent history of that pool ball is contained in the initial conditions. That's determinism. Quantum mechanics, on the other hand, says that we can't measure the initial conditions with complete precision, and there will always be some uncertainty in our knowledge. If a pool ball strikes the cushion at an angle of 45 degrees, it will bounce away at an angle somewhere between 44

and 46 degrees (the uncertainty in this example has been *wildly* exaggerated so that decimal expressions of 20 places are not necessary). Tiny uncertainties in our knowledge about the initial conditions will become increasingly larger uncertainties over time; it is simply not possible to know at exactly what angle the ball will deflect. The path followed by the ball *does not even exist with complete precision* and so is determined by nothing more than chaotic chance. That's indeterminism. These are the only two options available: the events of the world are *pre-determined* (the classical worldview, which holds for the large-scale events of everyday experience) or they are *un-determined* (the quantum worldview, which holds for the small-scale events of the atomic domain).

When we attempt to define the mechanism of free will, to explain the biochemical process by which we make a decision, we must do so within the context of one these two scientific regimes. The brain is made of matter and subject to material laws; any process of the brain is also subject to natural laws. The methodology we use to successfully describe the actions of atoms and molecules in every other substance, must also successfully describe the actions of atoms and molecules in the brain. Whether we are talking about the geometric nature of pool ball trajectory, or the chemical nature of molecular interaction, the problem is the same: such nature must be pre-determined by the initial conditions or it must be randomly determined by probabilities.

It will be helpful here to provide a (very) brief description of the chemistry of our decision-making processes. Our brains are divided up into different regions that are responsible for different kinds of cognitive function. The operations of these diverse regions of the brain are performed by brain cells, also called *neurons*. We have somewhere between ten and one hundred billion of them. They look vaguely like little trees with the cell nucleus within the dendritic "bushy" part, and at the uprooted ends of the axon "trunk" are the *synapses* - communications links between isolated cells. There are perhaps as many as a million-billion such connections in a healthy brain. The oscillating rhythm of positively and negatively charged ions in and around the nerve fibers of a brain cell creates a corresponding rhythm of charge differentials that travel down the long axon of the neuron to the synapses, where another corresponding series of neurotransmitters are emitted; if the necessary preponderance of excitatory rather than inhibitory neurotransmitters are present at the synaptic cleft, a positive potential charge difference will induce the neighboring neuron to similarly fire - thus continuing the cerebral cascade.

For the purpose of our discussion, let us suggest that these pool balls bouncing around the table correspond to atoms and molecules bouncing around in the brain. The analogy is not quite as inappropriate as it sounds. The interactions of chemicals in the brain are more complicated than the interactions of pool balls on a table, but it is analogous mechanistic laws, either random or determined, that define the motions of both large and small moving systems. Simple or elaborate, some kinds of interactions are permitted by the rules and others are not. Now, within this sample framework of a dynamic system that moves and progresses only according to certain rules, the problem of free will becomes apparent. In a predetermined world, the deflected trajectory must equal the incident trajectory; *atoms and molecules in the brain can only follow paths already decided by the initial conditions* (or classical laws of chemistry). In an undetermined world, the deflected trajectory must be smeared across a range of random possibilities; *atoms and molecules in the brain will haphazardly follow a path randomly decided by probabilities* (or quantum laws of chemistry). Both options sound wrong to us: "My actions are pre-determined by initial conditions that stretch back to the beginning of time? Nonsense! My actions are accidentally chosen at random from among many possible actions by some kind of molecular lottery? *Ridiculous*!"

Neither option satisfies the conditions necessary to produce that brain state that everyone believes they possess: "The movements of the molecules in my brain are determined by ME!"

What we (very much) want a decision to be is this: the pool ball strikes the cushion at an angle of 45 degrees and deflects away at a *specifically different angle* - for example, 45.432 degrees. We don't have any science to explain such bizarre activity. What force in that little pool ball (or in a tiny molecule in the vast neuron, or in a tiny neuron in the vast brain) compels it to break every rule of motion (or chemical interaction) and *not* deflect at the incident angle, *not* deflect randomly within a range of possible angles, but deflect off at a *specific angle of its own choosing*? What possible mechanism could give this billiard ball - or a great collection of willful billiard ball-neurotransmitters in the brain - *intention*?

Part III – The Problem in a Nutshell

If the world is *deterministic*, then every event is merely the inevitable consequence of causality chains, orderly rows of dominoes falling down through the history of the cosmos - right up to and including the molecular tumbling of neural processes in your brain. In a determined world, there is no possibility for choice: every event, from the galactic to the sub-atomic, is only the temporal extension of a prior event - a certain and pre-determined *re*-action to an earlier action beyond its control or influence, a fixed and unchangeable effect propagated by a fixed and unchangeable cause. And if you cannot exercise choice, then you are nothing more than a sophisticated abacus (although a quadrillion synaptic connections is indeed a lot of beads) - an algorithm that could be written down in a book, albeit a very large one. In a determined world, we are reduced to mere *formulas*.

If, on the other hand, the world is *indeterministic*, then every event is merely the accidental consequence of random activity, a crap-shot game of chance where any particular outcome (like a specific intention or decision) falls haphazardly out of a probabilistic chaos of every possible outcome. In an undetermined world, again, there is no possibility for choice: every current state has an infinite number of possible subsequent states (a few of which are quite likely and many more which are much less so), and *there is no physical mechanism to specify any one particular subsequent state* - no deterministic weight with which to load the indeterministic dice, no secret button to rig the roulette wheel for a certain guaranteed wager. If it were possible to replay the event again, it is a statistical certainty that a different, albeit quite likely very similar, outcome would result. In an undetermined world, the neuron-synapse machinery of consciousness is exactly analogous to sand particles helplessly tumbling within the aimless drift of fleeting dune formations: we are reduced to mere *dust in the wind*.

The world is either determined or it is not - and neither scheme can explain free will. This paradox is not the consequence of any limitation in our understanding neurology or the underlying physical principles of matter. Neurology and physics yet present many puzzles to solve that will, no doubt, be resolved in due time; free will, however, is a much *deeper* problem. Simple logic demands that events must and can only be pre-determined or un-determined; that is, a specific and particular event *must* happen or a specific and particular event *cannot* happen. The kind of specific and particular event that we believe a *decision* to be (an initiation of specific action that manifests mysteriously out of nothing) is *neither* of these things: choice is a strange and elusive "could possibly be this and/or might definitely be that" kind of phenomenon. Free will, determination *made by consciousness*, is a network cascade of purposive neural activity, an *organized avalanche of thought* falling suddenly into the world. If free will exists (and is not merely an illusory artifact of consciousness like dream images and events that have no external reality), then it is a phenomenon unlike any other in the universe: it

cannot be *pre*-determined and it cannot be *un*-determined - it must be *self*-determined. *Somehow*, it is the flow of information that determines how the information will flow; from an avalanche of rocks tumbling down a mountainside emerges the ability for that collection of rocks to choose the precise formation of their falling: *thought determines thought*. We will require a new kind of science (indeed, a new kind of logic) to describe cognitive events that are not caused by prior events and are not caused by statistical caprice, but are caused…*by themselves*. What or Who is this Promethean Atlas in the mind - stronger than the inexorable compulsion of physical law and mightier than the purposeless cascade of quantum uncertainty - that endeavors to do something so simple and mundane as annihilate every contrary impulse and reflex of the entire universe…and make a decision? And without some *Ghost in the Machine*, how does an idea that does not yet exist bring itself, uncreated, into the world?

Is Free Will an Illusion?

It is logically (if not emotionally) easier to suppose that we *cannot* make a decision. In fact, some exceedingly clever people (including Albert Einstein, who is in my opinion the greatest of our kind) do not accept the reality of free will, believing it to be only an illusory projection or artifact of cognitive function. According to this interpretation of the available facts, the brain is nothing more than the most sophisticated machine in the universe, a bio-computer running fantastically complicated software. Certain input, run through computations so complex that the causal pathways can never be traced, yields certain output. But this certain output is certain only to the application subroutines; the *uncertain* operating system (that we call "I") does not need, and is not programmed, to understand the complex subroutines and misinterprets a predetermined and inevitable result as…choice. And the state of the overall system is so dynamic, with all the different hyperactive subsystems always in constantly shifting relationships relative to each other, that the same input on different occasions rarely leads (or need not lead) to the same output. What appears to be a different choice is really nothing more than a different reckoning of the current ever-changing state of the overall system. All the subsystems are deterministic, but the overall system doesn't know it. The stressed-out operating system must effectively coordinate the frenetic non-stop activities of a huge cognitive corporation with many separate and sometimes competing divisions; it is simply not practical for the head-office to understand the intricate determinism out in the field. An effective administrator simply cannot bother with the exquisite details of the specialist's work, and so a kind of executive blindness (or oversight) prevails. There is no choice and free will is an illusion; you and I and everyone else are chimeras, the deluded hallucinations of organic machines.

Quantum mechanics is (as we soon see) strange. So strange that Richard Feynman once famously quipped, "If you think you understand quantum mechanics, you don't understand quantum mechanics." But we have enormously powerful theories about it that must be at least in part correct, because they have been so reliably useful to our understanding of the sub-atomic world. Science now also knows quite a bit about brains, and an impressive amount about mind, but cognitive science, linguistics, neurology, psychology, computer and AI science, etc., do not yet have even a *theory* of consciousness; it is the last, greatest mystery. Research and analysis will continue, of course, and it may come to pass that someday we know what it is. The prospect of such knowledge, however, should frighten us a little bit. It is perhaps not a coincidence that this *last greatest mystery* sounds rather like the *one forbidden thing* motif so common in mythologies around the world (the violation of which always results in catastrophe). Maybe those stories are just silly superstitions; on the other hand, maybe there really *are* things we shouldn't know.

Regardless, study will continue (as it should).

Our entire reshaping of the world is based upon what we think of ourselves: we believe *human are special* (10,000 years ago, humans and their domesticated animals represented about 0.1% of terrestrial (not aquatic) biomass; today the figure is closer to 98%). Only *we* feel love and joy and rapture, and misery and despair and agony. Yes, modern biology has forced us to concede, we are made of the same genetic stuff as all the other living things of the world, but only *humans* know of good (life) and evil (death). The single most obvious fact about the world is that biological organisms with advanced consciousness will determine what happens to it. There are disagreements about just where this authority came from, be it cannot be disputed that we have the *right* to do this – we are the *makers* of rights. And we will make the world whatever we want it to be for a simple, inexorable reason: because, of all the progeny of earth, *only we can*.

But what if the materialist-mechanistic view of consciousness is correct and we really are just bio-machines? If humanness is reducible to objective equations (love = chemical state *x*, ambition = chemical state *y*, excruciation = chemical state *z*) then this knowledge will surely change our opinion of ourselves more profoundly than any other event in human history. If humanness is expressible as numbers on a page, as predictable, as changeable, as reproducible, as *fake*-able, then all those subjective qualities about ourselves that we believe are unique and important, will be revealed as an *illusion*. If feeling and awareness are not states of some *intangible entity* but only processes of *tangible chemistry*, then the august and protected status we have given the human is a delusion: experience itself is a lie. No bliss, no pain, no life, no death, no *purpose*; instead life is only the relentless grind of a busy eating and shitting machine, mindlessly sweating out complex chemical reactions that merely *emulate* the quasi-magic of consciousness to accidentally advance an accidental process to a meaningless, accidental end.

In such a universe, our analogical picture of organisms as something *like* gears spinning and being spun by other gears in some cancerous clockwork monstrosity, becomes quite a bit *less* metaphorical than we previously imagined. If it should come to pass that we eventually discover this particular forbidden fruit of our true nature, we will indeed long for the paradise of our former ignorance. In fact, it is reasonable to wonder if a mechanistic human psyche would be strong enough to survive such knowledge. Can thesis and antithesis coexist in the same space?

That somewhat unsettling view is logically consistent with the available facts…*and free will is not*. But, as I have tried to demonstrate, there are important facts about the nature of space and time that are still beyond our comprehension. The physics of consciousness is Unknown. The world is machine or magic - *you* decide. And if free will is not an illusory mirage of consciousness, and we actually possess intent capable of making a decision - *if we tell chemistry what to do* - then we are truly magicians, wizards, every one of us…

The Observer Problem

Free will seems, in some way, to be the conjunction of these two incompatible worldviews: a decision is a specific (deterministic) but uncaused (indeterministic) phenomenon. It is interesting that these very same competing descriptions of the world also come into conflict in physics. The deterministic "classical" model describes the large-scale world very well and the indeterministic "quantum" model describes the small-scale world very well, but the classical model cannot describe the atomic domain and the quantum model cannot describe the galactic domain. (Actually, the quantum model *is* deterministic in unobserved stage one, but as soon as we look at it in stage two, it instantly becomes indeterministic – as we'll soon see.) This absence of a single, universal model that

explains both the large and the small, remains the most vexing problem in physics. Perhaps it is no coincidence that the biggest problem in physics and our understanding of the universe, and the biggest problem in philosophy and our understanding of ourselves…is the *same* problem: how can something - the universe or my brain - be both determined *and* undetermined?

As we have seen, if every event, past and future, is locked within a clockwork mechanism of cause and effect, then even the events in our brains are similarly constrained…and free will is not possible. The machine-like matrix of causality described by Newton, Maxwell, Einstein, and classical mechanics in general, however, encountered a problem with the notion of free will *only in theory*, *not* in experiment. The presence of an observer did not intrude into, change or affect, the world being observed. Consciousness could be treated as an external system and ignored without consequence to scientifically rigorous descriptions of an objective world. In pre-quantum physics, consciousness was a separate matter from science – possibly, but not necessarily, separate also from the determinism so anathematic to free will – it simply wasn't relevant to a scientific worldview as accurate and logically consistent as it could be at the time. We now know those classical descriptions of nature were incomplete, and so the old physics has been updated by the new physics of the mysterious microworld. But, unlike the passive, limbo-bound consciousness of the classical world-view, the observer *does* intrude into quantum mechanical descriptions of nature – *like a bull in a china shop*.

Our everyday experience of the world leads us to believe, not surprisingly, that it is actually there in an objective way. We may not understand the Newtonian mathematics of the activity we see around us, but we all have an intuitive sense that for every action there is an equal and opposite reaction. The world is predictable. Most importantly, the world is predictable even when we are not looking at it. If we do not look at or study it in any way, it goes on about its worldly business, oblivious. It exists (so it seems) in a real and permanent way that is not affected by how we look at it. It was, after all, only creatures who thought in this no-nonsense way that survived the predator-filled jungles we inhabited long ago, and so we descendants of those sensible creatures think likewise. Natural selection has *made* us objectivists - everyone thinks the world is actually there whether we look at it or not. In this reasonable belief, quantum mechanics says, we are mistaken.

This new physics describes in exquisite detail another even more important way that science encounters this self-*in*consistent paradox of determined-undetermined nature, a spooky aspect of quantum mechanics known as the quantum measurement problem, or *the observer problem*.

The microscape is made of a small variety of different things – electrons, protons, neutrons, etc. – and these things all exist in two dramatically different, yet co-existing aspects. On the one hand, they are all *particles*, discreet, individual, tiny dots of matter; on the other hand, they are also *field oscillations*, wave-like regions of disturbance analogous to other waveforms we see in nature. This is not conjecture: we can verify these seemingly incompatible qualities in exacting experiments. If we wish to examine the properties of an electron and set up an experiment to detect particles (that is, find a position state), particles are what we find; conversely, if we set a slightly different experiment to find waveforms (the momentum state), that's what's found. It should be noted that these particle-wave qualities are *stunningly* diverse: a particle is a sizeless mote smaller than any detector (or theory!) can reckon; a wave is an energy spike in a field that extends to the end of the universe. So, is the electron a) infinitely small, or b) infinitely large? The answer is *both are true*. How can that be? Nobody knows. There is a well-known real-world demonstration of this strangeness called the "two-slit experiment" (first performed by Clinton Davisson and Lester Germer, with an electron beam, in 1927)

which has been exhaustively tested and re-tested in many sophisticated variations; it always confirms the worst: the universe is *seriously* FUBAR.

In the simplest version of the experiment, a precision light source is placed in front of an opaque screen with two narrow vertical slits that will allow light from the light source to pass through to a photon detector beyond (the experiment works equally well with any other particle-wave from the theater of subatomic players). In the first part of the experiment, one of the slits is closed and a beam of photons is directed towards the detector. The resulting array of measurements recorded by the detector is called a *diffraction pattern*, a fuzzy, narrow vertical blob of light specks, a diffuse collection of many photons detected, thus indicating that light is made of many little pieces. In the next part, the second slit is also opened and a new beam of photons is directed at the detector. The resulting measurements look different this time: a series of alternating vertical bright and dark lines, banded regions of greater and lesser intensity, are arrayed across the detector in what is know as an *interference pattern*. By opening the second slit, we have doubled the overall illumination as expected, but in the bright bands the illumination is 4X brighter, and is completely absent from the dark bands – regions where photons were in fact detected when they passed through one slit only. The first diffraction pattern was understandable as the cumulative effect of many photons passing through the slit to form the measurement(s) found. The interference pattern, however, cannot be explained by the action of many particles; photons, in addition to their particle-like aspect, also have – and are seen here in – a wave-like aspect.

Imagine the surface of a pond disturbed by the energy of a dropped stone. This energy is then dispersed across the surface by waves carrying energy through the medium of the water. A wave has a peak of positive energy and a trough of negative energy. When two waves meet with and overlap each other, the size, or *amplitude*, of these waves combines: two equal peaks (or troughs) meeting *in phase* will *reinforce* and combine to form twice the amplitude; a peak and trough of equal (but opposite) amplitude meeting *out of phase* will exactly *cancel* each other, leaving the field flat. The effect of adding wave amplitudes together is called the *superposition principle* – it's what occurs when two or more waveforms combine to make a new and different waveform. This *constructive* or *destructive interference* between peaks and troughs radiating out from the two slits of the experiment is what causes the banded pattern seen on the detector.

It is, perhaps, strange enough to confirm that light is in one aspect infinitely small and in another infinitely large, but it gets stranger still. The precision light source in this experiment is able to release not only a beam of light, but also just one photon, a single corpuscular grain of light, at a time. Again, one of the two slits is closed and a succession of single photons is fired through the slit towards the detector beyond, with the same resulting diffraction pattern we saw with the beam of light through one slit. Things get very interesting, however, when the second slit is opened. As each single photon is released, it must pass through only one of the two slits; and yet, after many successive photons have been fired, traveling through one slit or the other, the *same* wave interference pattern results. Somehow that single particle of light is going through both slits at once, and *superposing with itself* to cause the interference pattern! And if we decide to mischievously insert a detection device at the slits, to determine which slit the particle actually goes through, subsequent measurements do not have the interference pattern. The photon "knows" it's being watched and changes its subsequent behavior accordingly (it makes a diffraction pattern).

Many photons could, in aggregate, assume wave-like properties. But how can *one tiny photon* simultaneously be a *universe-spanning wave*? How does the photon "know" that the other slit, the one it's *not* going through, is open, thus freeing it to become a wave that ripples out to the edge of the

cosmos? And when a detector is placed at the slit, how does that part of the probability wave on the far side of the universe instantly know that a peeping intruder is present and that it should suddenly and completely vanish into the single particle measured? It seems that all the tiny pieces of which the reliable world is made are actually pan-galactic ghosts – until we *coerce* them to exist here and now.

The physics of the very small, of atoms and things even smaller, inescapably involves something called Erwin Schrodinger's *wavefunction* equation, a mathematical description of the *probability distribution* of quantum events – of the always-changing chance of finding a quantum particle at a particular location.

Probability is, as the name suggests, an indeterminate business. Take two dice and throw them. What is the result? Probability theory doesn't have a clue about *one* roll of the dice; it knows a great deal, however, about *many* throws. Seven, the most likely combination of two six-sided dice, has a probability of occurring once in each six throws of the dice – about 16.666…% of the time – so if you throw the dice 100 times, it is quite likely that you will throw seven about 16 times. The more throws you make, however, the closer you'll get to exactly 16.666…% of all throws being seven. If you roll the dice more than a *billion* times, it is a statistical certainty that 16.666% of all throws will be seven. And if the probability you're trying to establish is the distribution of photons, well, an average 60-watt light bulb releases 100 billion-billion photons every second – more than enough "rolls of the dice" to ensure that the "fuzzy," "ghostly," "indeterminate," "probabilistic" nature of the very small is, nevertheless, subject to the entirely deterministic wavefunction equation. The free-rolling dice are in fact utterly constrained; with a vast number of rolls, they *must* conform to the probabilities. Similarly, the wavefunction – the shape and amplitude of a probability distribution as it evolves through space and time – never lies…unless, for some mysterious reason that the otherwise very powerful theory can't fathom, it suddenly *collapses*.

Our televisions, computers, and nuclear reactors all work as reliably as they do because Schrodinger's wave mechanics has provided an incredibly accurate description of what's going on down there in the microscape we cannot see. Thousands of experiments have verified that wavefunction is, at the very least, a *partially* true picture of reality. The probability wave described by the wavefunction equation is *so* useful, in fact, that everything would be happily settled…except that wavefunction also demonstrates some *exceedingly* strange, really rather unbelievable things about the world it describes so well.

Until we reach into the wavefunction and *cause* the enormous cloud to distill into a tiny drop, an action known as *state vector reduction* (or *wavefunction collapse*), quantum theory says the photon cannot have both a definite location *and* a definite velocity. That is, until it is observed, *the photon only exists in a ghostly superposition of every possible location*. Where the wave amplitude is large, the chance of detecting a particle is more likely; where the wave amplitude is small, the presence of a particle is less likely; where the wave amplitude is zero, no particle is present. And because the probability wave extends to the end of space, there is always an exceedingly small but importantly *non-zero* chance that a particle will be exorbitantly far from where you expect it (the photon is quite likely to be somewhere in the experiment, but it *could* be on the far side of the galaxy). So where *is* the photon, *really*? The theory says we're not allowed to look, because if we do, the wavefunction self-destructs: the locationless photon was nowhere and everywhere at once, and then, because we *said* so, it was forced to be at a certain location on a detection screen. What kind of object doesn't have a location until an experimenter's mind gives it permission? How does *that* work? Nobody knows.

If quantum theory is a complete description of the world (and its overwhelming experimental success strongly suggests that it could be), then

one of two possible worldviews must obtain: 1) the world "tells" *us* what kind of measurement-observation to make, thus ensuring accord between objective reality and experiment, or 2) the world is *not* objective. Both prospects are strange indeed, but *that's all the data tells us*. There are many competing but still unsatisfactory and unproven explanations for this quantum schizophrenia – *sum over histories*, *hidden variables*, *many worlds*, *decoherence*, etc. – and all of them reject *both* options, supposing instead some deficit in our understanding of the otherwise *spectacularly* successful Schrodinger equation. Stage one of the equation is a pristine and deterministic reckoning of the wavefunction throughout space and time; it is only our desire to know *anything* about the wavefunction that introduces the problematic stage two collapse – a non-mathematical ad hoc addition to the equation that is present only to explain the sudden dramatic change we see in the state vector when we do something so seemingly innocent: we merely *look* at it.

Does the universe exist if we're not looking at it? The answer is, apparently, no: the Observer's Choice makes the world. The free will enigma has now leapt from those ivory tower academies of philosophy and entered our scientific discourse in an obvious and undeniable way. The observer is problematic because it seems rather more *god-like* than nature-like; the heretofore silent elephant in the room is hungry and starting to make some noise…

Bigger than the Universe

I mentioned earlier that a "new science" will be needed to explain free will. This not-yet-imaginable mode of investigation will, I believe, somehow involve *hyperspace*. At the center of a large star that has collapsed into a black hole is something called a *singularity*, a place where the fabric of space-time has been compressed to infinite density and squished right out of the universe. It is the end of space-time - literally, the end of the universe. It's already there...waiting. Cosmology is not certain at this time (and probably never will be) just how long the universe is supposed to last, but if that cosmic lifetime is, for the sake of conversation, 100 billion years, then that distant future is already here, hiding beyond an event horizon in the corpse of a dead star. And if one were to leap into such a gravity-well (numbering, we now believe, in countless billions in the universe), they could make a 100 billion-year journey to the end of the cosmos in the blink of an eye. But from *that* journey there is no return.

There is, however, another kind of time travel from which there *is* a return. And we sentient beings make this journey many times every single day - without ever considering just how extraordinary such travel actually is. With our powers of cognition, we are able to "see" the consequences of our actions. No other animal does this (at least not over spans of time greater than brief moments). Somehow, we can describe in our minds different possible futures based upon certain different actions - and can modify or completely change our actual subsequent actions based upon the information thereby acquired. We think nothing of this. "I thought of doing that, and then I thought better of it. I could see that such action was a mistake." It is so easy for us to do this that we do not often think about just how magical such cognition actually is. *How* do we imagine a possibility in a future that does not exist and may never exist and then evaluate non-existent complexities to (sometimes) correctly determine immediate action? "I just thought about it," we say. But what is the mind *doing* that allows it to look into the future? It is protruding into hyperspace to cognitively survey a 4-dimensional *temporal landscape* - past, present, and future (or futures). We are all time travelers.

Imagine a 2-dimensional flat plane, above which hovers a 3-dimensional sphere. If that sphere were to descend and protrude into the flat plane, plane-beings there would perceive at first only a

point (of contact) and then an expanding circle as the sphere protruded to its maximum diameter. A 2-D plane is infinitely thin: it has no 3-D thickness. Correspondingly, a 3-D volume has no 4-D thickness: hyperspace is infinitely greater than mere space. If a 4-D hypersphere were to protrude into a 3-D volume, volume-beings (like us) would perceive at first a point and then an expanding sphere as the hypersphere protruded to its maximum diameter. I believe such a protrusion is happening: the stuff in our skulls, evolving ever larger over the last hundred-million years, is pushing out into hyperspace - *or something in hyperspace is pushing back*. And the point of contact is slowly getting *larger*…

Which came first, brain or mind? According to the way we commonly think about how the world came to be in its current form, it's a nonsensical question: we generally believe that brains evolved slowly over billions of years until they were sufficiently elaborate to allow the emergence of consciousness. The brain-mind relationship viewed in this way is rather like that between hands and manipulation: hands evolved from fins and paws to eventually manipulate the material of the world into shapes of our own design. First there is a thing and, second, an action that thing does: hands *then* manipulation. The other, less-common, view is that consciousness (whatever it is) was *always* there, waiting for a sufficiently elaborate mechanism (like a brain) to access it (or liberate it). The mind-brain relationship viewed in this way looks more like the relation between mathematics and equations: the eternal forms of the *idea-world* existed forever before we discovered them and how they define the shape and movement of the *matter-world* cosmos.

Perhaps this entity that observes and feels and has experience is not inside the brain at all; it is, rather, an external ("forever far, yet touching near") intelligence resonating with the sense-organs of our still-evolving *sixth* perception, a *hyperspatial* extension of mind reaching out into infinity, struggling to remember *Who* it is…

(There are some inevitable ontological inconsistencies in an existence where you are not really where you think you are. Perhaps humor has evolved in response to the prevalence of such incomprehensible curiosities: unlike synthetic *Turing Machine* intelligences that do not and cannot know when to stop calculating an infinite problem easily seen by humans to have no solution, we can laugh and walk away when faced with the absurd. In fact, if we approach it in good humor, we actually derive pleasure from paradox. It may be difficult to imagine just how the chemistry in the brain learned how to manufacture such a wonder-drug, but it is easy to see the benefit of such a skill once you have it: if there were no cognitive mechanism for dealing with the abundant absurdity of the cosmos, if we could not laugh and move on, the human mind would quickly and permanently immobilize itself in contemplation of its own existence...)

Where is the Observer?

There is another curious aspect of consciousness that eludes understanding: the simple awareness of ourselves as distinct and existing entities. In many ways we are machines, made of organic bone and tissue rather than bolts and steel, but machines nevertheless. But it is not anything to be a machine, as we commonly understand the term. The super-computer (as it might one day exist) may or may not be smarter than me - although it already surpasses my abilities in many respects - but it has no experience of itself. The super-computer does indeed seem smarter than my dog (in some ways), but it is something to be a dog; it is not anything to be a computer. If I smash the computer to pieces, its experience of itself is unchanged - it did not know it was assembled and it does not know it is smashed. Not much soul gets into machine parts; quite a bit more of *whatever it is that is aware* gets into a dog.

It seems that the predominant thought in modern philosophy is that the mind is simply the activity of the brain, the incessant hum of data gath-

ering and processing which, by virtue of some critical threshold of sophistication that we have evolved beyond, becomes self-aware. Consciousness is understood as an *emergent* property, curiously rising out of the transmission of vast amounts of data along neural pathways: the mind is what the brain does. Thought and comprehension of existence must be, according to this view, the product of brain activity: there is only the complex movement of electrical impulses between various processing hubs in the brain. Free will is an illusion; consciousness is an illusion - the mere byproducts of brain activity, the accidental effluent of cognitive number crunching. Organism is synonymous with mechanism; the general pattern is the same, only the materials are different. Or so the theory says.

Given our current level of technology, we can imagine a very human-like machine that is not, in principle, beyond our ability to construct, and let us say that money is no object here - we have unlimited funds. Prosthetic limb designers already build functional arms and legs. We could certainly apply very acute pressure-sensitive pads upon those limbs to emulate a sense of touch. We could even apply a veneer of skin-textured latex to give our Pinocchio a more human-like appearance. Cameras serve as eyes, and current scanning technology certainly enables the machine to perceive grades of lightness and the full spectrum of color. Gas chromatographs can analyze the chemicals present in solids, liquids or gases, and provide an analog to our senses of smell and taste. Microphones record sound to be processed by the best voice-recognition software, and little speakers in the synthetic mouth simulate speech. Motor control and the gathering and processing of data is all performed by our most sophisticated computer, and we can give the aspirant an enormous hard-drive pre-programmed with 1 million standard responses to 1 million standard questions. (And unless you *knew* someone was trying to trick you with a fake person, you would probably ask only very mundane questions of the kind popular in polite conversation - this is *not* a Turing test). We might even program the machine to emulate certain behaviors corresponding to certain emotional states (he "gives the finger" when asked about his sex-life). To finish the package, we invite Hollywood special effects wizards make the overall appearance as realistic as possible. In a dark room and a tightly controlled situation (no *funny* business), this silicon-chip Frankenstein might actually fool people for a while. But this pretender has no identity whatsoever. If I melt it down, it will think of itself in exactly the same way - which is to say, not at all. Such a thing is nothing more than a large abacus, and has the same experience of the world as the inert beads of which it is made - none whatsoever.

Once life actually gets started, it is not completely surprising that organisms capable of gathering data, and subsequently processing that data into useful survival-ensuring information, might evolve. But nothing in that equation requires the existence of self-awareness. Our walking calculator can easily be programmed to flee from predators; an object larger than a certain threshold size, approaching faster than a certain threshold speed, will trigger a specific "turn and move away at maximum velocity" response. Such an inclination in the programming would ensure that the machine endured to witness other days. There is no need for the machine to be *aware* of what it is doing; it only needs to act, not *think* about it. In fact, awareness is entirely superfluous and, quite possibly, detrimental: it is just another signal interfering with the data stream or, more seriously, the original survival programming.

We now have the imaging technology to monitor the traffic of information moving along the many synaptic highways of the brain to various processing hubs; we can actually detect the ways in which the brain acquires and uses the data it encounters. But where is the *observer*? Something that is *known* - data - is not at all the same thing as something that *knows* - awareness. Somehow the data knows itself? A bound stack of paper...

wonders whether it is a good book? A very long list of 0's and 1's...believes itself to be a rousing (digitally-produced) version of the Brandenburg Concertos? An intricate organization of precise spectral information...is having an identity-crisis because a dark-skinned woman in a green dress doesn't really *seem* like a painting about free will? It is often said that we are nothing more than complex organic machines: hardware brains running software minds - a cerebral abacus with neurotransmitter beads. But how can conscious awareness arise from the abacus, where there is only: a mechanism that processes data (enabling the movement of information in different usable forms), and data (information somehow contained or preserved in the movable machine parts of the mechanism)? The abacus knows nothing; the arrangement of beads knows nothing. Data cannot *know* anything, any more than can the pulses of electric current that move it from place to place, or the chemical brain-machinery that generates this activity. If the busy pattern-generating loom of the brain *and* the intricate tapestry of thought it weaves are utterly empty, then *how* is awareness possible? And if this *awareness above the data* is not actually made of data *or* the machine data-*mover*, what *is* it made of and how does it exist in our brains? *It must be somewhere else*, poking into this world through the peephole of human consciousness.

People are like clothing that this mysterious *observer* wears. Some clothing is fine and clean, and some is worn and dirty. The observer experiences these realities, but is untouched by them. Our identities, our memories, our interior experiences of ourselves, are all clothing - they are not permanent, and are, in fact, highly mutable. They are an imperfect way for a larger presence to inhabit and experience the universe: one Observer (and sometimes *another*) looking out through many eyes.

The entity that lives behind my eyes is the interaction of ageless Consciousness and rapidly-aging meat. When the meat finally spoils, consciousness withdraws. The entity formerly called [insert name here] is gone – and never truly existed. Each of us is merely a different, and yet gloriously unique, perspective on the cosmos. Like the noise of a crowd, Consciouness is not here or there but everywhere; like the voice of a symphony, it is what it is only in the totality of its many parts. Does Consciousness remember what it has seen through my eyes and yours? Who can say? But the profoundly long and difficult effort it has made to get to these many vistas of experience would be entirely wasted if it did not.

You and I and all the manifestations of life everywhere are *windows* through which an eternal consciousness watches - and thus endows the world with *will and purpose*. More life is more windows, and a *virtuous* life draws back the curtains from a narrow egocentric view, opening and enlarging it onto a greater vista of unknown possibility. We do not nurture life for the benefit of the other; it is *ourselves* that that is made greater when the ever-curious, Universal Watcher who dwells within sees *farther out*...

Cathedral of Illusion

And the magician became lost, wandering aimlessly in the Nowhere Realm, bound between two awesome, stupefying vistas...

There was the world: dark and brooding, musty and aging, weary and bewildered. The uneven bustle of listless movement was interrupted by a gasping wind, foul with decay, scattering bits of rancid detritus into growing piles of rot. Mournful noises ricocheted from every direction: rustlings of sorrow and misery, clatterings of greed and deceit, detonations of anger and violence. Far away the sound of vast, invincible machines pounded a martial rhythm like the battle drums of an advancing army, and a relentless apprehension oozed over the ground like a creeping putrefaction. A gurgling spasm shuddered beneath the world, and everything was dragged down. The very foundations of the earth decomposed, and inexorably succumbed to

a hideous ravening maw mercilessly sucking the living flesh of the world into a swirling hole of necrotizing filth. Down, down the world fell, into the bowels of time, digested slowly, still alive. A withering little flame fluttered in the deep, and was extinguished into sleep.

But *another* aspect was rapture and ecstasy in the embrace of soul-inflaming beauty...

There was the world: saturated with light, opulent with life, mysterious, beckoning, vivifying. The River of Life poured into the world, a shimmering, many-channeled ribbon that gently meandered across a misty dreamscape as ancient as the foundations of the earth, binding the world to some infinite and unknown Wellspring. There were many ferrying waterways to be explored in the vast forest sanctuary, but the unknown courses were by far the greater part of the River, flowing ever smaller into the flesh of everything that moves, flowing ever larger towards its unseen ocean destiny. A luminous apparition at the distant end of the visible wood appeared, a great window gleaming pure, as though cleansed of any worldly aspect, allowing the sacred light beyond to shine through into every evaporating shadow. The image of eternal regeneration, of the source and destination of all things, flared incandescent in the forest. In the surging swell of light, a great verdant cathedral emerged from the gentle mist of the forest, shimmering like a timeless paradise of holiness. In the cathedral garden, two lovers danced. One was a great red hawk, soaring around the lofty regions of the wood, strong and vigilant. The other was a delicate white dove, beautiful and wise, waiting peacefully below the circling hawk. And all the living things of the garden were their children, each one an extension of the living light beyond that never dies.

And the magician wondered if the form of the world was his to *choose*...

* * *

Personal Notes on *Cathedral of Illusion*

Sometimes, I get interesting ideas for a painting...that I have just completed (in addition to the current example, you will soon see that *Celestial Apparition* also suggested another possibility to me). I had just put the finishing touches on *Forest Light* and was writing the companion essay, when out of my brain fell these words: "... an apparition of the Goddess of Eternity in the great Cathedral of Illusion..." This image suddenly flashed in my mind. At first I wondered if I couldn't make some revisions to *Forest Light*, perhaps only adding the yonic "rose window" in the distance, rather than design a whole new painting. I quickly decided instead that the idea really needed a fully developed cathedral carefully integrated into a more peaceful and mysterious forest. And perhaps I could find a way to reinforce that "dynamic red and gentle white" motif that I had been playing with.

In general, I am trying to suggest with this image that there are some very important aspects of the world that we simply do not experience with the senses available to us, that the world *must be more* than it appears to be. When people ask me, conversationally, what this painting is about, I mercifully assume that they do not want to hear a lecture on consciousness, free will, and the observer problem ("Then why punish us?" you may be saying). I do want to convey to people that it is about trying to see beyond, but unlike William Blake (who wants to "cleanse the windows of perception") or Jim Morrison (who wants to "break on through to the other side"), I think *something* is trying to see into *this* place, break through to *our* side from ...*elsewhere*.

Within the comfortable privacy of my own thoughts, I like to call this painting, *A Womb with a View*...